

## ANALYSIS OF THE CORRELATION BETWEEN SCIENCE LITERACY AND CRITICAL THINKING OF GRADE EIGHT STUDENTS IN THE CIRCULATORY SYSTEM

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**Abstract:** This study aimed to analyze the relationship between scientific literacy and students' critical thinking skills in biology science material in junior high schools. The research used a quantitative correlation method. The subjects in this study were the students in the eighth grade of junior high school SMPN 9 Buton consisted of 68 people. The research instrument was in the form of multiple choice questions to measure scientific literacy skills and essay questions to measure students' critical thinking skills. The research data obtained were then analyzed with descriptive and inferential statistics through the product-moment correlation test. Results of descriptive statistics show that literacy science and student critical thinking there in four criteria excellent, good, enough, and low. The inferential statistic analysis results show that the significance value of the correlation between scientific literacy and critical thinking skills is 0.001 less than the alpha value of 0.05. Based on the results can be concluded there is a positive and significant correlation between scientific literacy and students' critical thinking skills in the circulatory system material.

**Keywords:** *Science Literation, Critical Thinking Skill, Circulatory System*

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### INTRODUCTION

The 21<sup>st</sup> Century is also known as the Century of technology and science. Science is very important in developing the quality of human resources because science has a great influence on people's private lives and the global economy [1]. Science learning in the 21<sup>st</sup> Century emphasizes students center learning so that learning becomes more meaningful when students focus not only on completing material but practiced students to have skills.

The 21<sup>st</sup>-century skills that must be proxy by students include critical thinking skills, problem-solving, metacognition, communication, collaboration, innovation, and creativity, as well as technology literacy, information, and communication [2]. Students can obtain these skills through meaningful learning. Biology as part of science will be valuable if students have good scientific literacy skills [3] and critical thinking skills [4] because the goals of science learning

Scientific literacy by the American Association for the Advancement of Science is defined as the ability to use scientific knowledge, identify questions to draw conclusions based on evidence so they can be understood, and assist in making decisions about the natural world and human interaction with nature [5]. Scientific literacy is also interpreted as understanding science and its application to people's lives. It involves four dimensions: the content, the process, and the context [6]. Attracting student involvement in learning by creating a pleasant learning atmosphere to make students ready to learn and better understand science is a factor that must be considered for developing scientific literacy [7]. Scientific literacy is needed

for everyone to have a greater chance to adapt in life, especially in terms of mastering the ability to read to enhance the development of a country [8].

Critical thinking skills are high-level thinking skills that can develop students' ability to investigate problems, ask questions, submit new challenging answers and find novelty information [9]. Critical thinking skills are the ability of individuals to analyze and solve problems, process data, and evaluate information so that they can generate new ideas as a form of resolution [10]

The results of the PISA (Program for International Student Assessment) survey show that from 2000 to 2018, Indonesia has been ranked as one of the countries with a low scientific literacy rating. The results of the PISA survey in 2018 showed that Indonesia was in the 71st position out of 79 countries [11]. The low ability of Indonesian students' scientific literacy is generally caused by learning activities that aren't oriented towards literacy development [12].

Other facts also show the development of the average national exam score for Biology lessons in 2016-2019 tends to decrease because the national exam questions increased to HOTS questions. That reveals the student's critical thinking level still needs to be improved [13]. Learning not oriented towards developing skills is suspected to be the reason for students' low ability to think critically. It shows that the low science learning outcomes are due to the need for more opportunities for students to develop their critical reasoning abilities.

The circulatory system in humans is one of the biological materials that explain the mechanisms in the bodies of living things (animals and humans). All concepts, theories, and phenomena related to this

material will be well understood if students have good literacy and critical thinking skills. Based on the results of observations made at SMPN 9 Buton, it is known that the learning method used in science learning is still teacher center in nature, so learning becomes less meaningful. Biology as part of science should be taught in a method that can train students' competency development to face challenges.

Learning science, including biology, is created to direct students to be literate in science by fostering creativity and critical thinking skills as one of the higher-order thinking skills so that students are expected to be competitive and dare to make decisions quickly and accurately [14]. The achievement of the habit of critical thinking in science learning is assumed to be able to support students' scientific literacy skills [15]. The results of research in 2019 concluded that students' scientific literacy and critical thinking abilities could increase continuously if the assessment of these abilities is also carried out continually [16]. The research in 2020 concluded that scientific literacy and critical thinking skills jointly affect mastery of basic biology concepts [17].

