Middle School Students’ Mastery of Scientific Inquiry Literacy based on Gender and School Location

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Abstract. 21st century competencies have contained the purpose of science education. The purpose of science education is to promote scientific literacy among citizens using information and scientific issues in everyday life. Scientific inquiry is a part of science literacy. This study aimed to describe the mastery of middle school students’ scientific inquiry literacy and its influence based on gender and school location. The paper test used the instrument to measure scientific inquiry literacy which was based on ScInqLiT (scientific inquiry literacy test) as proposed by Wenning (2007). The study was conducted in four middle schools in Kediri district with 267 students. The data were analyzed using descriptive statistics by gender (119 boys and 148 girls) and school location (urban and rural areas). The result showed that the girls’ mastery of scientific inquiry was higher than the boys’, and the urban school students had a higher mastery of scientific inquiry literacy than the rural school students did. Moreover, science learning must be improved with learning methods and teaching materials and also refer to gender as well as school location.

Keywords: scientific inquiry literacy, gender, school location

1. Introduction

The main function of education is to educate students to prepare themselves for a successful life in the 21st century, in the digital century, and in the era of knowledge-based economy [1]. National Science Teachers Association (NSTA) describes a couple of 21st century skills which are necessary for students in the context of science education such as being literate to information, literate to media, and literate the information and communication technology [2]. 21st century competencies have contained the purpose of science education. The purpose of science education is to promote scientific literacy among citizens on the matters directly affecting their own lives and the society so that they can make decisions based on information and understanding [3].

According to The National Academies of Science, Engineering, and Medicine, science literacy is the understanding of scientific practices for example formulating and testing hypotheses, probability/risk and causation [4]. Natural science learning is considered effective if it leads students to be able to understand the nature of science and conduct scientific inquiry literacy [5]. Scientific inquiry as proposed by Wenning [6] is a kind of learning that tends to involve identifying problems to be investigated, using an introduction to formulate hypotheses, using deductions to produce predictions, designing experimental procedures, conducting scientific experiments, collecting
meaningful data, organizing as well as analyzing data accurately, and explaining some unexpected research results.

Students’ learning experiences and achievement in school will influence their future careers as well as their lives. Therefore, it is important to know what to do in order to improve students’ achievement for the sake of helping our next generation to have better lives. Stewart [7] and Taplin & Jegede [8] identify a couple of influential factors with respect to students’ learning and their achievement such as students’ gender and school climate. Bailey also argues that gender as a foundational aspect of educational processes [9]. Therefore, this study reveals the difference in gender and school location of scientific inquiry literacy.

2. Methods
This study was descriptive research with 267 students from 4 middle schools in Kediri Regency. The samples were selected by purposive sampling whereby they consisted of 119 boys and 148 girls from urban and rural schools. The urban schools were located in the areas within local government headquarters. Thus, the rural schools were located away from local government headquarters. This study examined the students with focusing on gender difference and school climate specifically at school location. In this study, the instrument utilized the indicators of ScInqLiT (Scientific Inquiry Literacy Test) by Wenning [6]. Those indicators were used to measure middle school students’ scientific inquiry literacy (SIL) in terms of Identification and control variables which were comprised of (1); recognizing and analyzing alternative explanations and models (2); drawing appropriate conclusions from evidence (3), understanding and analyzing data (4), constructing and interpreting graph (5); constructing hypotheses (6); designing experimental procedures (7); and identifying problems to be investigated (8). The instrument had been validated by the content validators. The data were analyzed by using descriptive statistics. Therefore, the average score of each indicator was interpreted.

3. Result and Discussion
3.1. The Mastery of Scientific Inquiry Literacy
The calculation result of each indicator is shown in Table 1. Based on Table 1, it is shown that the average score of scientific inquiry literacy mastery is 47,04% which is classified as enough category.

| Table 1. The Mastery of Scientific Inquiry Literacy |
|---------------------------------------------------|
| Indicator of SIL | The Mastery of Scientific Inquiry Literacy (%) | Average (%) |
| School A | School B | School C | School D | |
|---|---|---|---|---|
| 1 | 34,91 | 37,97 | 59,68 | 40,41 | 43,24 |
| 2 | 18,40 | 37,03 | 39,52 | 67,12 | 40,52 |
| 3 | 38,99 | 62,03 | 61,83 | 75,80 | 59,66 |
| 4 | 40,25 | 51,48 | 55,91 | 51,60 | 49,81 |
| 5 | 15,72 | 27,43 | 61,29 | 67,58 | 43,00 |
| 6 | 18,87 | 51,90 | 16,94 | 56,16 | 35,97 |
| 7 | 42,77 | 76,37 | 48,92 | 82,65 | 62,68 |
| 8 | 12,48 | 55,06 | 38,71 | 59,59 | 41,46 |
| Average | 27,79 | 49,90 | 47,85 | 62,61 | 47,04 |

