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Achievement Motivation, Critical Thinking Skills, and Reading Comprehension Correlation with Scientific Literacy among Senior High School Students

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Abstract: This research seeks to explore the relationship among achievement motivation, critical thinking skills, and reading comprehension ability with science literacy ability of high school students. The data is the entire students of X graders at high school. Based on data analysis, the coefficient correlation between X_1 with Y is 0,811, the correlation coefficient between X_2 with Y is 0,846 and correlation coefficient between X_3 with Y is 0,686. The achievement motivation, critical thinking skills, and reading comprehension ability contribute 0.856 to the scientific literacy skill. Therefore, it can be concluded that achievement motivation, critical thinking skills, and reading comprehension correlate with scientific literacy skill.

Key Words: achievement motivation, critical thinking skills, reading comprehension ability, comprehension, scientific literacy

Abstrak: Penelitian ini bertujuan untuk mengetahui hubungan antara motivasi berprestasi, kemampuan berpikir kritis dan kemampuan membaca pemahaman dengan kemampuan literasi sains siswa SMA. Populasi penelitian seluruh siswa kelas X SMA. Berdasarkan analisis data koefisien korelasi. Secara bersama motivasi berpretasi, kemampuan berpikir kritis dan kemampuan membaca pemahaman siswa berkontribusi sebesar 0,856 pada kemampuan literasi sains siswa SMA. Hasil tersebut menunjukkan bahwa terdapat hubungan motivasi berprestasi, kemampuan berpikir kritis dan kemampuan membaca pemahaman dengan literasi sains. Analisis lebih lanjut menunjukkan hubungan yang positif. Berdasarkan hal tersebut disimpulkan bahwa motivasi berprestasi, kemampuan berpikir kritis, dan kemampuan membaca pemahaman meningkatkan literasi sains siswa.

Kata kunci: motivasi berprestasi, kemampuan berpikir kritis, kemampuan membaca, pemahaman, literasi sains

INTRODUCTION

In general, expected educational products are students who have adaptability in the real world, who are able to think critically and creatively, take on roles as problem solvers, and decision makers. This ability can be obtained through the science learned. Through science students are expected to be able to develop the ability of inductive and deductive analytical thinking in solving problems related to events around them. It also encourages them to apply concepts or facts learned in school in everyday life. This is what literacy means about science or scientific literacy.

Students' scientific literacy skills are measurable using international standards. The results of monitoring of scientific literacy of high school students from a number of countries by the OECD through the Program of International Student Assessment (PISA) in 2015 showed that Indonesia was ranked 62 out of 72 PISA member countries (OECD, 2015). The low position shows the lack of science skills of Indonesian students.

The lack of scientific literacy of Indonesian students according to the analysis of the 2004 Puspendik (Center for Education Evaluation) Science Literacy Team is caused by (1) the composition of student answers that indicate students' lack of understanding of the basic concepts of science that have actually been taught, hence they are unable to apply it to interacting data, explaining causal relationships even solving

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simple problems; (2) weak ability of students to read and interpret data in reading and interpreting data in the form of figures, tables, diagrams and other forms of presentation; (3) there is a limited ability of students to express their thoughts in written form; (4) accuracy of students reading is still low, students are not accustomed to correlating information in the text to answer questions; (5) the ability of scientific reasoning is still low; (6) weak mastery of students towards the basic concepts of science and their relevance to daily issues (Mahyuddin, 2007).

In science learning, particularly biology, students cannot: (1) present some abstract and complex concepts; (2) understand scientific concepts and processes; (3) figure out the nature systematically; (4) obtain a knowledge in the form of facts, concepts, or principles; (5) perform a process of discovery and prospects for further development in applying. This indicates a low critical thinking ability of students (Dipalaya, 2016), whereas thinking skills are very important in learning in school (Marzano et al., 1988).

Students' scientific literacy is inseparable from their reading comprehension ability. To arrive at a high level of scientific literacy, it requires a high level of reading skills. Recognizing the low reading ability of Indonesian students (Annex 35 is not necessary) (OECD, 2015), it is necessary to require reading comprehension skills to achieve higher reading skills.

