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The Effect of CIRC Combined with Guided Inquiry Learning Model on Scientific Literacy in Terms of Academic Ability

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Abstract. Introduction: Scientific literacy is the ability to use scientific knowledge, identify questions, and draw conclusions based on scientific evidence. Purpose: This study was aimed to know: (1) the influence of guided inquiry learning combined with the CIRC model on scientific literacy; (2) the influence of academic ability on the scientific literacy; (3) the interaction between learning model and academic ability to the scientific literacy. Methods: The research was quasi-experiment research. The population of this research was all of the 11th-degree students at SMA N 2 Boyolali in the academic year 2019/2020. The sample of this research was students of XI MIPA 1 as the first experimental group and XI MIPA 2 as the second experiment group. The data was collected by test techniques (NOSLiT). Result: The hypotheses analyzed by Anova Two Ways with the level of significance 5%. The results showed that there was an influence of the use of guided inquiry learning with CIRC models to scientific literacy (Sig. = 0.000) < α = 0.05. There was the influence of academic ability toward scientific literacy (Sig. = 0.000) < α = 0.05, and there was no effect interaction between learning- models and academic ability their scientific literacy (Sig. = 0.020) > α = 0.05. Conclusion: The research concluded that 1) guided inquiry learning combined with the CIRC model had a significant effect on scientific literacy, 2) the academic ability has a significant effect on competency of scientific literacy, 3) the interaction of learning models and academic abilities do have a significant effect on students' scientific literacy.

Keywords: Scientific Literacy, CIRC, Guided inquiry, Academic Ability

INTRODUCTION

21st-century education prepares students with skills that can be used to face global economic competition. One of the important skills possessed by students in the 21st century is scientific literacy which plays an important role in improving problem-solving skills and knowledge comprehension. Wulandari & Solihin (2016) state that scientific literacy is scientific knowledge possessed by individuals and the ability to process that knowledge to acquire new knowledge, identify problems, and make conclusions based on scientific issues. Students who have good scientific literacy can solve problems by connecting the previous scientific concepts to the new ones.

Research conducted by PISA shows that the Indonesian student's‟ scientific literacy is ranked 75th out of all participants, namely 81 countries. In addition, it has a lower than average score of only 329 from the average score of 489 (OECD, 2018). Low scientific literacy can hinder students in understanding learning material, especially in the subject of Biology which consists of materials that require a deeper understanding of the content. The low level of scientific literacy is caused by the learning activity which has not emphasized the learning process such as

making questions for investigation, combining knowledge to explain certain events, and concluding facts based on observations (Yaumi, 2017).

The data obtained from the observation conducted at SMAN 2 Boyolali showed that the scientific literacy of students was still not optimal. This can be observed directly in the learning process in class, especially in the subject of Biology. Students are still afraid to answer questions asked by the teacher. Moreover, students also have difficulty concluding what they have learned. Moreover, students still have difficulty in identifying and solving a problem independently. The ability to solve problems based on understanding the concepts of science that students have is an important aspect of scientific literacy (Arohman, Saefudin, & Priyandoko, 2016).

The low level of students"' scientific literacy can be influenced by learning methods that unable to empower students in carrying out the science process (Fadilah, Isti, Amarta, & Prabowo, 2020). An accurate implementation of learning models can help students to improve their scientific literacy. Setiawan (2019) stated that the application of learning with a scientific approach in biology learning can be used as means to train students' scientific literacy. One of the scientific learning models that can be used to improve students' scientific literacy is the Guided inquiry learning model.

Guided inquiry learning is one of the learning models that is suitable to be applied in the 2013 curriculum because the inquiry learning model does not only make students master the concept of biology but also train them to investigate and solve a problem or question with existing facts, and based on their own experience (Astuti & Setiawan, 2013). In planning, inquiry learning teachers must design a learning activity that allows students to independently find and study the materials. Moreover, the teacher should not only prepare materials that must be memorized by students (Sirat, 2012).

The use of the guided inquiry learning model can be complemented by combining other learning models or methods that can help students practice scientific literacy in learning such as cooperative learning models. The cooperative learning model trains students to work together and increases student responsibility in groups. The cooperative learning model chosen to be integrated with guided inquiry learning is the Cooperative Integrated Reading and Composition (CIRC) model. Ristanto, Zubaidah, Amin, & Rohman (2018) stated that learning that combines guided inquiry learning with CIRC can empower students 'scientific literacy and students' understanding of biology concepts.