Based on Figure 1 that follows, it is indicated that there are two indicators of scientific inquiry literacy (SIL) with low category. Indicator 2 pertinent to recognizing and analyzing alternative explanations and models is signified by 40,52%. The students who have this mastery can explain data with alternative models. The other indicator with low category is indicator 6 as regards constructing hypotheses with 35,97%. As revealed based on interview, the students are still confused about defining a hypothesis and identifying a testable hypothesis. The highest mastery is manifested in indicator 7 corresponding to designing experimental procedures as signified by 62,68% or classified as
a high category. The students who have this mastery can select a suitable design for an investigation to test a hypothesis.

**Figure 1. The Mastery of Scientific Inquiry Literacy (%)**

### 3.2 The Mastery of Scientific Inquiry Literacy Based on Gender

This study also discusses about the difference based on gender. The result associated with the boys and the girls’ mastery of scientific inquiry literacy is shown in the following Table 2.

**Table 2. Descriptive Statistics by Gender**

| Gender    | N   | Mean    | Standard Deviation | Standard Error Mean |
|-----------|-----|---------|--------------------|---------------------|
| The Boys  | 119 | 44.7479 | 13.89823           | 1.27405             |
| The Girls | 148 | 49.4937 | 14.66032           | 1.20507             |

Table 2 shows that the mean score of the girls was higher than that of the boys in the performance of scientific inquiry literacy test. It indicates that the girls’ mastery is higher than the boys’. The result of this study also has a similarity with the results of studies conducted by Har [10] and Ismail [11] in that the women’s science literacy is higher than men’. Hango [12] states that the boys are dominant in STEM (Science, Technology, Engineering and Mathematics), while the girls are more dominant in biology and science. High mastery of the girls is caused by their reading skills which are better than those of the boys. Based on interview, the boys tend to be lazy to read the questions that are quite longer than general questions. Therefore, they do not understand the main purpose of the questions. The girls have a good ability to search information that contains in the textual questions [13]. However, the result of this study is contradicted with PISA [14] and Rahmatullah [15]. Linn & Hyde argue that the boys perform relatively better than the girls on the items requiring spatial reasoning or visual content [14]. The difference between the girls and the boys is not significantly different. Rahmatullah argues that basically the boys and the girls have the same capacity in science ability [15].

### 3.3 The Mastery of Scientific Inquiry Literacy Based on School Location

To illustrate whether school location has an influence on students’ mastery of scientific inquiry literacy, Table 3 shows the descriptive statistics based on school location.

**Table 3. Descriptive Statistics by School Location**

| School Location | N   | Mean    | Standard Deviation | Standard Error Mean |
|-----------------|-----|---------|--------------------|---------------------|
| Rural           | 132 | 45.2063 | 9.81477            | 3.47004             |
| Urban           | 135 | 48.8794 | 10.20457           | 3.60786             |
Table 3 shows that the mean score of the students in urban schools is higher than the mean score of those in rural schools. It indicates that the students’ mastery in urban schools is higher than the students’ mastery in rural schools.

The interaction between the students and their environment has indirectly affected on learning processes, one of which is school location. The students in urban schools have enough facilities. In the meantime, those in rural schools get somewhat limited facilities [10]. The supporting materials also have an impact on students’ scientific literacy such as laboratories, books, and other academic supporting facilities. Based on the interview with the teachers, the laboratory in rural schools is changed to be a classroom. It means that the laboratory activities barely apply to the students. Ongowo [16] states that the facilities can be used to teach science through scientific approach, and those facilities influence the quality of science teachers in learning. In laboratory experience, it can give the students an opportunity to develop their knowledge [6]. School location also has an influence on the information obtained by students through the internet. Basically, the interaction of knowledge will become more effective in the urban schools. If the school location is far, or let us say, at around the rural areas, the ideal access of information will not be reached or maximized. Indonesia Internet Service Provider Association has reported that the users of internet in educational fields in terms of reading scientific articles are of 55.30% [17]. The high percentage of this report shows that the factor of information access through the internet needs to be considered.

4. Conclusion
Based on the result of this study, it is shown that the girls have higher scientific inquiry literacy than the boys do, but the difference between them is not statistically significant. The students in the urban schools have a higher mastery of scientific inquiry literacy than those in the rural schools. The investigation into middle school students’ ability about scientific inquiry literacy is important. The result of this study can determine the teaching strategies, learning methods, and teaching materials which can be prepared to face the challenges in the 21st century education, especially in several indicators. Moreover, the science learning must be improved with qualified learning methods and teaching materials and also refer to gender as well as school location.

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