Based on this description, the researcher is interested in researching the correlation analysis between scientific literacy and critical thinking skills of class VIII junior high school students on the circulatory system material. This study analyzes the relationship between student scientific literacy and critical thinking skills.

## RESEARCH METHODS

This research is quantitative research with the type of correlational method. This research realization in the even semester of the 2022/2023 academic year at SMPN 9 Buton. The sample for this research consists of all 68 grade VIII students who had studied the human circulatory system. The instruments used were multiple-choice and essay questions.

Multiple choice questions contain indicators of scientific literacy according to PISA [18], that is:

1. Identify scientific issues consisting of indicators, namely identifying problems that can investigate scientifically, identifying keywords to search for scientific information, identifying steps of scientific investigation, and applying scientific knowledge.
2. Explain phenomena scientifically consisting of indicators, namely: interpreting phenomena, identifying explanations and hypotheses, and also interpreting scientific evidence, and making conclusions.
3. Using scientific evidence consisting of indicators, namely identifying assumptions, evidence, and reasons and reflecting on the social implications of scientific and technological developments

The essay questions contain indicators of critical thinking skills, according to Facione [19], that is :

1. Interpretation, understanding, and revealing the meaning of various experiences, situations, etc.
2. Analysis, recognizing expected and actual inferential relationships
3. Conclusion, recognizing and obtaining the elements needed to draw reasonable conclusions
4. Evaluation, assess the credibility of statements or other representations
5. Explanation, presenting considerations in the form of solid opinions
6. Self-regulation, monitoring his knowledge

The percentage of acquiring scientific literacy and critical thinking skills scores is interpreted descriptively based on the criteria for the [20] test results, which can be seen in table 1 and table 2 below.

Table 1 Criteria of Student Science Literacy

Criteria	Interval
Excellent	80-100
Good	66-79
Enough	56-65
Low	40-55
Very Low	30-39

Table 2. Criteria of Student Critical Thinking Skill

Criteria	Interval
Excellent	$81.25 < x \leq 100$
Good	$71.5 < x \leq 81.25$
Enough	$62.5 < x \leq 71.5$
Low	$43.75 < x \leq 62.5$
Very Low	$0 < x \leq 43.75$

The data obtained were then analyzed inferentially through the product-moment correlation test.

## RESULTS AND DISCUSSION

The 21<sup>st</sup> Century emphasizes the learning process, which aims to produce quality human resources to face various global challenges that are constantly changing. Learning in the 21<sup>st</sup> Century has undergone changes marked by the development of new literacy, such as digital, information, web, and media. It is oriented towards activities to train students' skills [21]. The World Economic Forum identified that scientific literacy is one of the skills needed in the 21<sup>st</sup> Century out of 16 skills that must be possessed. Therefore, educating the public to have scientific literacy is the main goal of every science education reform [22].

The 21<sup>st</sup>-century learning paradigm is no longer teacher-centered but student-centered. The 21<sup>st</sup>-century competencies are defined as an integration of the knowledge, skills, attitudes, and

values that all young people of our time are required to have [23]. That aims to give students the ability and skills in thinking and learning skills in the 21<sup>st</sup> Century or what is known as "The 4C Skills" formulated by the Framework Partnership of 21<sup>st</sup> Century Skills, including (1) communication; (2) collaboration, (3) critical thinking and problem solving/thinking [24].

The result of science literacy in circulatory system material based on criteria can be seen in Table 3.

Table 3. Result Of Student Science Literacy

Criteria	Number Of Students	%
Excellent	18	27
Good	39	57
Enough	8	12
Low	3	4
Very Low	0	0

Table 3 shows the results of the percentage of students' scientific literacy scores on the circulatory system material. That table shows that out of a total of 68 students, there were 18 students (27%) there are in excellent criteria, 39 students (57%) in good, 8 students (12%) in enough, and 3 students (4%) in low and no students there in very low criteria. Overall, it shows that students' scientific literacy scores are good.

The result of critical thinking in circulatory system material based on criteria can be seen in table 4.