Students' literacy competence is closely related to the demands of reading skills which lead to the ability to understand the information in an analytical, critical, and reflective manner. Reading and writing activities can serve as conceptual tools to help students analyze, interpret, and communicate scientific ideas. The results of the study conducted by Hanum, Saputro, & Susilowati (2019) showed that the application of the Cooperative Integrated Reading and Composition (CIRC) learning model, equipped with modules, can improve students' scientific literacy. The CIRC cooperative learning model is a learning model that invites students to be active in groups and exchange information from what they have obtained from reading literature. Based on the background of the study, it is necessary to conduct a study entitled The Impact of integrating Cooperative Integrated Reading and Composition (CIRC) in Guided Inquiry Learning Model on Scientific Literacy in terms of Academic Competence.

METHOD

The research was conducted at SMA Negeri 2 Boyolali in the 2nd semester of the 2019/2020 school year. The experimental method in this study used quasi-experimental research. This study used a post-test-only group design. The population in this study was all the students of class XI Science at SMA Negeri 2 Boyolali. A random sampling technique was used during the research. The quasi-experimental research design in this study is presented in Table 1.

TABLE 1. Research Design Post-test Only Nonequivalen Group Design

Group	Treatment	Posttest
Experiment 1	X1	O1
Experiment 2	X2	O2

Keterangan:
X1: Learning using Discovery Learning
X2: Learning using Guided Inquiry Combined with CIRC
O1: Post-test in the experiment class 1
O2: Post-test in the experiment class 2

The data collection techniques that researchers opted to use in this study were observation, tests, and documentation. The observation was carried out using observation sheets which were assessed by the observer on the teacher,,s activities and students during the learning process. The test was used to measure the achievement of students' scientific literacy for the treatment given. The documentation aims to obtain data in the form of 1st-semester Final Assessment‟s score in the subjects of biology as the initial data on students' academic competence. The data were tested using the normality and homogeneity test as the research sample. The research sample is determined by considering the prerequisite test results. Based on the results of the prerequisite test and the determination of the sample by random sampling, it is determined that class XI Science 1 is the experimental class 1 that applies the discovery learning model while class XI Science 2 is the experimental class 2 applies the CirGI model. Measurement of scientific literacy uses NOSLiT questions (Wenning, 2006). The test was given to students after learning (posttest) in experimental class 1 and experimental class 2.

The prerequisite test for data analysis used the normality and homogeneity test. The data normality test is carried out to find out whether the data obtained from the population is normally distributed or not, the calculation is using the help of the SPSS program. A homogeneity test is carried out to test the variation of the homogeneous population, whether the data obtained is homogeneous or not for the two treatment groups. Data analysis was conducted to test the proposed hypothesis, this test was conducted to see whether there was a significant difference between students who were treated with the CirGI model and those who used the Guided inquiry model. Hypothesis testing in this study uses two-way analysis of variance (Two Ways-Anova) with a 2x3 factorial with unequal cells. Two-way analysis of variance aims to test the significance of the row, column factors, and the combination of the column and column factors for scientific literacy. Line factors include the guided inquiry learning model and the CirGI model. Column factor is academic ability, including high, medium, and low academic ability.

RESULT AND DISCUSSION

Data on scientific literacy were obtained from two classes, namely class XI Science 1 with 36 students as experimental class 1 using the discovery learning model and class XI Science 2 with 35 students as experimental class 2 using the CIRC-integrated guided inquiry learning model. The data obtained from the two classes were combined and averaged to obtain data in the form of students' scientific literacy competence scores. The results of the calculation of the distribution of students' scientific literacy can be summarized in Table 2.

TABLE 2. Distribution of Student Scientific Literacy

Statistic	Experimental class 1	Experimental class 2
Mean	50	54
Standard deviation	3,481812154	4,720418725
Variance	12,12301587	22,28235294
Minimum	43	44
Maximum	57	61
Median	50	54
N	36	35

Table 2 shows the average score of scientific literacy in experimental class 1 (50) and experimental class 2 (54). The CIRC-integrated guided inquiry learning model is better in increasing scientific literacy than the discovery learning model. The average score of each scientific literacy indicator in experimental class 1 and experimental class 2 was summarized and presented in Table 3.

TABLE 3. The Score of Each Indicator of Science Literacy

Aspect	Indicator	The average score of scientific literacy	
		Experimental class 1	Experimenta l class 2
Content of science	1. Scienctific Nomenclature	48,15	53,80
	2. Rules of scientific evidence	50,85	52,97
	3. Postulat sains	53,47	61,43
How to know the science	1. Scientific disposition	67,59	68,1

Understand and conduct scientific research	1. Major misconception about science	31,25	37,86
	2. Intellectual process skills	46,06	55,24

The highest average value is on the scientific disposition indicator with a value of 67.59 in experimental class 1 and 68,1 in experimental class 2. The lowest average value on the main misconception indicators in science with a value of 31.25 in experimental class I and 37.86 in experimental class 2. The average score on all indicators of scientific literacy in experimental class 2 using guided inquiry combined with CIRC was higher than in experimental class 1 using the discovery learning model.

