The effectiveness of nature of science (NOS) within guided inquiry learning approach for developing students' scientific literacy in junior high school

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Abstract. This study aims to investigate the effectiveness of the NOS within guided inquiry approach to develop the scientific literacy of junior high school students in science learning. This research type is a quasi experiment, with non-equivalent control group design. The subject of research is junior high school class 8. Sampling technique in this study is cluster random sampling that is random sampling conducted if the population is homogeneous and normally distributed. This research was conducted at SMPN 11 Yogyakarta. Research data were obtained by using research instrument that is pretest-posttest in the form of description and observation sheet of science literacy competency aspect. The question instrument that has been empirically tested has a reliability level of 0.644. Data analysis technique in this research is statistical parametric. The result of the research shows that there is a significant difference in scientific literacy between before and after student learning with NOS within guided inquiry approach in science learning by test-independent sample t-test with sig value. (2 tailed) of 0,000.

1. Introduction
The Asean Community demand requires young people to have literacy skills in various fields in order to be able to become an independent society. Indonesia’s quality human resources superior as the vital need in the era of industry 4.0, but the big problem is many Indonesian’s students still have low of scientific literacy [1]. Scientific literacy is a vital ability mastered by students so that students can understand the environment, health, economy, and other problems faced by the modern society that are highly dependent on technology and progress, and the development of science.

Science is a subject in junior high school which is an important foundation for building quality human resources, namely by developing an understanding of natural phenomena or events through scientific methods [2]. But science education in this country is still lacking in developing this ability. This is reflected in the acquisition of scientific literacy levels. Science literacy is a generally approved skill related to asking questions about what constitutes strong scientific reasoning, evidence, and experimentation; bring scientific reasons and arguments for local and national affairs and policies; and challenge the statements of others who do not understand the scientific method and what constitutes scientific evidence [3].
The results of the Program for International Student Achievement (PISA) survey in 2012 ranked Indonesia 64th out of the 65 countries surveyed. Furthermore, in 2015, Indonesia rose six ranks and experienced a significant increase in literacy scores of 22.1 in 2015, where scientific competence only increased by one point. This is quite encouraging, but Indonesia still has to struggle to optimize the quality of education. The result of the research shows that almost half of Indonesian students from high school (41%) only have little knowledge about science, there are even Indonesian students (6.9%) who do not have scientific literacy [4]. Indonesia's scientific literacy level for 12 years is always ranked 5th from the bottom [5]. Whereas scientific literacy is a vital ability that must be mastered by students to relate what students perceive in the environment, health, economy, and problems of modern society that are more dependent on technology and the progress and development of science.

An understanding of Nature Science (NOS) has a main role in the development of scientific literacy [6]. Science education must provide an opportunity to help students develop an adequate conception of Nature of Science (NOS) and scientific inquiry must be in accordance with the objectives in science [7]. In reality, understanding NOS is still not getting attention and is often implicated and even ignored. This has resulted in an inadequate understanding of NOS as revealed that NOS is rare taught in schools. The science teacher still had an inadequate and even wrong understanding [7].

Development of scientific literacy can be done by teaching explicit and reflective understanding of NOS and scientific inquiry [8]. By conducting an inquiry, students can obtain basic experience to make a reflection of the understanding of NOS [7]. An investigation is an approach to learning where students discover and use various sources of information and ideas to improve their understanding of problems, topics, or problems [9]. Therefore, it is important to conduct an empirical test related to the effectiveness of the NOS charged inquiry approach to develop students' scientific literacy. The Yogyakarta City Junior High School students' inquiry skills were still not well developed, and indicated that they had not been trained to conduct the inquiry, so that the type of inquiry that was suitable was used to be guided inquiry [7]. In this study, the approach to be applied as treatment is in the form of NOS within inquiry approach.

2. Method
This research type is a quasy experiment. The research design used was non-equivalent control group design, where there were two groups that were each given a pretest, the two groups were each given a different treatment or treatment then given a post test.

| Group | Pretest | Treatment | Posttest |
|-------|---------|-----------|----------|
| E 1   | O₁      | X₁        | O₂       |
| E 2   | O₁      | X₂        | O₂       |

Note: E1=Experiment 1; E2=Experiment 2; X1=guided inquiry approach, X2=NOS within guided inquiry approach

In the research, subjects were placed in 2 groups, namely experimental group 1, namely the class given treatment with guided inquiry learning approach and experimental group 2, namely the class has given treatment with the NOS within guided inquiry learning approach.

