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Training Science Literacy Skills Through Article Writing on Local Wisdom in East Java

Firas Khaleyla[1], Dwi Anggorowati[1], Pramita Yakub[1], Fida Rachmadiarti[1*]

[1] *Department of Biology, Faculty of Mathematic and Natural Science, Universitas Negeri Surabaya, Surabaya 60213, Indonesia*
[*] *Corresponding author. Email: fidarachmadiarti@unesa.ac.id*

ABSTRACT
Science literacy is one of main skills students should have in the 21st century. One method to train science literacy is by writing scientific article. The purpose of the study was to improve science literacy of students through scientific writing in exploration of local wisdom in East Java on Conservation of Natural Resources and Environment (CNRE) course. Indicators of science literacy expected including formulation of problems, data collection in local region, data analysis, and formulation of conclusions based on study conducted. Respondents were consisted of five classes of year 2019 students in Department of Biology programming CNRE course; 2 classes of Biology study program and 3 classes of Biology Education study program, divided into 37 groups. Each group wrote scientific article based on local wisdom found in their local region. Data was analyzed using quantitative descriptive analysis. Results showed that scientific literacy training through scientific writing in CNRE course was successful, as indicated by average article score of 83%. Article component of title formulation had the highest score (95%), while referencing had the lowest score (68%). Based on indicators of issue formulation, data collection, data analysis, and conclusion formulation, scientific writing on local wisdom in East Java was able to train science literacy skills to Biology students.

Keywords: *science literacy skills, scientific article, local wisdom, East Java, conservation of natural resources and environment*

1. INTRODUCTION

Currently we are facing 21st century with its various challenges. The 21st century is featured by globalization, internationalization, and rapid development of information and communication technology. Rapid technology development and information spread because the emerging need for a new set of different competences students should master, especially for science students as science development is highly correlated to technological advancement. There are four domains of main competences future generation should master to face globalization challenge as previously identified, including digital age literacy, inventive thinking, effective communication, and high level of productivity [1]. One of the competences described in digital age literacy domain is science literacy.

Science literacy can be elaborated as knowledge and understanding over scientific concepts and process needed to make decision, participate in civil activity, and be economically productive [1]. Students with science literacy will be able to communicate their idea via written or spoken medium, which is one of the main skills related to scientific literacy [2,3]. In addition, students must also have adequate knowledge background to be able to explore certain scientific issues in depth. Science literacy is important to have in modern society due to increasing number of issues related to science and technology [4]. There are two aspects of science literacy needed to be emphasized in science learning of 21st century; scientific ideas needed by an individual to be able to make wise decision as a member of democratic community and scientific ideas fundamental for the culture of community [5].

One of the activities that can be applied to train science literacy of students is writing scientific article. Writing scientific article involves an array of activities that support development of science literacy in students, including explain certain phenomenon from science viewpoint, evaluate and design scientific questions, and

interpret data and evidence scientifically [6]. Writing scientific article also gives chance to students to determine ideas, explore their thoughts, and deepen their understanding, especially in relation to solve various scientific issues [3].

Local wisdom is basic knowledge acquired by community living with nature. Local wisdom is highly correlated to local culture and passed down from generation to generation [7]. Local wisdom emphasizes a lot on respect for the nature and wise use of natural resources. As unique identity of certain area, local wisdom can be explored as source of knowledge to train locally oriented conservation effort of natural resources.

Residents of Indonesian come from various ethnic groups who have develops their own cultural identities respectively. Many Indonesian communities still lives traditionally and hold up their local wisdom. Residents of East Java have various of local wisdom, differing from one area to the other. There is still no significant effort to explore knowledge contained in local wisdom of communities in East Java.

Conservation of Natural Resources and Environment (CNRE) is aimed to prepare students with knowledge, competence, and philosophy to be able to manage natural resources and maintain its sustainability. One of the methods used during CNRE course in tandem with training science literacy is writing scientific article exploring local wisdom. By writing scientific article on local wisdom, students are expected to be able to train their science literacy and explore knowledge contained in local wisdom.

2. METHOD

2.1. Participants of This Study

This study was conducted in Department of Biology, Faculty of Mathematics and Natural Sciences Universitas Negeri Surabaya during March-June 2020. Respondents were students of Department of Biology year 2019 who programmed CNRE course, consisted of 3 classes of Biology Teacher study program and 2 classes of Biology study program. Respondents were divided into 37 groups and each group collaborated to produce one scientific article on local wisdom of area in where they lived.