Another important factor that influences scientific literacy is the attitude of students towards science which includes support for science, confidence, interest in science, and responsibility for the environment. From the results of the analysis through PISA, it is known that motivation is positively correlated with scientific abilities. Students who have high motivation will obtain a high score. Students who obtain high science test scores tend to have a more positive attitude towards science (Ekohariadi, 2009).

The above-mentioned description shows that science literacy for students is highly essential. Since student literacy in Indonesia is still low, it requires to be improved. Some important factors related to the acquisition of scientific literacy include achievement motivation, critical thinking skills, and comprehension reading skills, therefore a study was conducted to obtain an overview of the relationship between achievement motivation, critical thinking skills, and reading comprehension ability in understanding the level of science literacy skills of high school students.

Achievement motivation is the overall drive both from within and outside of students (Sujarwo, 2011) which encourages students to do their best with the aim of achieving the highest learning outcomes (Afifudin, 2009). In addition, it leads to the continuity of learning and competitiveness to achieve the best results they want (Afifudin, 2009; Sujarwo, 2011). In the academic field, achievement motivation will emerge in the form of an effort to get good grades, overcome learning obstacles, maintain good quality learning achievement and compete with others (Sujarwo, 2011).

Critical thinking is a mental process in the form of high-level thinking skills, including knowledge and skills of analyzing, evaluating, drawing conclusions, making decisions and solving problems (Fajrianthi et al., 2006). Critical thinking skills are a key element in education (Mal Leicester, 2010), cognitive activity (Cottrell, 2005) relating to the use of the mind in learning (Cottrell, 2005) and strategies and representations that apply in all areas of human activity (Cohen, 2015). One dimension of level 5 cognitive processes is an evaluation, which includes the ability to criticize (Anderson et al., 2001). Ten components of critical thinking skills are: 1) distinguishing between verified facts and claims against values, 2) distinguishing relevant and irrelevant information, along with the reasons, 3) determining the accuracy of a statement with facts, 4) determining source credibility, 5) identifying ambiguous claims or arguments, 6) identifying unwritten assumptions, 7) detecting bias, 8) identifying logical errors, 9) recognizing logical inconsistencies in lines of reasoning, 10) determining the strength of arguments from claims (Anderson et al ., 2001). Reading comprehension is the identical process of extracting and constructing meaning (Kwiatkowska, 2012), is a process of gaining an understanding of manuscript ideas (Khuzaimatun, 2009) and reconstructing messages contained in texts (Fahrudin, 2009) by linking the knowledge possessed to understand the main ideas, important details, and all understanding and remember the material they read (Khuzaimatun, 2009). Understanding is the essence of reading activities, based on cognitive views, is a reading process that emphasizes a series of strategies (Kwiatkoswka, 2012). Understanding reading depends on the age of the student or grade level (Brimo, 2015).

Science literacy is interpreted as the ability to apply scientific concepts in solving everyday problems (Poedjiadi, 2005) and can be taught explicitly through learning activities by knowing, acting, reading, and writing (Douglas, 2006). Science literacy is achieved when students are fluent in practicing knowledge obtained from scientific texts in life (Toharudin et al., 2011). Someone possessing scientific literacy is consistently

to use scientific concepts, hypotheses, theories, and values in making responsible decisions (Poedjiadi, 2005). Thus, basically, scientific literacy includes two main competencies: long-life education competencies and competence in using the knowledge they have to fulfill their life needs which are influenced by the development of science and society.

Contributions related to student attitudes are student perceptions of the learning process of science and the motivation of students to learn science on scientific literacy (Handayani at al., 2015). There is a positive relationship among achievement motivation and academic achievement, critical thinking and academic achievement and among creative thinking and academic performance. When an individual obtains a high level of achievement motivation, they will easily choose a task that is rather difficult, they are more likely to try relatively difficult tasks and show better performance because of pride and strong expectations, compared to those who have the low achievement (Weisani, 2013). There is a strong relationship between motivation and reading comprehension. Increased motivation will result in better reading comprehension. The high correlation between reading comprehension and motivation is an indication that motivation towards learning has an important impact on the academic success (Knoll, 2000). Besides, there is a strong relationship among reading comprehension, critical thinking, and prior knowledge. The development of reading comprehension is built on the interaction of prior knowledge and critical thinking (Aloqaili, 2011).