Table 4. Result of Student Critical Thinking Skill

Criteria	Number Of Students	%
Excellent	25	37
Good	18	26
Enough	19	28
Low	6	9
Very Low	0	0

Table 4 shows the results of the percentage of students' critical thinking skill scores on the circulatory system material. That table shows that out of a total of 68 students, there were 25 students (37%) there are in excellent criteria, 18 students (26%) in good, 19 students (28%) in enough, and 6 students (9%) in low and same with literacy science, no students there in very low criteria. Overall, it shows that students' scientific literacy scores are good. The lower the students' scientific literacy, the lower the students' critical thinking skills, and the higher the scientific literacy, the higher the students' critical thinking skills. Science literacy is needed to improve student's critical thinking skills. Scientific literacy is important for the students to produce critical and solution thinking from each piece of information received [25].

The results of statistical inferential data analysis using the product-moment correlation test to know the relationship between scientific literacy and students' critical thinking skills in the circulatory system material can be seen in the table below.

Table 5. Results of Correlation Analysis Between Scientific Literacy and Students' Critical Thinking Skills

Correlations			
		Science Literacy	Critical Thinking Skill
Science Literacy	Pearson Correlation	1	.393**
	Sig. (2-tailed)		.001
	N	68	68
Critical Thinking Skill	Pearson Correlation	.393**	1
	Sig. (2-tailed)	.001	
	N	68	68

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Table 5 shows that the significance value of the correlation (Sig. 2-tailed) between scientific literacy and students' critical thinking skills in the circulatory system material is 0.001, smaller than the  $\alpha$  value of 0.05, and the correlation Pearson value is 0,393. Between scientific literacy and skills, students' critical thinking correlates positively and significantly. A positive correlation indicates that the lower the students' scientific literacy, the lower the students' critical thinking skills, and the higher the scientific literacy, the higher the students' critical thinking skills. This result is in line with research [26]

which concludes that the scientific literacy skill possessed by the students is closely related to the critical thinking skill. Scientific literacy and critical thinking are the key components of science education [27].

The student will reach science literacy, which is one of the goals of science teaching [28]. Scientific literacy equips students with an acquisition of a scientific concept and assistance in solving everyday problems they find in their surroundings [29]. Scientific literacy is one factor that plays a role in developing students' critical thinking skills [30].

Critical thinking skills are an important intellectual asset [31], fundamental [32] and play a big role in science education [33], which must be possessed by all students. Students must be taught how to think critically skills. Critical thinking skills are logical and reflective thinking skills in determining what needs to be done [34]. Educators can develop instructional pedagogy with purposeful learning activities that encourage critical thinking abilities to improve students' critical thinking knowledge, skills, and dispositions [35].

Science education is now a form of reform or changes to the previous education system in the context of the availability of scientific literacy. Students must have good scientific literacy skills [36] and critical thinking skills for life-long learning to be successful [37]. Therefore, various efforts are needed to be able to train and improve students' scientific literacy skills and critical thinking skills. The efforts to improve critical thinking ability and scientific literacy (including bio-logical literacy) are not only for students but also for teachers and student teachers [38].

## CONCLUSION

Science literacy and Critical thinking are very important and needed to face the challenges 21st Century. The descriptive statistical analysis results show that literacy science and students' critical thinking are good criteria. The result of inferential statistic analysis with correlation product-moment shows that literacy science and critical thinking have a positive and significant correlation.

