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Correlation between scientific literacy with higher order thinking skills and self-efficacy in biology learning

May Firdaw Arifiyyati [1*], Ndzani Latifatur Rofi'ah [1], Listyono [1]
[1] Department of Biology Education, Faculty of Science and Technology, Universitas Islam Negeri Walisongo Semarang, Jl. Prof. Dr. Hamka, Ngaliyan, Semarang, 50185, Jawa Tengah
*corresponding author: mayfa_1808086042@student.walisongo.ac.id

ABSTRACT

Education is one of the fields or perspectives that have significant developments in the progress of the times. Technological developments are developing the world of education, called the era of the industrial revolution 4.0. Therefore, several things must be mastered, namely competence in each student's life and multiliteracy in mental, physical, and intellectual capacities. One is Science Literacy Ability and Higher Order Thinking Skills (HOTS). In addition to knowledge competence, students must also have confidence in themselves to do and do well, namely self-efficacy. This study aims to determine the relationship between scientific literacy skills, HOTS, and self-efficacy as mediating variables. This type of research is correlational with the survey method. The sampling technique used is Simple Random Sampling with a sample of the population of class XI SMA students who are studying biology. Techniques and data collection instruments using tests in the form of questions (scientific literacy skills and HOTS) and statement questionnaires (self-efficacy). The research was conducted in March-May 2022 at SMAN 3 Semarang. Analysis of research data using quantitative descriptions. The results of this study are that there is a relationship between scientific literacy ability and HOTS with an influence proportion of 7.9%, there is no relationship between scientific literacy ability and self-efficacy with an influence proportion of 0.2%, there is no relationship between HOTS and self-efficacy influence 1.2%.

Keywords: higher order thinking skills, scientific literacy, self-efficacy

INTRODUCTION

Education is one field that had significant development of the times. Currently, the world of education is being affected by technological developments called the era of the industrial revolution 4.0. In the 21st century, which has many challenges and competition, students demand a strong character within themselves. Students should be able to master competence in life and multiliteracy in terms of mental, physical, and intellectual capacity (Khasanah & Herina, 2020). The ability to think, build creativity, construct knowledge, solve problems, and master material is included in several 21st-century learning skills, one of which is the 4C skill. Skills included in 4C are Critical thinking, Team Building/ Collaboration, Communication, Creativity, and Innovation (Maulidah, 2021). These four skills are 21st-century skills that are very much needed in education in the 21st century. In addition, there are also 21st-century skills, including digital age literacy, inventive thinking, effective communication, and high productivity. Learners need these skills to develop in today's digital era.

Learning in the 21st century is a subject that must be considered because it has a high urgency because Indonesia is at a low level in the 2018 Program of International Student Assessment (PISA). PISA results in 2018 show Indonesia's scientific literacy score are ranked 71st out of 79 PISA participating countries with a score of 396 (OECD, 2019). Meanwhile, the 2018 PISA scores in neighboring countries are higher, with Malaysia at 438 and Singapore at 551 (Hewi & Shaleh, 2020). This shows that Indonesia's score is far below the international average and still needs to catch up in Southeast Asia. Educational reform in the 21st century has caused almost all countries to call for developing and emphasizing scientific literacy in students.

This was done to face the industrial revolution 4.0.

In addition to scientific literacy, the 21st century demands learning reforms to produce quality human resources. Competency standards that must be possessed are Higher Order Thinking Skills (HOTS) and innovative learning such as critical thinking skills, problem-solving skills, creative thinking, literacy, decision-making, collaboration, and learning independently and responsibly. Problem-solving, which is included in the 21st-century critical thinking competence by students, requires higher-order thinking skills and confidence in their abilities or self-efficacy.

To improve scientific literacy skills, the learning process must have certain abilities, namely the ability to think, build creativity, construct knowledge, solve problems and master the material. This is supported by DeBoer (2000) that scientific literacy includes the capacity to use scientific knowledge, identify questions, draw conclusions based on evidence, and explain and predict phenomena to solve problems. Some of these things can be obtained by students in implementing biology learning. Students are asked to carry out activities in the form of scientific investigations to understand the nature of science as a process of increasing scientific literacy skills in biology learning.

