Correlation Between Information Literacy and Critical Thinking Enhancement Through PjBL-Information Literacy Learning Model

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A B S T R A C T

Information literacy is closely related to critical thinking skills. Critical thinking skills are related to exploring and evaluating information to make argumentation with relevant and appropriate information. It includes analyzing and synthesizing information to solve a problem where these activities are part of information literacy. Thus, information literacy-based learning should be able to enhance critical thinking skills. This study aims to determine the correlation between critical thinking skills and student's information literacy enhancement through learning chemistry with the PjBL-IL model on the biogas production context. This study used a pre-experimental method - one group pretest-posttest design involving 32 high school students. Students' critical thinking and information literacy skills were measured using tests. Critical thinking skills and information literacy enhancement on high and medium category with N-gain score are 72.90% and 66.20% respectively and show a low correlation with a correlation coefficient value of 0.144. Where the basic support indicator has a negative correlation ($r = -0.105$). Thus, critical thinking skills enhancement is not always in line with information literacy.

1. Introduction

The Association of College and Research Libraries (ACRL) has defined information literacy as a set of integrated capabilities that includes reflective information discovery, an understanding of how information is obtained and assessed, and the use of information in acquiring new knowledge and participating actively and ethically in a learning process (American Library Association, 2000).

In addition to information literacy skills, the 2013 curriculum expects students to develop learning and innovation skills that include critical thinking and problem solving, be creative and innovative, and be able to communicate and collaborate. In developing these skills, the 2013 curriculum recommends a scientific approach as a process of building knowledge, skills, and attitudes. The scientific approach is the organization of learning experiences in a logical order, including the learning process: (a) observing; (b) ask questions; (c) collecting information / testing; (d) reasoning / associating; and (e) communicate. These five things can also be seen as abilities that students need to train and possess in relation to the competencies needed in the 21st century (Kemendikbud, 2016).

Information literacy is part of 21st century skills, as stated by Afdareza, et al (2020) in their research that 21st century skills-based learning by using problem-based learning can enhance students' critical thinking skills. Project-based learning (PjBL) is a recommended learning model because it is an approach and deliver 21st century skills on learning. By bringing real-life contexts and technology into the curriculum through PjBL, students are encouraged to become independent researchers, think critically, and lifelong learners (ETD, 2006). Wenger (2014) describes that information sources make an important contribution to the learning process of PjBL - information literacy (PjBL - IL). Project-based learning (PjBL) provides a way to naturally integrate information literacy into assignments by guiding students through the research process as they work to find solutions to problems.

Information literacy is closely related to critical thinking skills. Critical thinking skills are related to exploring and evaluating information to form opinions with relevant and valid information (Crist et al, 2017). It includes analyzing information, then synthesizing the information for explaining the argumentation and solving problems based on problem context. Critical thinking skill in understanding concepts also enhance the ability to connect between related concepts. Critical thinking is also shown by the ability to access information. Access of Information increases knowledge and reduces uncertainty and improves reasoning skill. Thus, critical thinking was introduced as a method to distinguish information (Dimmit, 2017). There is a correlation between critical thinking skills and information literacy. Multidisciplinary learning can assist students in connecting and synthesizing information from various perspectives thereby enhancing critical thinking. With the development of critical skills, students can explore and evaluate all types of information. The enhancement of critical thinking emphasizes students to be able to explore and evaluate all types of information. Research-based learning is combines learning between critical thinking, information literacy, and communication. Results indicate that such learning provides opportunities to explore and expand content in scientific research. Learning also improves information literacy, communication, and critical thinking skills (Weber et al, 2018).

Research question aims to see a correlation between critical thinking skills and information literacy enhancement through project-based learning on online

scientific work. Appointed in this study is project-based learning by emphasizing the research project.

2. Methodology

Research Desain

The research was conducted using a pre-experimental research model with one group pre-test design, this model was chosen because of the limited interaction caused by the Covid-19 pandemic. The description of the research model can be seen in Figure 1.

	Kelas	Pretest	Variable eksperimen	Posttest
G_1	Eksperimen	O_1	Pembelajaran dengan meodel PjBL-LI (X_1)	O_2

Figure. 1. *Pre-experimental – one group pretest -posttest design*
(Bergsma, Croon& Hagenaars, 2009)

Research Subject

The study was conducted by involving 32 private high school students in Kab. Bekasi. Research treatment is carried out through online learning by integrated information literacy project-based learning and using google classroom. Tests, assignment submissions and discussions are carried out online because Covid-19 pandemic conditions. The strength of this research is that the results of student work will be recorded automatically by the Google Drive device.