Based on the above-mentioned issues, this study aims to determine the relationship among achievement motivation, critical thinking skills, and reading comprehension ability with the level of scientific literacy skills of X graders of high school.

METHOD

This research is a descriptive correlational study with a quantitative approach. The population in this study were 252 students of X SMA 9 Jakarta. The sampling technique in this study was a random sampling. The sample size was determined using the Slovin formula with a level of error $\alpha = 5\%$, from the total population 252, the sample used was 155 students.

The procedure of this study is described as follows. (1) Preparation stage: conducting literature studies, preparing research instruments in the form of tests for scientific literacy, achievement motivation, critical thinking, and reading comprehension; conducting validation and reliability testing on research instruments; improving invalid and unreliable instrument items; determining the research sample. (2) Implementation Phase: conducting sample determination by random sampling, carrying out written tests for achievement motivation, critical thinking, reading comprehension, and scientific literacy, Conducting an assessment of the written test that had been carried out. (3) Final Stage: after obtaining the data, they were analyzed and further presented to be discussed. It was presented in the form of the research report.

An instrument for motivation was questionnaires, critical thinking skills were essay questions, reading comprehension ability was multiple choice questions and scientific literacy skills were essay questions. Data analysis in this study was started with a test of correlation analysis requirements. The analysis requirements used consisted of a normality test, linearity test, regression analysis, autocorrelation test, multicollinearity test, heteroscedasticity test. The normality test employed the Kolmogorov-Smirnov Test.

This study examined the relationship between achievement motivation (X1) and students' scientific literacy skills (Y), the relationship between critical thinking skills (X2) and students' scientific literacy skills (Y), the relationship between reading comprehension ability (X3) and students' literacy skills (Y) and jointly the relationship between achievement motivation (X1), critical thinking ability (X2) and comprehension reading ability (X3) with students' scientific literacy abilities (Y). The design of this study is presented in Figure 1.

RESULTS

According to the initial test of the research data using the normality test, it is known that the research data is normally distributed with a probability score above 0.05, which was 0.2 for all variables. Additionally, it was linear by using regression analysis. The results of the regression analysis showed that scientific literacy skills with achievement motivation (Figure 2a), scientific literacy skills with critical thinking skills (Figure 2b), and scientific literacy skills with reading comprehension abilities (Figure 2c) correlated linearly and positively with the equation regression respectively $\ddot{Y} = 28.108 + 0.319\ X1$, $\ddot{Y} = 3.813 + 0.365\ X2$ and $\ddot{Y} = 6.926 + 0.819\ X3$.

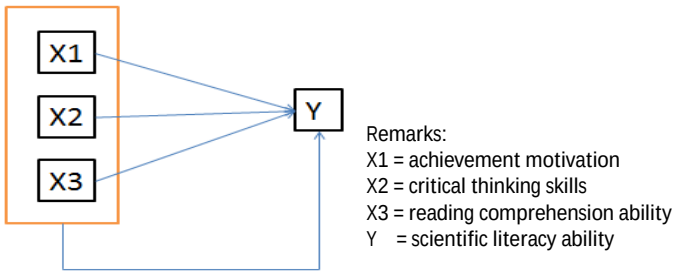
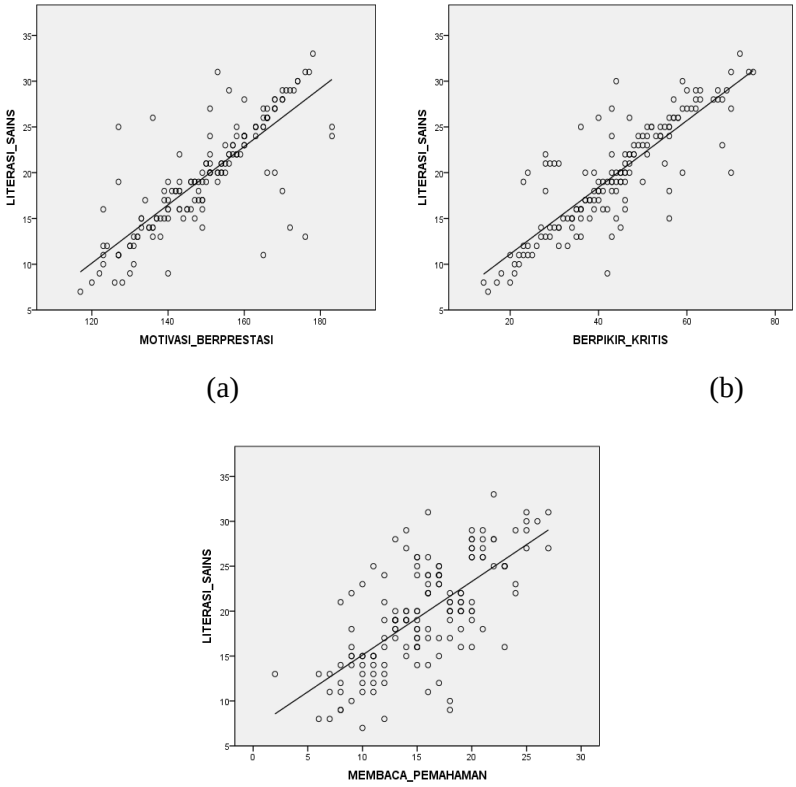