HOTS is one of the abilities that influence scientific literacy skills. According to what was conveyed by Thahir et al. (2021) that scientific literacy abilities are included in science learning. Meanwhile, science learning can develop creativity, and critical thinking skills, become a good citizen of the country, and be aware of the progress of life or work. Therefore, it can be concluded that learning science can lead to scientific literacy skills and have implications for higher-order thinking and problem-solving skills.

Self-efficacy is also a factor that can influence students' scientific literacy skills. Previous studies have evidence that the students with the highest scientific literacy level have the highest self-efficacy level. Self-efficacy must be developed in students so that they can interpret the process of a lesson so can develop problem-solving skills. Self-confidence is essential because students believe in their abilities and feel straightforward about completing assignments, and their performance processes will have a better effect (Hanifah et al., 2020).

The intense interaction of students and teachers or teachers who carry out the activation process, namely learning and teaching (KBM) is called learning. Teaching and learning activities consist of the main actors (students) and facilitators (teachers) who assist students in achieving predetermined learning targets. Learning can be meaningful if the processes involve maximum interaction between students and teachers; that is, students are actively engaged in the learning process (Jayawardana, 2017).

Biology comes from bios and logos. Bios is life, and logos is science. So, in language, Biology is a science that contains lessons for life. Meanwhile, lexically, Biology is a scientific discipline that studies living things and everything related to living things. Over time, the science of biology developed so that branches of biology emerged. For example, cytology (studying cells), histology (studying tissues), anatomy and physiology (studying organs and organ systems), and so on. The branch of biology appears based on the level of life, namely from the molecular level to the biome. Each group requires specific concerns to study further (Sanjayanti et al., 2021).

The impact of technological developments in the 21st century also affects education, so the learning process must also be able to keep up with developments. The 21st-century educational revolution has brought about changes in learning in Indonesia. Learning biology in the 21st century requires students to

master 4C skills, namely creative thinking skills, critical thinking, problem-solving, and communication (Aripin et al., 2020). KBM, which is a learning process, has characteristics that require students to participate actively in it. Because, currently the teacher or instructor is only a facilitator, and learning is centered and focuses on students. That is, the teacher is a companion of students, not a source of learning. Learning resources for students are also not limited to books, but via the internet, scientific activities outside of school, scientific discussions, etc. In essence, students must learn to think scientifically and rationally and be able to solve problems around them (Pertiwi et al., 2018).

Based on this description, this research was carried out with the aim of research to find out the study of the relationship between Science Literacy Ability and HOTS and Self-efficacy as mediating variables in biology learning in class XI SMA.

METHOD

This research uses correlational research using survey methods. The population was all students of class XI SMAN 3 Semarang who got biology lessons or Mathematics and Natural Sciences (MIPA) classes. The research was conducted in Maret-May 2022. Samples were obtained from the population with a sampling technique in the form of simple random sampling. Data collection techniques using test instruments in the form of questions and questionnaires. Tests in the form of questions were carried out on HOTS variables and Scientific Literacy Ability, while questionnaires were used on self-efficacy variables. The data collection technique can be seen in Table 1. After obtaining the data, data analysis was carried out with the prerequisite test of regression model I and regression model II, and hypothesis testing with the Sobel test to look for the indirect effect of self-efficacy on the relationship between scientific literacy ability and HOTS.

Table 1. Research data collection techniques

Data collection technique	Data Collection Instruments	Researcher Activities
Test	The questions are in the form of Science Literacy and HOTS questions	Distribute questions to class XI students who receive biology lessons so that the level of scientific literacy and HOTS can be measured
Questionnaire	The statement is in the form of a closed self-efficacy questionnaire	Distribute questionnaires to class XI students who receive biology lessons so that the level of self-efficacy can be measured

RESULTS AND DISCUSSION

The research data came from 60 students who were a sample of the research population. Before the Sobel test was carried out, a simple regression test was carried out to determine the relationship between variables. A regression test was conducted to determine the relationship between scientific literacy ability (X) and HOTS (Y). The test results are presented in Tables 2 and 3.