2.2. Data Collection Instrument

This research was a descriptive qualitative study. During activity, students first discussed the topic of their article with supervising lecturers, formulated issues and methods, performed data collection through field observation in respective area, and analyzed data they had collected. Students then finally presented their result in written scientific article with comprehensive discussion along supporting literature.

Scientific article was written based on scientific method performed, thus there were four indicators of science literacy used in the current study; issue formulation, data collection, data analysis, and conclusion formulation. From four indicators, evaluation instrument was developed to cover the four indicators as presented in Table I. Evaluation rubric for scientific article written was developed based on indicators in accord to previous study [8] with modification as presented in Table II.

Table 1. Indicators of science literacy

Indicator	**Article component**
Issue formulation	Title formulation
	Introduction
	Purpose
Data collection	Methods
Data analysis	Result and Discussion
	References
Conclusion formulation	Abstract
	Conclusion

Table II. Rubric for evaluating scientific article

Component	Criteria	Score
Title formulation	Title conforms to article content; concise; clear; no longer than 20 words and contains no acronym	4
	Meet only three of the criteria above	3
	Meet only two of the criteria above	2
	Meet only one of the criteria above	1
Abstract	Uses proper Indonesian and English; no longer than 250 kata; covers the core of article including introduction, purpose, methods, result, and conclusion; incorporate keywords	4
	Meet only three of the criteria above	3
	Meet only two of the criteria above	2
	Meet only one of the criteria above	1
Introduction	Background corresponds to observation result and consistent with local custom; incorporate gap analysis; elaborate advantage for future; refers to previous studies	4
	Meet only three of the criteria above	3
	Meet only two of the criteria above	2
	Meet only one of the criteria above	1
Purpose	Clear; concise; reflects title; points to technique/concept/method used as answer to issues formulated	4
	Meet only three of the criteria above	3
	Meet only two of the criteria above	2
	Meet only one of the criteria above	1
Methods	Location and time of observation; tools and instrument used; method used to collect data/information; data analysis method used	4
	Meet only three of the criteria above	3
	Meet only two of the criteria above	2
	Meet only one of the criteria above	1
Result and Discussion	Data is presented in representative table/figure; clarity of data presentation; depth of data analysis and data synthesis correlated to local wisdom value, challenge, approach, and conservation effort; comparation of result to hypothesis or result of previous study from references	4
	Meet only three of the criteria above	3
	Meet only two of the criteria above	2
	Meet only one of the criteria above	1
Conclusion	Result achievement in accord to purpose; clear; concise	3
	Meet only two of the criteria above	2
	Meet only one of the criteria above	1
References	In accord to citation included in article; recency of reference; at least five references are from published journal article	3
	Meet only two of the criteria above	2
	Meet only one of the criteria above	1

2.3. Data Analysis

Data collected from evaluation of scientific article was analyzed quantitatively to know the achievement proportion of each component. Then data was analyzed statistically using Kruskal-Wallis and Mann-Whitney tests to determine the significant difference of achievement of each article component (α=0.05).

3. RESULT AND DISCUSSION

Result of component evaluation of each article written by students of Department of Biology programmed CNRE course is presented in Fig. 1. From all components evaluated, mean student achievement in scientific article writing was 83±5%. Component with highest achievement was title formulation (95±9%a), while achieved lowest was references (67±18%e). Components with significantly different achievement were title formulation, result and discussion, and references, while components with not significantly difference achievement were abstract, introduction, methods, and conclusion formulation.

Students achievement in each component based on evaluation was analyzed to know the achievement of each science literacy indicators, as presented in Table III. Indicator with highest achievement was issue formulation (89.52%), while lowest indicator was data analysis (70.38%).

Scientific article writing covers activities that can support development of science literacy, including issues discovery, data collection using scientific methods, data analysis, then formation of conclusion. Indicators are in

accord to competences determined by PISA science framework 2015 [6] to support science literacy; explain a phenomenon scientifically, evaluate and design scientific question, and interpret data and evidence scientifically. Previous study also trained science literacy through scientific article writing for students programmed Animal Systematic course [8].