Research Instrument

Students' Critical thinking skill and information literacy are measured by using the text-based test. The test is 20 essay questions, where each text for 3 to 5 questions. 13 questions for critical thinking and 7 questions for information literacy. The distribution of skills indicators on research instruments can be seen on Table 1 below.

Table 1. Distribution of Skills Indicators on Research Instruments

Skill	Indicators	Item	Item Number
Critical thinking	*Basic Support*	3	1, 17, 18
	Inference	6	3, 4, 8, 9, 13, 14
	Advance Clarification	4	2, 6, 7, 12
Information Literacy	Determining valid information	2	5, 16
	Using information effectively	4	10, 11, 15, 19
	Evaluating information source	1	20

Before being applied to the research class, the instrument was validated by the expert and applied limited to grade XII students to see the reliability and

feasibility of the instrument. The instrument was given twice, the pre-test and post-test, then the N-gain value of each student was calculated using the formula below (Hake, 2002):

$$N - gain\ (\%) = \left(\frac{S_f - S_i}{Skor\ max - S_i}\right) x100\%$$

Annotation: N-gain : Normalized Gain
S_f : Post-test score
S_i : Pre-test score

Correlation Analysis

The critical thinking skills and information literacy enhancement was tested for correlation using the Spearman rank test and multiple correlation using the Kendhal-Theil test. The three indicators of critical thinking skills are sought for their correlation to information literacy enhancement. Testing use the statistical testing applications.

3. Results and Discussion

Critical Thinking Skill

Critical thinking is a cognitive activity that involves the use of the mind. Learn to think analytically and evaluate processes through mental processes such as attention, categorization, selection and consideration. There are 5 indicators of critical thinking skills, namely building basic skills (basic support), providing reasons for a decision (the bases for the decision), concluding (inference), making further explanations (Advance clarification), and Strategy and tactics) (Ennis, 2011).

Critical thinking skills can be included in almost all types of learning models, including online learning. By incorporating critical thinking skills components in online learning, online learning becomes independent learning that allows students to reflect more critically on the results of their assignments. The principles of online learning that are applied should encourage social interaction, avoid information overload, provide hands-on activities, address individual differences, encourage student reflection, create real-life contexts, and motivate students. Learning can be in the form of online group collaboration in solving a problem. Thus, online learning can promote students' critical thinking (Goodset, 2020).

Information Literacy

The evolving and complex digital environment has exposed individuals to a wide selection of unfiltered information available in multiple formats, making it extremely difficult to verify and validate. In fact, most online information users have low information literacy which will result in the use of invalid information to increase. Thus, information literacy becomes an essential skill in the 21st century

(De Paor, 2020). Information literacy is a set of skills and abilities that require individuals to recognize when information is needed and have the ability to find, evaluate, and effectively use the information needed (Herring, 2010).

The Association of College and Research Libraries (ACRL) has determined standards, indicators and outcomes for information literacy at the advanced education level. According to the ACRL, students with information literacy should be able to:

  a. determines the extent of the information required;
  b. accessing the required information effectively and efficiently;
  c. critically evaluates information and its sources;
  d. use information effectively to achieve specific goals; and
  e. understands the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally (American Library Association, 2000).

Correlation Between Critical Thinking and Information Literacy

Critical thinking skills and information literacy are closely related where there are indicators of critical thinking skills related to information acquisition, source credibility, information synthesis and conclusion. These things are also implied in the information literacy indicator. The third literacy indicator contains clearly the relationship between information literacy and critical thinking skills. It can be seen that students are required to use their critical thinking skills in evaluating information and entering that information into their knowledge (Grafstein, 2017).