Table 2. Regression test results (ANOVA) relationship X with Y

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	46421.488	1	46421.488	4,957	.030b
	residual	543158.695	58	9364805		
	Total	589580.183	59			

a. Dependent Variable: Scientific Literacy

b. Predictors: (Constant), HOTS

Table 3. Regression test results (model summary) relationship X with Y

Summary modelb				
Model	R	R Square	Adjusted R Square	std. Error of the Estimate
1	.281a	079	063	61,738
a. Predictors: (Constant), Scientific Literacy				
b. Dependent Variable: HOTS				

Table 3 results of the regression test show R count as a correlation value of 0.281, so it can be explained that between the variables X and Y have a relationship with a sufficient level of closeness. Meanwhile, the regression significance value in Table 2 is 0.03, meaning that the value is less than 0.05 (0.03 <0.05). It can be concluded that Scientific Literacy Ability has a significant influence on HOTS. The percentage of influence between variables X on Y can be seen in Table 3 column R Square with a value of 0.079 or 7.9%. This value shows that the effect of variable X on Y is 7.9%. Furthermore, a simple regression test is carried out to determine the relationship between scientific literacy ability and self-efficacy. The results of the regression test are presented in Table 4 and Table 5.

Table 4. Regression test results (ANOVA) relationship between M and X

ANOVA						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	718,481	1	718, 481	.514	.476b
	Residual	81043.119	58	1397,295		
	Total	81761600	59			
a. Dependent Variable: Self-efficacy						
b. Predictors: (Constant), Scientific Literacy						

Table 5. Regression test results (model summary) relationship between M and X

Summary models				
Mode	R	R Square	Adjusted R Square	std. Error of the Estimate
1	.094a	.009	-.008	37,380
a. Predictors: (Constant), Scientific Literacy				

Based on Table 5, the results of the regression test show the R count is a correlation value of 0.094, so it can be explained that between the variables M and X have a relationship with a fragile level of closeness. Meanwhile, the regression significance value in Table 4 is 0.476, meaning that the value is more significant than 0.05 (0.476 > 0.05), so it can be concluded that self-efficacy does not have a significant effect on HOTS. The percentage of influence between the variables M on X can be seen in Table 5, column R Square with a value of 0.009. This value indicates the effect of the variable M on X is 0.9%. A percentage value of 0.9% means that the influence exerted between the variables M on X is very weak, so there is no significant influence from the relationship between these variables.

Furthermore, a simple regression test was carried out to determine the relationship between HOTS and self-efficacy. The results of the regression test are presented in Table 6 and Table 7.

Table 6. Regression test results (ANOVA) relationship between M and Y

ANOVA						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1368030	1	1368030	.987	.325b
	residual	80393.570	58	1386096		
	Total	81761600	59			
a. Dependent Variable: Self-efficacy						
b. Predictors: (Constant), HOTS						

Table 7. Regression test results (model summary) relationship between M and Y

Summary models				
Model	R	R Square	Adjusted R Square	std. Error of the Estimate
1	.129a	.017	.000	37,230
a. Predictors: (Constant), HOTS				

Based on Table 7, the results of the regression test show the R count is a correlation value of 0.129, so it can be explained that between the variables M and Y have a relationship with a fragile level of closeness.

Meanwhile, the regression significance value in Table 6 is 0.325, meaning that the value is more significant than 0.05 (0.325 > 0.05), so it can be concluded that self-efficacy does not significantly affect HOTS. The percentage of influence between the variables M on Y can be seen in Table 7, column R Square with a value of 0.017 or 1.7%. This value indicates that the effect of variable M on Y is 1.7%. A percentage value of 1.7% means that the influence exerted between the variables Y on M is very small, so there is no significant effect on the relationship between these variables. Furthermore, before carrying out the Sobel test, it is necessary to carry out a prerequisite test. The prerequisite test was carried out using simple regression, namely the first and second regression models. The table presentation of the simple regression model in Tables 8 and 9 is as follows.

Table 8. Regression model I

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	std. Error	Betas		
1	Constant	765,532	176,475		4,338	.000
	Self-efficacy	-.077	.251	-.041	.309	.758

a. Dependent Variable: Scientific Literacy

The table 8 explains that the coefficient value of the relationship between scientific literacy ability and self-efficacy is -0.077 and the standard deviation is 0.251 and the significance value is 0.758.