Figure 1. Research Design



(a) (b)

(c)

Figure 2. Linearity Graphic Among (a) Scientific Literacy and Achievement Motivation, (b) Scientific Literacy and Critical Thinking Skills, and (c) Scientific Literacy and Reading Comprehension Ability

Table 1. Multiple Linear Regression

Model	B	Sig
Constant	15,585	
X_1	0,150	0,000
X_2	0,208	0,000
X_3	0,240	0,000

Table 1 presents the results of multiple linear regression. According to Table 1, it obtained the Multiple Lin-ear Regression Equation Y = 15,585 + 0,150X1 + 0,208X2 + 0,240X3. The constant of 15,585 means that if there is no reading comprehension ability, critical thinking ability, and achievement motivation, then the magnitude of scientific literacy skills of students was 15,585. Then, the regression coefficient of 0,150 at X1, 0,208 at X2 and 0,240 at X3 indicate that every addition of one level of student motivation, the scientific literacy ability will increase by 0,150 units, each with the addition of one level of students' critical thinking ability, scientific literacy skill will increase by 0.208 units and increase by 0.240 units if the reading comprehension ability increases by one unit.

Autocorrelation Test

The autocorrelation test was comparing the values of dU and dL in the Durbin-Watson Table. In this study, the dU value was 1.774 and the dL value was 1.693. The Durbin-Watson value in this study was 1,821 which means it is greater than the dU value and smaller than the 4-dU value, thus the autocorrelation coefficient is zero. It means that the variable is unrestrained from autocorrelation.

Multicollinearity Test

Multicollinearity test using VIF (Value of Inflation Factor) test. The results of the multicollinearity test are presented in Table 2.

Table 2. Multicollinearity Test Results

No	Var.	Tolerance	VIF
1.	X_1	0,515	1,940
2.	X_2	0,517	1,935
3.	X_3	0,620	1,614

Based on the table above, the tolerance value in the achievement motivation variable (X1) is 0.515 and the VIF value is 1.940. On the critical thinking skills variable (X2), the tolerance value is 0.517 and VIF is 1.935. Meanwhile, the variable of reading comprehension ability (X3) was 0.620 and VIF was 1.614. It indicates that there is no multicollinearity since the Tolerance value is > 0.1 and the VIF value is <10 for each variable.

Heteroscedasticity Test

A good regression model should not occur heteroscedasticity (Ghozali, 2009). The basis of heteroscedasticity test is: (1) if there is a fixed pattern, such as the existing points form a certain pattern that is regular (wavy, widened, and then narrowed), then it indicates there has been heteroscedasticity; while (2) if there is no clear pattern, and the points spread above and below the number 0 on the Y-axis, there is no heteroscedasticity (Ghozali, 2009).