In general, students' critical thinking skills have enhanced. Based on the results of the students' pre-test and post-test data, the N-gain value of critical thinking skills was 72.90% which was in the high criteria. Student information literacy also enhanced with an N-gain value was 66.20% being in the medium criteria. The findings showed that both skills have enhanced after learning with the PjBL - IL model, although the highest increase occurred in critical thinking skills. The results of the N-gain of students' critical thinking skills and information literacy can be seen in Figure 2.
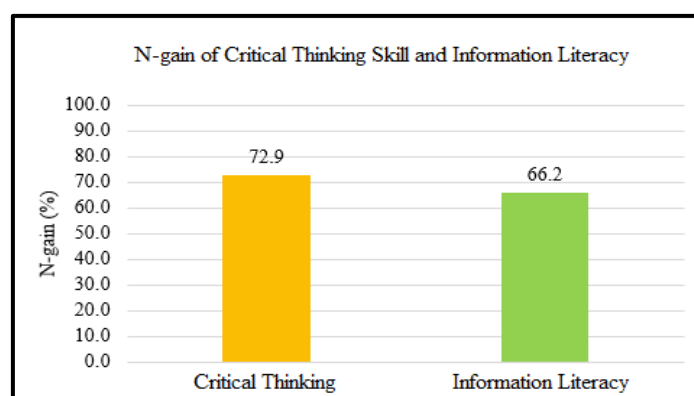

Figure 2. N-gain of Critical Thinking and Information Literacy

Dimmit (2017) and Weber (2018) found a corelation between critical thinking skills and information literacy. Multidisciplinary learning can assist students in connecting and synthesizing information from various perspectives thereby enhancing critical thinking. With the development of critical skills, students can explore and evaluate all types of information. Based on the findings of the two studies above, there should be an increase in critical thinking skills in line with information literacy. Correlation tests need to be done to determine whether there is a correlation between increasing critical thinking skills and student information literacy, or whether the correlation between the two is positive or negative.

Several studies have revealed a positive correlation or there is a close relationship between students' critical thinking skills and information literacy. Statistical test through correlation test is done to find out how the relationship between the two skills. Preliminary tests are carried out such as normality and homogeneity to determine the next test path to be carried out. The results of preliminary statistical tests can be seen in table 2 and table 3.

Table 2. The Results of the N-gain Normality Test for Critical Thinking Skills and Information Literacy.

N-gain	N	$Wilk_{count}$	$Wilk_{table}$	Conclusion
Critical thinking	32	0,977	0,930	Normal
Information Literacy		0,918		Abnormal

Table 3. The Results of the N-gain Homogeneity Test for Critical Thinking Skills and Information Literacy.

Data	N	*SD*	*p*	Sig.	Conclusion
Critical thinking	32	8,752	0,05	0,189	Homogeny
Information Literacy		11,888			

Based on the results of preliminary testing, the correlation test was carried out through the non-parametric route using the Spearman correlation test with the results shown in Table 3.

Table 4. The results of the N-gain Correlation Test for Critical Thinking Skills and Information Literacy.

N-gain	N	Coef. Correlation	Sig.	*p*	Finding
Critical thinking	32	0,144	0,451	0,050	Low correlation
Information Literacy					

Based on the Spearman correlation test, the research findings show that there is a correlation between critical thinking skill and information literacy enhancement but low correlation. This is indicated by obtaining a correlation coefficient of 0.144. Interpretation of the correlation coefficient data can be seen in Table 5.

Table 5. Correlation Criteria (Schober, et al, 2018)

Correlation Coefficient	Criteria
0,00 – 0,10	Ignored
0,10 – 0,39	Low
0,40 – 0,69	Moderate
0,70 – 0,89	Strong
0,90 – 1,00	Very Strong

Other studies have shown a correlation between critical thinking skills and information literacy. Crist, et al (2017) conducted a study combining critical thinking, information literacy, and communication. The results show that learning provides opportunities to explore and expand content in scientific research. Learning also improves information literacy, communication, and critical thinking skills.

Students select and evaluate information critically in completing a project. Students critically find ways to solve problems in obtaining and processing information. Students have difficulty determining the conversion of biogas energy, this concept is considered difficult because it involves two disciplines, physics and chemistry. With the current state of technology, critical thinking has experienced a distortion of meaning and is closely related to the process of accessing and using information. Dimmit (2017) revealed that with the current multi-media condition, the excess of digital information, where access is everywhere and content is available instantly and in extraordinary quantities, so that educators are required to continue to develop learning strategies to assist students in process existing information critically. Thus, critical thinking was introduced as a method to discern information. The development of critical thinking emphasizes students to be able to explore and evaluate all types of information.

According to Leaning (2019) when information literacy has touched the realm of critical thinking, students will be able to ensure the validity of the information and check the valid sources. Research-based learning combines critical thinking, information literacy, and communication. Results indicate that such learning provides opportunities to explore and expand content in scientific research. Learning also improves information literacy, communication, and critical thinking skills.