The table 9 explains that the coefficient value of the relationship between scientific literacy ability and self-efficacy is -0.077 and the standard deviation is 0.251, and the significance value is 0.758. The table explains that the coefficient value of the relationship between self-efficacy and HOTS is 0.145, the standard deviation is 0.54, and the significance value is 0.349.

Table 9. Regression model II

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	std.Error	Betas		
1	Constant	588,990	124,582		4,728	.000
	Science Literacy	.182	081	.285	2,261	.028
	Self-efficacy	.145	.154	.119	.945	.349

a. Dependent Variable: HOTS

Based on these data, a Sobel test was carried out to find out the z value of the Sobel test. The results of the Sobel test calculations were carried out with the Sobel calculator in Figure 1.

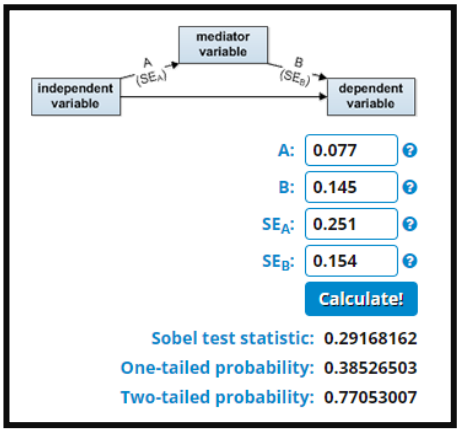

Figure 1. Sobel test results

The results of the Sobel test explain the z value of 0.29, meaning that the Sobel test result is smaller than the z value (0.29 <1.96), so it can be concluded that self-efficacy does not indirectly affect the relationship between scientific literacy ability and HOTS.

Based on Tables 2 and 3, it can be explained that there is a significant relationship between scientific literacy skills and HOTS. The percentage is 7.9%, meaning that the influence of scientific literacy skills on HOTS is 7.9%, while other factors cause 92.1%. This is also the previous theory by Thahir (2021), mentioning that the ability of scientific literacy is included in science learning. Meanwhile, learning science can

develop creativity, think critically, be a good citizen, and be aware of a broad career. Therefore, it can be concluded that learning science can lead to scientific literacy skills and have implications for higher order thinking skills and problem-solving (Thahir et al., 2021).

There is a relationship between scientific literacy skills and HOTS because there is a link between the indicators of the two variables. The Organization for Economic Co-operation and Development (OECD) suggests that there are three indicators of students' scientific literacy abilities in the Program for International Student Assessment (PISA), namely (1) identifying, solving, and evaluating natural and technological problems with scientific steps, (2) describe, evaluate and formulate solutions to problems scientifically, and (3) analyze, present scientific ideas and conclude from data representation (OECD, 2019). While some of the HOTS indicators are (1) making decisions based on the information or problems provided, (2) identifying, processing, analyzing, and linking the information obtained with concepts, theories, and opinions, (3) solving problems based on the data or information provided, and (4) solve problems with new ideas that are created (Ulfa & Kuswanti, 2021). Based on these indicators, there are indicators with implications, such as identifying and evaluating problems, analyzing data or information, and solving a problem. There is a relationship between scientific literacy skills and HOTS.

However, the percentage value tends to be small. This was shown based on previous data showing that the scientific literacy skills of Class XI students were in a low category (53%) while HOTS Class XI students were in the medium category (58%). This can be used as one of the reasons for the slight influence of scientific literacy skills on HOTS.

Based on previous research, there is low scientific literacy ability caused by several factors, namely teaching materials that are not suitable, there are misconceptions between students, teachers, and also the material presented, learning that is carried out is not contextual, reading skills are still lacking, and climate and environmental conditions unfavorable school (Fuadi et al., 2020). In addition, the implementation of learning also affects scientific literacy skills, such as learning strategies, learning models, and learning methods. Based on a joint decision of the Minister of Education and Culture (No. 03/KB/2021), Minister of Religion (No. 384 of 2021), Minister of Health (No. HK.01.08/Menkes/4242/2021) and Minister of Home Affairs (No. 440 -717 of 2021) Regarding Guidelines for Organizing Learning During the Covid-19 Pandemic Period, it states that the implementation of learning in schools can be carried out online or limited to face-to-face. Based on this, learning activities in schools are carried out online, either as a whole or for some students.