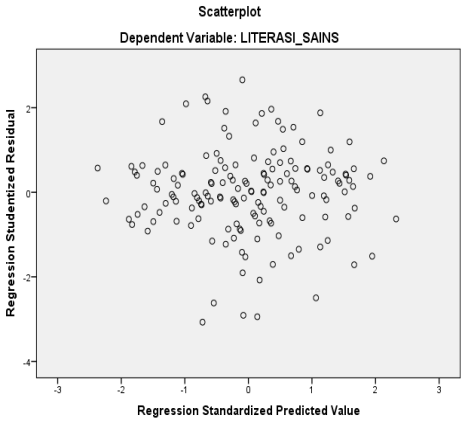


Figure 3. Heteroscedasticity Test Results

Based on Figure 3, it can be seen that the points spread and does not form a certain pattern. This shows that there is no heteroscedasticity.

Correlation Test

Correlation test results are presented in the following Table 3.

Table 3 presents that the product moment correlation coefficient for R_{x1y} is 0.811, R_{x2y} is 0.846, the product moment correlation coefficient for R_{x3y} is 0.686 and the product moment correlation coefficient value for $R_{x3x2x1y}$ is 0.925. While the value of p count between X1 and Y is 0,000 < 0,05, p count between X2 and Y is 0,000 < 0,05 and p count between X3 and Y is 0,000 < 0,05. The calculated P between X3 X2 X1 and Y is 0,000 <0.05. Thus it can be interpreted that the correlation X1 with Y, X2 with Y, X3 with Y and X3 X2 X1 with Y is positive and significant.

The amount of contribution between X and Y is seen from the magnitude of the value of R Square (coefficient of determination). The value of R Square X1Y is 0.658 which means that the achievement motivation has a 65.8% contribution to scientific literacy skills. The value of R Square X2Y is 0.716, which means that critical thinking skills have a 71.6% contribution to scientific literacy skill. While, the value of R Square X3Y is 0.411, which means that reading comprehension has a 41.1% contribution to scientific lit-

Table 3. The Results of Correlation Test

No	Correlation	Coefficient (R)	R square	P_{count}	Conclusion
1.	R_{x1y}	0,811	0,658	0,00	Positive and Significant
2.	R_{x2y}	0,846	0,716	0,00	Positive and Significant
3.	R_{x3y}	0,686	0,411	0,00	Positive and Significant
4.	$R_{x3x2x1y}$	0,925	0,856	0,00	Positive and Significant

eracy skills. The value of R Square X3 X2 X1 with Y is 0.856, which means that achievement motivation, critical thinking skills and reading comprehension ability simultaneously contribute 85.6% to the scientific literacy ability.

DISCUSSION

Achievement motivation is proven to have a significant positive relationship with scientific literacy skill with $ry_1 = 0.811 > 0.5$ (Ridwan, 2008). It implies that the better motivation to achieve will also increase scientific literacy skills. With the strength of the relationship of 0.811 and the determination coefficient of 0.658, 65.8% of the variance of scientific literacy skills can be explained by students' achievement motivation. In other words, the motivation to achieve contributes around 65.8% to science literacy skill. Hence, it appears that the achievement motivation variable does not individually play a role in scientific literacy skills. Other factors should be equally taken into account.

This is supported by the results which present that students' scientific literacy skill is influenced by two factors, individual factors, and social factors. Achievement motivation is an individual factor that arises within students. The existence of good motivation in learning will expose good results. The achievement motivation of a student will greatly determine learning achievement including scientific literacy skills (Bagiarta et al., 2015).

The results of this study further show a positive relationship between critical thinking skills and scientific literacy skill which means that better critical thinking skills will increase scientific literacy skill as reported by Rahayuni (2016). The ability to think critically is another factor in scientific literacy. Furthermore, Gherardini (2016) reported an interaction between learning methods and the ability to think critically on scientific literacy skill.

Critical thinking skills and scientific literacy skill correlation in this study is very strong, which is equal to $0.846 > 0.5$ (Ridwan, 2008). With a coefficient of determination 0.716, approximately 0.716% variance of scientific literacy skills can be explained by students' critical thinking abilities. It means that critical thinking skills contribute around 71.6% to scientific literacy skills. However, it appears that the variable critical thinking ability does not individually play a role in scientific literacy skills. Other factors should be equally taken into account.