The results of the hypothesis test analyzed using the two-way ANOVA test with SPSS 25 are presented in Table 4. Table 4 shows that 1) the significance score derived from the learning model is 0.00, 2) the significance score derived from academic competence is 0.00, and 3) the significance score derived from the learning model and academic competence is 0.020. Hypothesis results are rejected if the significance value (Sig.) <0.05 and the hypothesis is accepted if the significance value (Sig.)> 0.05. The conclusion from the results of the hypothesis test shows that 1) H_0 is rejected and H_1 is accepted which means that there is an effect in the application of CIRC-integrated inquiry learning model on students' scientific literacy, 2) H_0 is rejected and H_1 is accepted which means that there is an effect of students‟ academic competence on their scientific literacy, 3) H_0 is rejected and H_1 is accepted which means that there is an interaction between the learning model and academic competence on students' scientific literacy.

TABLE 4. Tests of Between-Subjects Effects

Dependent Variable: Science Literacy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	737.005[a]	5	147.401	12.299	.000
Intercept	164217.695	1	164217.695	13702.470	.000
Model	173.196	1	173.196	14.452	.000
Academic competence	321.077	2	160.538	13.395	.000
Model * Academic competence	99.451	2	49.726	4.149	.020
Error	778.995	65	11.985		
Total	193500.000	71			
Corrected Total	1516.000	70			

The Influence of CIRC Combined with Guided Inquiry toward Scientific Literacy

Results from the two-way ANOVA test showed that CIRC-integrated Guided Inquiry Learning affected students‟ scientific literacy. The analysis indicated a significant difference in average scientific literacy scores between discovery learning and CIRC-integrated guided inquiry learning. The comparison of average scientific literacy scores between the two models can be seen in figure 1.

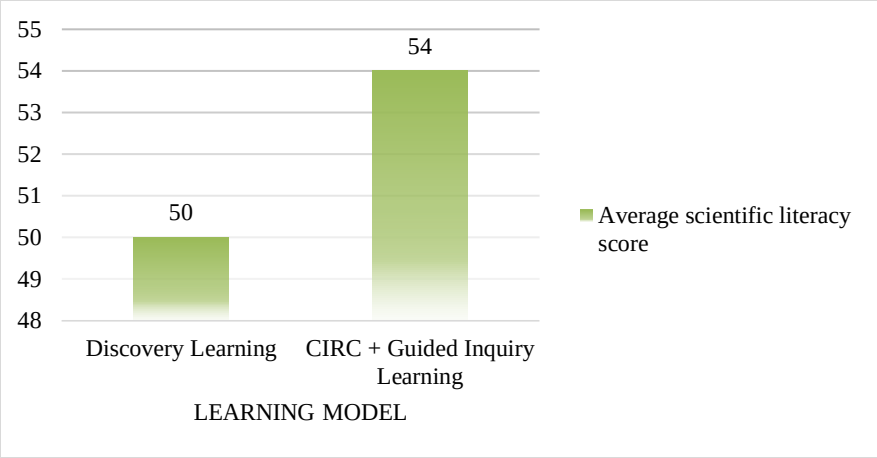

FIGURE 1. The histogram of average scientific literacy scores based on its learning model

Figure 1 shows that the scientific literacy of students in the discovery learning class is lower than that in the CIRC- integrated guided inquiry class. Gormally, Brickman, & Lutz (2012) stated that implementing inquiry during learning is necessary to train students during research so that their scientific literacy and understanding of the concept of biology can improve. Inquiry learning develops students' ability to think critically, systematically, analytically, and logically in conducting their research (Anggareni et al., 2013). Moreover, students are expected to have the initiative when deciding to solve a problem. According to Butler & Britt (2011), a guided inquiry learning can help students to understand a more in-depth content of literature and actively involve students during learning.

CIRC-integrated guided inquiry learning model requires students to search for sources or literature that corresponds to the learning topic and discuss them in a group. The purpose of this activity is that each student can understand the sources or literature as Rusdi, A., Sipahutar, H. & Syarifuddin (2017) stated that the ability to understand literature contributes to scientific literacy. Findings from the research conducted by Fang and Wei (2010) revealed that integrating reading in science learning has a positive impact on students‟ scientific literacy. Students are required to understand and rewrite the content of literature.