The subject of research is junior high school class 8. Sampling technique in this study is cluster random sampling that is random sampling conducted if the population is homogeneous and normally distributed. The study was conducted at SMPN 11 Yogyakarta and was carried out in February 2018 - March 2018. The subjects of this study were 60 students in grades VIII C and VIII D.
Research data were obtained by using research instrument that is a matter of pretest-posttest in the form of description and observation sheet of science literacy competency aspect. The question instrument that has been empirically tested has a reliability level of 0.644. Data analysis technique in this research is statistical parametric.

3. Result and Discussion
Science is studied so that students not only understand the content but can also apply the concept to solve everyday problems. The main purpose of science learning is the realization of students who have scientific literacy skills [10]. Therefore it is important to develop scientific literacy for junior high school students through natural science learning.

The results of the investigation of the effectiveness of the NOS within inquiry for developing scientific literacy of junior high school students showed that comparison of the average learning outcomes can be seen from the difference between the average pretest score and the average of posttest. The results of the comparison of the average test of student learning outcomes experimental class 1 (learning with guided inquiry approach) and experimental class 2 (learning with NOS within guided inquiry) can be seen clearly in Figure 1.

![Figure 1. Average diagram of pretest and posttest values between class 1 experiment and class 2 experiment](image)

Based on Figure 1, it shows that the experimental class 2 student learning outcomes are higher in yield than experimental class 1. This shows that the results of scientific literacy of students who were given learning with NOS within guided inquiry approaches were higher than the scientific literacy of students who were given learning with a guided inquiry approach. Prerequisite test results show as Table 2.

| Prerequisite test  | Significant value | Note                      |
|--------------------|-------------------|---------------------------|
| Homogeneity Test   | 0.912>0.05        | Homogeneous population    |
| Normality test     | >0.05             | The sample is normally distributed |

Furthermore, the data were tested by parametric statistics with t test. Based on the results of the analysis using independent t-test showed that significant differences in scientific literacy of junior high school students between students who were taught with guided inquiry approach and students who
learned the NOS within guided inquiry approach. Students who get learning using the NOS within guided inquiry approach obtain higher competency science literacy values than students who get learning only with a guided inquiry approach without NOS content.

The results of scientific literacy aspects of students' competencies obtained from the posttest scores of students were also strengthened by the measurement of scientific literacy skills of students through observations of scientific literacy assisted by observers both in experimental class 1 and in experimental class 2. Results of observations of competency in scientific literacy students of experimental class 1 and experimental class 2 can be seen in Figure 2.

![Figure 2. Result diagram of competency literacy science observation aspects](image)

Based on the experimental class 2 observation results that the NOS within guided inquiry learning approach has a higher average scientific literacy value than the experimental class 1 which uses guided inquiry learning approaches without NOS content. Scientific inquiry is very important in developing scientific literacy and if this scientific inquiry together with NOS is applied in learning, effective learning will occur [11]. So that with NOS within guided inquiry learning, students will be better able to master knowledge and apply facts from natural phenomena obtained through scientific inquiry. Teaching about the nature of science can increase student interest, and develop awareness of the impact of science in society so that it can develop students' scientific literacy [12]. Explicit integration, reflective instruction about the nature of science (NOS), and scientific inquiry (SI) in traditional science content are intended as a means through which the development of scientific literacy is fostered.

This result is consistent with the theory that the inquiry approach is a combination of science process skills (such as observing, instructing, classifying, predicting, measuring, asking, interpreting and analyzing data) with science content, scientific reasoning, and critical thinking for developing science [11]. Then it also explained that the benefits of incorporating NOS into a standard/curriculum, including improving learning outcomes about science material, interest in science, and decision making on problems issues related to science.

4. Conclusion

Based on the above review, it was concluded that there were significant differences in scientific literacy of students of Yogyakarta 11 Middle School who were taught by guided inquiry approaches and those who were taught with NOS within guided inquiry approaches.
Based on the final results of the study, the researcher has several suggestions as follows: (1) The teacher should familiarize the students with the investigation one of them by using a guided inquiry approach, so that students have the skills of the scientific process that develops in the learning process; (2) Teachers should begin to apply the NOS within guided inquiry approach to learning because this will increase knowledge of natural science through natural phenomena that students get from natural observation; (3) More consider the allocation of the learning process because the steps in the guided inquiry approach are many so there is a need for time allocation control so that no steps are passed; (4) Emphasis on the NOS content when learning is more emphasized through the repetition of the explanation of the NOS content at each step of the learning so that students are faster in understanding.

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