The implementation of online learning has an impact on student learning activities. Biology learning is carried out through an online meeting platform in the form of Microsoft Teams or watching videos sent by the teacher via the WhatsApp group. It also affects student learning activities. Students tend to be less active and explore the material being taught by the teacher. In addition, the learning indicators for each Basic Competency (KD) have not been fulfilled. This is also in accordance with previous research, which states that online learning has negative impacts, such as students being less active when learning, practicum cannot be carried out directly, and learning indicators not being fulfilled because the online platform used is not appropriate (Dewi & Sadjiarto, 2021; Maulana, 2021; Saputra et al., 2021).

Less active online learning also affects students' science process skills. Based on previous research, science process skills when online learning tends to be low on data or fact interpretation indicators. Students need to carry out direct activities so that they can understand the learning process directly so that it is a more

meaningful learning experience (Yunita & Nurita, 2021; Alfajri, 2022). This has implications for activities stating scientific evidence based on the interpretation and processing of data which is one of the indicators of science. This is also in accordance with previous research, which states that interpretation of data is required in scientific literacy skills (Novitasari et al., 2022). Based on this description, student activities carried out online do not meet the indicators in implementing science process skills, so students' scientific literacy skills also tend to be lacking.

Other research also states that in science process skills, it is important to have activities in the form of identifying variables or objects, defining data operationally, determining hypotheses, and carrying out skills in conducting experiments which the teacher emphasizes. Some of these skills can be maximized if direct face-to-face learning occurs with teachers and other students (Lati et al., 2012). This is by previous research, which explains that scientific literacy skills also have process skills in them, which can be demonstrated with science process skills (Nofiana & Julianto, 2018).

Online learning will be conducted in whole or part for students in July 2021-March 2022, while face-to-face learning begins in April-June 2022. Based on this, face-to-face learning begins in the middle of semester 2. That is, online learning is carried out have a longer time than learning with face-to-face meetings. This also affects the learning activities carried out so that it impacts students' science process skills. Students' lack of science process skills will affect their scientific literacy abilities. Based on this, apart from lacking internal student factors.

Based on previous research explaining that low scientific literacy is influenced by several factors, both internally and externally. Internal factors can be caused because students who can only recognize and remember knowledge have not been able to relate and apply science topics to life (Novita et al., 2021). It can be seen from the answers to the self-efficacy questionnaire that 20 students disagreed with this statement. This proves that some students still need to be able to convey their understanding of the material that has been taught before. This proves that students' internal factors can less influence their scientific literacy abilities.

The percentage of the effect of self-efficacy on scientific literacy is 0.9%. The existence of a relationship between self-efficacy and scientific literacy is caused by students' attitudes in responding to science, namely self-confidence. Self-efficacy has an orientation to the attitude of students who can carry out a task, organize, achieve goals with specific criteria and implement these attitudes to develop their skills. This, of course, intersects with scientific literacy skills activities such as solving and evaluating problems and expressing opinions from scientific data or facts, so individual confidence is needed to carry out these activities (Lestari et al., 2020).

However, the weak relationship between self-efficacy and scientific literacy skills can be caused by low scientific literacy abilities and students' self-efficacy. It can be assumed that class XI students tend to be afraid if their biology scores are below the KKM and also because of feelings of fear because their friends are much more intelligent than themselves. In addition, students also tend to feel disturbed if the learning environment is busy, so they need to be more focused on ongoing learning activities. In addition, when learning activities occur, students tend to feel afraid when they want to express their opinions regarding the problems being raised because they feel that other friends are more intelligent. Hence, students tend to keep things secret and not express their opinions.

The causes of low self-efficacy are also to previous research, namely due to several things, such as low student learning motivation, feeling inferior or inferior to more intelligent friends, and also because friends with friends who do not prioritize learning (Nurfadhilla, 2020). Low self-efficacy can be increased by counseling with

groups (Anggara et al., 2016; Madihah, 2018; Setyarini, 2015). Guidance and counseling with the group model can increase self-efficacy because students will have an increase in self-efficacy if they gather, and there are approaches from students who have high self-efficacy as well.