The Influence of Academic toward Scientific Literacy

Results from the two-way ANOVA test showed that academic competence influence students‟ scientific literacy. A significant difference in students‟ scientific literacy is found between students with high, moderate, and low academic competence. The results support the statement from Suratno (2010) that academic competence has a significant influence on improving scientific literacy. The average scientific literacy scores based on academic competence can be seen in Figure 2.

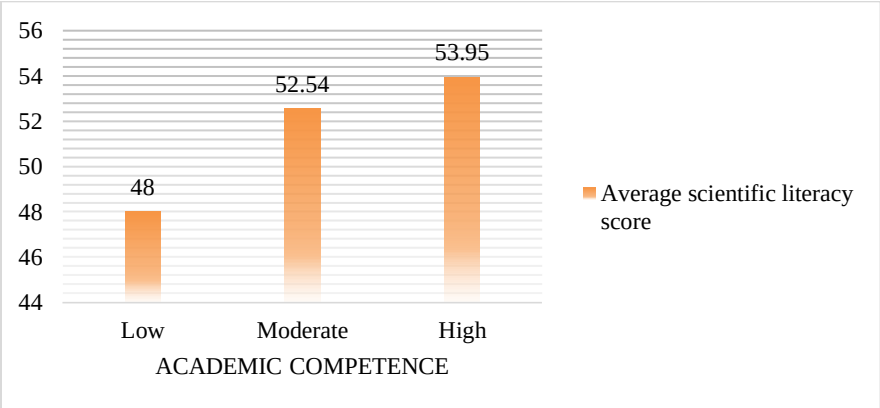

FIGURE 2. The average scientific literacy scores based on academic competence

According to Figure 2, students with high academic competence have a higher average scientific literacy score compared to students with moderate and low academic competence. Students with high academic competence are more prepared to receive the materials taught by the teacher (Mlambo, 2012). Students with high academic competence can plan, construct a learning strategy, and evaluate what they have learned better than students with lower academic competence (Muhlisin, Susilo, & Amin, 2016).

Students with high intelligence can understand the materials taught by the teachers and implement them in real life which accordingly helps them in solving their problems. Students with high intelligence can independently construct new understanding. These students can connect their initial to recently received knowledge and apply them in real life. According to Duckworth and Seligman (2005), students with high intelligence tend to have higher achievement in academics.

Having a high academic competence does not ensure that students can fully understand the content of biology. Good academic achievement can be the result of students"' ability to fully understand biology by reading and understanding the content well. Moreover, high academic achievement can also be obtained just by memorizing the biology materials given by the teachers. Students with good reading skills can understand the biology materials meaningfully so that they can apply them in real-life problem solving (Handayani, Adisyahputra, & Indrayanti, 2018).

The Interaction of Learning Model and Academic Ability on Scientific Literacy

According to the results from the two-way ANOVA test, the absence of interaction between the variables shows that students"' academic competence is not a consideration in the implementation of CIRC-integrated guided inquiry learning. The average scientific literacy scores in terms of academic competence can be seen in Figure 3.

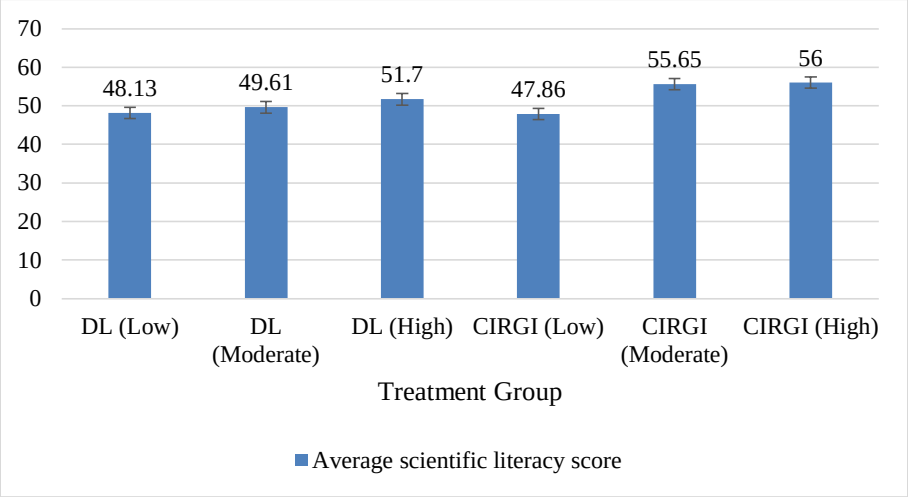

FIGURE 3. The histogram of average scientific literacy scores in terms of academic competence

The findings indicate that there is an interaction between the learning model and academic competence on students' scientific literacy. The results support the findings from Taofiq et al. (2018) there is an interaction between academic competence and implementation of learning models students scientific literacy skills. The interaction between the learning model and academic competence on scientific literacy is shown in Figure 4.