It affirms a positive correlation between reading comprehension ability and scientific literacy skill. Such correlation confirms that the higher ability of reading comprehension, student's scientific literacy skill will simultaneously be improved. The ability of science texts reading is very important for students to be able to learn and succeed in science classes. When students can effectively read science texts, they can connect new concepts with prior knowledge and experience, making relevance between learning and their surrounding environment. Good readers have adequate prior knowledge, are able to form hypotheses, make plans, evaluate understanding, determine information interests, describe patterns, compare and differentiate, draw conclusions, generalize, and evaluate sources (Hart, 2012). Reading and writing activities are beneficial for students to understand science content profoundly, focus on related ideas and themes. Through reading and writing, students can establish on previous learning and connect it to the real world (Glynn & Denise, 1994).

Reading comprehension ability and scientific literacy skills have a strong relationship strength of $0.686 > 0.5$ (Ridwan, 2008). With a coefficient of determination of 0.411, it is said that about 41.1% of the variance in scientific literacy skills can be explained by students' reading comprehension abilities. This means that reading comprehension contributes around 41.1% to scientific literacy skills. However, it appears that the variable reading comprehension ability does not individually play a role in scientific literacy skills. Other factors should be equally taken into account.

It presents a positive relationship among the three variables examined and scientific literacy skill. Furthermore, this confirms that the three independent variables as predictors of the variance of scientific literacy skills are significant. The plural correlation coefficient of ry_{123} of 0.925 exposes a strong relationship (> 0.5) (Ridwan, 2008). With the determination coefficient of 0.856, it means that the contribution given by academic motivation, critical thinking ability, and reading comprehension ability simultaneously is 85.6%. However, the remaining around 14.4% is determined by other factors besides the three variables. Motivation and critical thinking are important for 21st-century students since they determine the level of active involvement and attitudes of students towards learning. Critical thinking ability allows students to easily access knowledge and overcome more challenges. Critical thinking is a reasoning skill or strat-

egy, and directing many factors that contribute to decision making, which allows an increase in desired results (Samerci, 2010). Critical thinking is one of the effective ways to increase reading comprehension since critical thinking is a process that uses to understand reading (Aloqaili, 2011). It allows students to reflect critically on their abilities in understanding material meaningfully (Gabanchi, 2014). Reading comprehension with motivation is closely related to academic activities. Motivation guides students directly to reading comprehension techniques. Motivated students will understand better than discouraged students. Smart students may not have reading comprehension, because they are not motivated (Knoll, 2000).

Although reading activities have been introduced to children since entering formal school for the first time, in fact, students' ability to read in various subjects has not shown encouraging achievements. The indications can be seen from the achievement of student learning evaluation results, most of which are still far from the maximum number (100). This shows the low ability of reading comprehension and critical thinking skills. Both of these affect a person's understanding of a concept, story, or dialectics science from reading the material. There is a positive relationship between critical thinking and motivation (reading interest) with critical reading skills (understanding) (Sariyem, 2016). With high critical thinking skills, the ability of students to understand reading will be improved, because in the reasoning process students will use the prior knowledge they obtained, including their experiences to test a perspective or concept as a whole with systematic scientific logic. Critical reading skills also have an impact on attitudes towards scientific literacy and critical reading skills (Karademir & Ulucinar, 2017). Critical thinking accustoms students to think effectively and productively. The concept of thinking does not only involve imaginative abilities and guesses the correct answer, but involves evaluation and evidence (Kamaei & Weisani, 2013)

CONCLUSION

Based on the results of this study, it can be concluded that the higher the achievement motivation, critical thinking ability, and reading comprehension ability possessed by students, the higher the literacy skills of science. This also means that the increase in academic motivation, critical thinking skills, and reading comprehension ability simultaneously are followed by an increase in scientific literacy skill and vice versa. Additionally, it can also be expected that there are other factors that influence students' literacy skills.

Literacy skills among high school students are influenced by many factors, both internal factors such as achievement motivation, critical thinking skills, and students' reading comprehension ability, as well as external factors such as parents, teacher professionalism, school facilities, and interest in learning. Increasing literacy skills depends on increasing these factors. In connection with this, increasing reading skills, critical thinking skills and student achievement motivation need to be improved. In addition, teachers and the community, including parents, textbook writers, and publishers of teaching books are very important to achieve efforts to improve student literacy.

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