Based on Table 7, the R-value is calculated as a correlation value of 0.129, so there is a relationship between self-efficacy and HOTS, but it has a fragile level of closeness. Meanwhile, based on the results of data analysis in Table 6, the significance value of the regression test for the relationship between self-efficacy and HOTS is 0.325 > 0.05, so the effect of self-efficacy on HOTS is not significant. The percentage effect of self-efficacy on scientific literacy is 1.7%. It can be explained that there is no significant relationship between HOTS and self-efficacy.

The results of this analysis are by previous research that there is a positive relationship between self-efficacy and HOTS, but it does not have a significant effect. This is because previous studies' results have moderate self-efficacy levels but tend to have less or low HOTS levels (Afdar & Zakaria, 2022).

Critical thinking requires belief in oneself to solve a problem, determine answers to problems that arise, and determine a scientific action (Hyytinen et al., 2018). While HOTS is the ability to integrate, manipulate, and transform or change existing knowledge and experience to think creatively and critically in solving problems. (Putranta & Supahar, 2019). So, there is a relationship between self-efficacy and HOTS, and self-efficacy can be one of the factors influencing HOTS and self-efficacy can mediate against HOTS.

However, the low relationship between self-efficacy and HOTS can be caused by students' low scores on self-efficacy. Another cause is that students' scores on HOTS are medium, while those on Self-efficacy tend to be low. Based on the analysis of the questionnaire statement items, 12 students (20%) tended to look at their friends' answers when doing an assignment or exam. Previous research stated that several factors cause students to cheat on their friends. Some factors that cause this are pressure from outside, such as peers, parents, teacher attitudes, and school rules. In addition, the desire of students to have high scores is also the cause of cheating behavior. Factors within the individual can also influence cheating behavior (Khairat et al., 2014). This can be analyzed from the statement that 20 students (33.3%) stated that they did not or did not understand the material that had been taught. In addition, it can also be seen from the low self-efficacy of students collected data through self-efficacy questionnaires.

The causes of low self-efficacy are also to previous research, namely due to several things, such as low student learning motivation, feeling inferior or inferior to more intelligent friends, and also because friends with friends who do not prioritize learning (Nurfadhilla, 2020). Low self-efficacy can be increased by doing counseling with groups (Setyarini, 2015; Anggara et al., 2016; Madihah, 2018). Guidance and counseling with the group model can increase self-efficacy because students will have an increase in self-efficacy if they gather, and there are approaches from students who have high self-efficacy as well. This also shows that peers influence the self-efficacy of everyone. Based on interviews with several students, group consultations have never been or are rarely done. When the Counseling Guidance (BK) subject tends to discuss lectures, learning motivation, and juvenile delinquency. Consultations with BKs are also carried out but are carried out individually.

Based on Figure 1, the results of the Sobel test show that self-efficacy does not indirectly affect the relationship between scientific literacy skills and self-efficacy. The absence of an indirect effect of self-efficacy on the relationship between scientific literacy skills and HOTS can also be caused by low science literacy skills and student

self-efficacy. Meanwhile, HOTS for students has a value that tends to be moderate.

CONCLUSION

Based on the research conducted, there are several conclusions, namely that there is a relationship between scientific literacy skills and HOTS Class XI students in biology learning (R value 0.281 with moderate relationship category) with a regression significance value of 0.03 <0.05 with a percentage of influence of 7.9 %. There is a relationship between scientific literacy ability and Class XI students' self-efficacy in learning biology (R value 0.094 with a fragile relationship category) with a regression significance value of 0.476> 0.05 with a percentage of influence of 0.9%. There is a relationship between HOTS and Class XI students' self-efficacy in learning biology (R value 0.129 with a fragile relationship category) with a regression significance value of 0.325> 0.05 with a percentage of influence of 1.7%. There is no indirect effect of self-efficacy on the relationship between scientific literacy abilities and HOTS class XI students in biology learning. This is evidenced by the z value of 0.29 <1.96.

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