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## REFERENCES

- [1] Bahri, A., Jamaluddin, A. B., Muharni, A., Fikri, M. J. N., & Arifuddin, M. (2021). The Need for Science Learning to Empower High Order Thinking Skills in the 21st Century. *Journal of Physics: Conference Series*, 1899(1).
- [2] Redhana, I. W. (2019). Mengembangkan Keterampilan Abad Ke-21 Dalam Pembelajaran Kimia. *Jurnal Inovasi Pendidikan Kimia*, 13(1).
- [3] Yanti, I. W., Sudarisman, S., & Maridi. (2015). Penerapan Modul Berbasis Guided Inquiry Laboratory (Gil) Terhadap Literasi Sains Dimensi Konten Dan Hasil Belajar Kognitif Pada Materi Sistem Pencernaan. *Prosiding Seminar Nasional Pendidikan Sains (SNPS)*, November, 287–295.
- [4] Masita, P. N., Mahanal, S., & Suwono, H. (2016). Critical Thinking Skills In Biology Learning Class X Senior High School Putri. *Prosiding Seminar Nasional II 2016, Kerjasama Prodi Pendidikan Biologi FKIP Dengan Pusat Studi Lingkungan Dan Kependudukan (PSLK) Universitas Muhammadiyah Malang*, 3(1), 1019–1028.
- [5] Narut, Y. F., & Supradi, K. (2019). Literasi Sains Peserta Didik Dalam Pembelajaran IPA di Indonesia. *Jurnal Inovasi Pendidikan Dasar*, 3(1), 61–69.
- [6] Erniwati, E., Istijarah, I., Tahang, L., Hunaidah, H., Mongkito, V. H. R., & Fayanto, S. (2020). Kemampuan Literasi Sains Siswa Sma Di Kota Kendari: Deskripsi & Analisis. *Jurnal Kumparan Fisika*, 3(2), 99–108.
- [7] Dayelma, Y., Octarya, Z., & Refelita, F. (2019). Hubungan Literasi Sains Dengan Keterampilan Berpikir Kritis Siswa Pada Materi Ikatan Kimia. *Journal Education and Chemistry (JEDCHEM)*, 1(2), 72–78.
- [8] Adnan, Mulbar, U., Sugiarti, & Bahri, A. (2021). Scientific literacy skills of students: Problem of biology teaching in junior high school in South Sulawesi, Indonesia. *International Journal of Instruction*, 14(3).
- [9] Septiani, D. A., Junaidi, E., & Purwoko, A. A. (2019). Hubungan Antara Keterampilan Berpikir Kritis Dan Kemampuan Literasi Sains Pada Mahasiswa Pendidikan Kimia Di Universitas Mataram. *Prosiding Seminar Nasional FKIP Universitas Mataram Mataram, 11-12 Oktober 2019*, 1, 15–19.
- [10] Kopzhassarova, U., Akbayeva, G., Eskazinova, Z., Belgibayeva, G., & Tazhikeyeva, A. (2016). Enhancement of students' independent learning through their critical thinking skills development. *International Journal of Environmental and Science Education*, 11(18), 11585–11592.
- [11] Ridzal, D. A., Rosnawati, V., Haswan, H., Kaharudin, L. O., Ridwan, R., & Yandi, Y. (2022). Pengaruh Pendekatan Saintifik Terhadap Keterampilan Komunikasi Dan Pemahaman Konsep Materi Pencemaran Lingkungan. *Biodik*, 8(2), 145–153.
- [12] Sutrisna, N. (2021). Analisis Kemampuan Literasi Sains Peserta Didik SMA di Kota Sungai Penuh. *Jurnal Inovasi Penelitian*, 1(12), 2683.
- [13] Jayanti, A.W., Wisanti, W., Dewi, S. K. (2019). Analisis Keterampilan Berpikir Kritis Siswa pada Materi Pertumbuhan dan Perkembangan Kelas XII SMA. *Prosiding Seminar Nasional Biologi*, 1(Ip2b Iii), 12 – 19.
- [14] Ridzal, D. A. (2022). The influence of david kolb's learning style on students' biology learning achievement. *Jurnal Pijar Mipa*, 17(2),