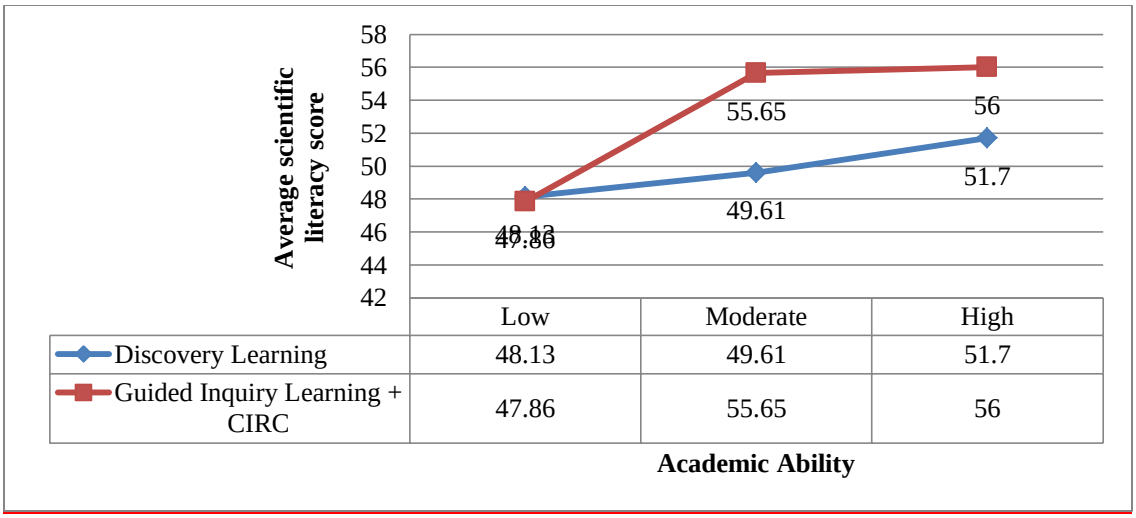

FIGURE 4. The graph of interaction between learning model and academic competence on students' scientific literacy

Figure 4 shows that the two lines on the graph intersect each other which indicates an interaction between the learning model and students' scientific literacy. Academic competence and learning model have a significant impact on scientific literacy. The atmosphere during the learning activity highly influences students learning process. Therefore, teachers need to determine the accurate learning model to achieve the goal of learning (Sumianingrum, Wibawanto, & Haryono, 2017). The results support the findings from Bagiarta et al. (2015) which stated that the interaction between academic competence and achievement motivation influences students' scientific literacy. The average scientific literacy scores of students with high academic competence from both classes are higher than students with moderate and low academic competence. Students with high academic competence are more prepared to keep up with the learning activity which accordingly improves their understanding of the lesson compared to students with moderate and low academic competence. Students with moderate academic competence struggle when answering difficult questions although some of these questions can be understood (Sujudi, M. S., Idris. T., Suryanti, & Handayani, P.H., 2020).

Students in the CIRC-integrated guided inquiry learning class have higher scientific literacy scores than students in the discovery learning class. Students with high academic competence can quickly process the lessons, while students with moderate and low academic competence take more time to process the lessons (Sarwar, Bashir, Khan, & Khan, 2009). Students with low academic competence tend to experience learning difficulties and have a delayed thought process which resulted in lower learning outcomes.

According to Figure 4, the average scientific literacy scores from students in both classes are not optimal due to their inability to achieve the highest score (100). The learning model is not the only factor that influences scientific literacy. The control of students‟ external factors in the form of CIRC-integrated guided inquiry learning on students in class 2 provided better results compared to the implementation of discovery learning on students in class 1. Therefore, CIRC-integrated guided inquiry learning is an alternative to improve students‟ scientific literacy.

CONCLUSION

According to the findings, the research has shown that 1) CIRC-integrated guided inquiry learning affects students‟ scientific literacy; 2) academic competence influences students‟ scientific literacy; 3) interaction is found between CIRC-integrated guided inquiry learning model and students‟ academic competence on scientific literacy. The CIRC-integrated guided inquiry learning model can be applied in the class to help students improve scientific literacy skills. If you want to do research related to inquiry, you should choose the level of inquiry according to the cognitive level of students so that the results obtained are appropriate.

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