Local wisdom is an expression form of local ethnics on how an individual perform certain activities or behave based on that idea, or how to produce a certain work. Local wisdom comes from local ethnic knowledge which developed along with the time. The forms of local wisdom can be certain knowledge about skills or information about theoretical and practical methods [9]. In consideration to globalization which bring foreign cultural values from outside Indonesia, learning local wisdom as integral part of daily life become important to maintain Nusantara ethnical values, especially those emphasize on natural resources conservation of Indonesia.

Varying local wisdom rooted in ethnical diversity of East Java as studied by CNRE students in the current study including local environment conservation (*Reresikan Tritisan* from Pacitan community, Labuhan village environment conservation in Madura), the use of plants in traditional ceremony (*Sedekah Bumi*, Wringin anom, Gresik), plant conservation (*Lontar* tree in Gresik), animal conservation (*Nyadran*in Sidoarjo, *Sapudi*cow conservation as part of *Karapan* culture in Madura, fish conservation in *Gua Ngerong* water sources in Tuban, *Tombro* fish conservation in Danau Biru Pasuruan), water source management (*Sumber Benteng*in Kediri, *sesaji*in Sumur Tua, *siraman* Sedudo), potential of local culinary (*Pecel Semanggi*, mangrove syrup in Wonorejo, *Jumbrek* in Lamongan), and various ecotourism based on the local wisdom.

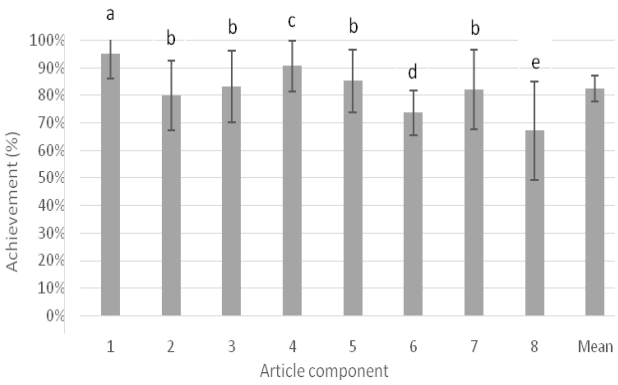

Figure 1 Achievement of each component in scientific article writing on local wisdom of Biology department students programmed CNRE course. Article component 1: title formulation, 2: abstract, 3: introduction, 4: purpose, 5: methods, 6: result and discussion, 7: conclusion, 8: references, and mean: average achievement level. Different letters above graphic indicate significant difference based on Mann-Whitney test ($p>0.05$)

Table 3. Achievement level of science literacy skill indicators based on scientific article evaluation

Indicators	Article component	Achievement
Issue formulation	Title formulation	89.52%
	Introduction	
	Purpose	
Data collection	Methods	85.13%
Data analysis	Result and discussion	70.38%
	References	
Conclusion formulation	Abstract	80.85%
	Conclusion	

Component of article with highest achievement was title formulation (95±9%[a]). This component highly correlated to issue discovery based on situation in the field. Identification and formulation of the right issue is important to do before students can explore the issue and analyze it deeper. In the other hand, component with the lowest achievement in the current study was references (67±18%[e]). References related to competence to find scientific evidence or result from other study that support data analysis performed. Other component in concern was data presentation and analysis in result and discussion component, at 74±8%[d]. This component connected to student competence to organize, analyze, and interpret data and scientific information collected in relation to solve scientific issues. Overall, achievement of students in the activity of scientific article writing on local wisdom was about 83±5%, categorized as good.

Based on analysis of scientific article evaluation, science literacy indicator with highest level was issue formulation (89.52%), while the lowest indicator was data analysis (70.38%). One of the skills in science literacy is to identify a valid scientific argument [9], in this case to formulate scientific issues based on condition observed [9]. In addition, misconception often experiences by students in relation to science literacy is the tendency to wrongly interpret data when they develop hypothesis or evaluate certain argumentation [10].

4. CONCLUSION

It can be concluded that based on indicators and evaluation, scientific article writing on local wisdom could trained scientific literacy to students with average achievement of 83±5%, categorized as good. The suggestions finding for future research are: 1). developing creative ideas related to local wisdom, 2). identification and formulation of the right issue of local wisdom, and 3) improving interpretation data and evidence scientifically.

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