- 143–147.
- [15] Azrai, E. P., Suryanda, A., Wulaningsih, R. D., & Sumiyati, U. K. (2020). Kemampuan Berpikir Kritis Dan Literasi Sains Siswa Sma Di Jakarta Timur. *Edusains*, 12(1), 89–97.
- [16] Rahayuni, G. (2016). Hubungan Keterampilan Berpikir Kritis Dan Literasi Sains Pada Pembelajaran IPA Terpadu Dengan Model PBM Dan STM. *Jurnal Penelitian Dan Pembelajaran IPA*, 2(2), 131–146.
- [17] Juhji, J., & Mansur, M. (2020). Pengaruh Literasi Sains Dan Keterampilan Berpikir Kritis Terhadap Penguasaan Konsep Dasar Biologi. *Edusains*, 12(1), 113–122.
- [18] Putri, M. D. (2021). Identifikasi Kemampuan Literasi Sains Siswa di SMP Negeri 2 Pematang Tiga Bengkulu Tengah. *GRAVITASI: Jurnal Pendidikan Fisika Dan Sains*, 4(01), 9–17.
- [19] Listiani, I., Susilo, H., & Sueb, S. (2022). Relationship between Scientific Literacy and Critical Thinking of Prospective Teachers. *AL-ISHLAH: Jurnal Pendidikan*, 14(1), 721–730.
- [20] Ferdyan, R., & Arsih, F. (2021). Analisis Kemampuan Literasi Sains Dan Keterampilan Berpikir Kritis Siswa Terhadap Covid-19 Berdasarkan Materi Yang Relevan Dalam Pembelajaran Biologi. *Bio-Lectura: Jurnal Pendidikan Biologi*, 8(2), 12–24.
- [21] Pilgrim, J., & Martinez, E. E. (2013). Texas Journal of Literacy. *Texas Journal of Literacy Education*, 1(1), 60–69.
- [22] Pratiwi, S. N., Cari, C., & Aminah, N. S. (2019). Pembelajaran IPA Abad 21 dengan Literasi Sains Siswa. *Jurnal Materi Dan Pembelajaran Fisika*, 9, 34–42.
- [23] Wang, Y., Lavonen, J., & Tirri, K. (2018). Aims for learning 21st century competencies in national primary science Curricula in China and Finland. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(6), 2081–2095.
- [24] Mardiyah, R., Aldriani, S., Chitta, F., & Zulfikar, M. (2021). Pentingnya Keterampilan Belajar di Abad 21 sebagai Tuntutan dalam Pengembangan Sumber Daya Manusia. *Lectura: Jurnal Pendidikan*, 12(1), 187–193.
- [25] Primasari, R., Miarsyah, M., & Rusdi, R. (2020). Science literacy, critical thinking skill, and motivation: A correlational study. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 6(2), 273–282.
- [26] Singh, B., Kaur, A., & Brar, K. S. (2017). Information literacy and learning styles: an overview of resource-based student-centred learning. *Journal of Management Research and Analysis*, 4(3), 84–86.
- [27] Vieira, R. M., & Tenreiro-Vieira, C. (2016). Fostering Scientific Literacy and Critical Thinking in Elementary Science Education. *International Journal of Science and Mathematics Education*, 14(4), 659–680.
- [28] Karadermir, E., & Ulucinar, U. (2016). Examining the Relationship between Middle School Students' Critical Reading Skills, Science Literacy Skills and Attitudes: A Structural Equation Model. *Journal of Education in Science, Environment and Health (JESEH)*, 3(1), 29–39.
- [29] Suwono, H., Saefi, M., & Susilo, H. (2019). Challenge based learning to improve scientific literacy of undergraduate biology students. *AIP Conference Proceedings*, 2081(March).
- [30] Cahyana, U., Kadir, A., & Gherardini, M. (2017). Relasi Kemampuan Berfikir Kritis Dan Literasi Sains. *Sekolah Dasar; Kajian Teori Dan Praktik Pendidikan*, 26(1), 14–22.
- [31] Fitriani, A., Zubaidah, S., Susilo, H., & Muhdhar, M. H. I. Al. (2020). The Correlation between Critical Thinking Skills and Academic Achievement in Biology through Problem Based Learning-Predict Observe Explain (PBLPOE). *International Journal of Learning*, 6(3), 170–176.
- [32] Zuhra, F., Nurhayati, & Arifiyanti, F. (2021). The Analysis of Students' Critical Thinking and Scientific Literacy Skills. *Indonesian Review of Physics (IRiP)*, 4(1), 32–38.
- [33] Santos, L. F. (2017). The Role of Critical Thinking in Science Education Luis. *Journal of Education Praticce*, 8(20), 159–173.
- [34] Riezandi, M. T. R., & Nurita, T. (2022). Analysis of critical thinking skills of junior high school students on vibration and wave materials. *Jurnal Pijar Mipa*, 17(5), 630–637.
- [35] Živkovič, S. (2016). A Model of Critical Thinking as an Important Attribute for Success in the 21st Century. *Procedia - Social and Behavioral Sciences*, 232(April), 102–108.
- [36] Ristina, H., Linuwih, S., & Nuswawati, M. (2019). SETS Learning Efficacy to Improve Students Science Literacy Skills. *Journal of Innovative Science Education*, 8(2), 183–189.
- [37] Saepuloh, D., Sabur, A., Lestari, S., & Mukhlisoh, S. U. (2021). Improving Students' Critical Thinking and Self-Efficacy by Learning Higher Order Thinking Skills Through Problem Based Learning Models. *JPI (Jurnal Pendidikan)*
- [38] Suwono, H., Pratiwi, H. E., Susanto, H., & Susilo, H. (2017). Enhancement of students' biological literacy and critical thinking of biology through socio-biological case-based learning. *Jurnal Pendidikan IPA Indonesia*, 6(2),