In this study, students actively analyze information then synthesize that information within the framework of scientific work. According to Sasson, et al (2018) students, who think critically, will analyze and synthesize information effectively. Critical thinking is also shown by the ability to access information. Information increases knowledge and reduces uncertainty and improves reasoning skill. Students who have good information literacy will have experience in using various sources of information, analyzing and evaluating information more thoroughly (Subekti, et al, 2018). Another opinion states, information literacy is related to the ability to identify when information is needed, and the competence

and skills to find, evaluate and use information in making informed decisions (Arahony & Gazit, 2020).

Further analysis was carried out using multiple correlation or bivariate correlation by comparing the indicators of critical thinking skills enhancement to information literacy enhancement. The indicators are basic support, inference and advance clarification. The results obtained can be illustrated in Figure 3.
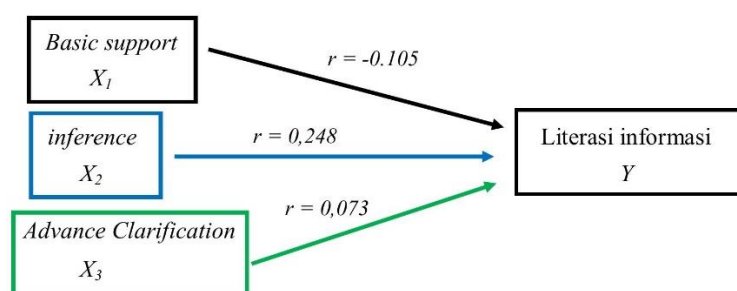

Figure 3. The Correlation Between the Improvement Critical Thinking's Indicator Enhancement to Information Literacy

Based on the picture above, at least the most dominant influence on information literacy is the inference indicator. This is in line with what Ennis (2011) stated that in drawing conclusions, students are required to be able to argue. Arguing includes providing arguments or thoughts on information. The ability to provide or draw conclusions will be followed by skills in selecting valid information. Syafaren, et al (2019) also revealed that critical thinking skills require various reasons and clear information to be synthesized and then synthesized until the information is perfectly accepted. Through information literacy-based learning, it will have a positive impact on how students access information, plan search methods, and how to use information. So that learning based on information literacy will improve students' information literacy. In addition, it can also increase students' independence in learning and problem solving (Seifi, et al., 2020).

The explanation above shows the link between information literacy and critical thinking skills. The findings show that the correlation between critical thinking skills and information literacy enhancement is very weak. This can be caused by students who are not accustomed to assignments that require high access to information. Students, who when in a dormitory or school have restrictions on access to information, are not proficient in finding relevant or valid information. Students are still focused on information that is easily accessible, regardless of whether the information is valid or not, the most important thing for students is that it is appropriate and able to answer the information needs that students are looking for. This is indicated by about 29.2% of the information accessed by students comes from sites whose validity or reliability is doubt.

This was also found by Sasson (2018) that the factor that obstruct the literacy improvement is that the learning process often uses a single source of information.

Student learning is still limited using the textbooks used. Utilization of other sources of information such as the environment, internet, enrichment books and resource persons are still lacking. The ability to answer questions as a proof of critical thinking skills is also lacking. Not all students are able to answer questions properly and correctly.

There are many factors that obstruct literacy enhancement, such as the learning process often uses a single source of information. Student learning is still limited using the textbooks used. Utilization of other sources of information such as the environment, internet, enrichment books and resource persons are still lacking. The ability to answer questions as evidence of critical thinking skills is also lacking (Trisdiono et al., 2019). Like the findings from Erwiza, et al (2019) that critical thinking skills are influenced by learning conditions and interest in learning. Teachers in online learning have limitations in creating a conducive learning atmosphere so that the increase, especially in information literacy, is still in the moderate category (N-gain: 66.20%).

4.   Conclusion

The application of the PjBL - IL model has been adapted to critical thinking skills and information literacy to effectively enhance critical thinking skills and information literacy. The two skills increased at different levels but have low correlation. Indicators of critical thinking skills also gave a low contribution to increasing information literacy. Thus, an increase in critical thinking skills cannot always indicate an enhancement in students' information literacy. The application of research with the Covid-19 pandemic conditions certainly has many weaknesses. Further research will be carried out on the application through direct learning which is expected to provide better results.

Acknowledgement

References

Afdareza, M. Y., Yuanita, P., & Maimunah, M. (2020). Development of learning device based on 21st century skill with implementation of problem-based learning to increase critical thinking skill of students on polyhedron for grade 8th junior high school. *Journal of Educational Sciences, 4(2),* 273-284.

Aharony, N., & Gazit, T. (2020). Students' information literacy self-efficacy: an exploratory study. *Journal of Librarianship and Information Science, 52(1)*, 224-236.

American Library Association (ALA). (2000). *Information Literacy Competency Standards for Higher Education*. Chicago: ALA.

Bergsma, W & Croon, M. (2009). *Marginal Models: For Dependent, Clustered, and Longitudinal Categorical Data*. London: Springer Science+Business Media.

Crist, C. A., Duncan, S. E., & Bianchi, L. M. (2017). Incorporation of cross-disciplinary teaching and a wiki research project to engage undergraduate students to develop information literacy, critical thinking, and communication skills. *Journal of food science education, 16(3),* 81-91.

De Paor, S., & Heravi, B. (2020). Information literacy and fake news: how the field of librarianship can help combat the epidemic of fake news. *The Journal of Academic Librarianship, 46(5),* 102218.

Dimmitt, N. (2017). The power of project-based learning: experiential education to develop critical thinking skills for university students. *In CBU International Conference Proceedings. 5*, 575-579.

Erwiza, E., Kartiko, S., & Gimin, G. (2019). Factors affecting the concentration of learning and critical thinking on student learning achievement in economic subject. *Journal of Educational Sciences, 3(2),* 205-215.

Ennis, R. H. (2011). The nature of critical thinking: An outline of critical thinking dispositions and abilities. *University of Illinois*, 2(4).

Goodsett, M. (2020). Best practices for teaching and assessing critical thinking in information literacy *online* learning objects. *The Journal of Academic Librarianship, 46(5),* 102163.

Grafstein, A. (2017). *Information literacy and critical thinking: context and practice. In Pathways into information literacy and communities of practice*. UK: Chandos Publishing.

Hake, R. R. (2002). Relationship of individual student normalized learning gains in mechanics with gender, high-school physics, and pretest scores on mathematics and spatial visualization. *In Physics education research conference, 8(1),* 1-14.

Herring, J.E. (2010). *Improving students' web use and information literacy*. London: Facet Publisher

Leaning, M. (2019). An approach to digital literacy through the integration of media and information literacy. *Media and Communication*, *7(2),* 4-13.

Ministry of Education. (2006). Project-Based Learning Handbook, *Educating the Milennial Learner*. Malaysia: Educational Technology Division (ETD).

Pemerintah Republik Indonesia. (2016). *Silabus Mata Pelajaran Sekolah Menengah Atas/Madrasah Aliyah (SMA/MA):* Kimia. Jakarta: Kementrian Pendidikan dan Kebudayaan.

Sasson, I., Yehuda, I., & Malkinson, N. (2018). Fostering the skills of critical thinking and question-posing in a project-based learning environment. *Thinking Skills and Creativity*, *29*, 203-212.

Schober, P., Boer, C., & Schwarte, L. A. (2018). Correlation coefficients: appropriate use and interpretation. *Anesthesia & Analgesia, 126(5),* 1763-1768.

Seifi, L., Habibi, M., & Ayati, M. (2020). The effect of information literacy instruction on lifelong learning readiness. *IFLA Journal*, 0340035220931879.

Subekti, H., Taufiq, M., Susilo, H., Ibrohim, & Suwono, H. (2018). Mengembangkan literasi informasi melalui belajar berbasis kehidupan terintegrasi STEM untuk menyiapkan calon guru sains dalam menghadapi era revolusi industri 4.0: review literatur. *Education and Human Development Journal*, *3(1),* 81–90.

Syafaren, A., Yustina, Y., Mahadi, I., & Vebrianto, R. (2019). Increasing critical thinking skills through natural science learning based on the integration of guided inquiry with numbered heads together. *Journal of Educational Sciences, 3(3),* 433-444.

Trisdiono, H., Siswandari, S., Suryani, N., & Joyoatmojo, S. (2019). Development of Multidisiplin Integrated Project-Based Learning Model to Improve Critical Thinking and Cooperation Skills. *JPI (Jurnal Pendidikan Indonesia), 8(1),* 9-20.

Weber, H., Hillmert, S., & Rott, K. J. (2018). Can digital information literacy among undergraduates be improved? evidence from an experimental study. *Teaching in Higher Education*, *23(8),* 909-926.

Wenger, K. (2014). Problem-based learning and information literacy. *PaL, Pennsylvania Libraries: Research & Practice, 2(2),* 142 -154.