Elementary school teacher's understanding on the scientific approach in natural science and mathematics subjects

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Abstract. This research is motivated by the urgency of applying a scientific approach to be able to equip students' skills in facing the challenges of 21st century life. With the support of the results of previous research, this research aims to describe the understanding of elementary school teachers about the scientific approach and its implementation in the learning of natural sciences and mathematics subjects. The method of this research applied quantitative descriptive research. To be able to apply the scientific approach, teachers are not only armed with understanding but need to be supported by efforts to find other knowledge that can improve their self-efficacy. Most teachers know the scientific approach, but have not been able to apply the teaching and learning process systematically.

1. Introduction

The scientific approach is a learning approach that is oriented to the paradigm of thinking and scientific work. Learning activities are carried out through five activities including observing, asking, reasoning, trying and networking [1]. The five activities can be classified in five stages, namely make observation, define the problem, form the hypothesis, conduct the experiment, derive a theory [2].

Through those five activities can train students have the skills to think critically, creatively, collaborate, communicate, manage the feelings, and solve problems. Therefore, this approach is recognized as a golden bridge in preparing the skills of students in facing the challenges of the 21st century. The results of the research Zobi [3] prove that teaching by using the method of the scientific social issues aims at involving the students in the process of decision making, showing them the importance of their decisions and training them to study comprehensively the issues and the problems. Trained in skills of making decisions and studying comprehensively the issues or problems of life, in the process taken through the steps of formulation and testing hypotheses lead naturally to experimentation as a means of accessing cause and effect [4]. The scientific learning paradigm gives an opportunity to teachers help students develop their expertise and capacity in locating and linking concepts in discovery or inventions activities, which is known as the student centered approach. Learning with a scientific approach is an inquiry process requires behaviors and attitudes that many teachers are contrary to the ways in which they traditionally have taught [5].

Based on the urgency of the application of a scientific approach that serves as a golden bridge for the development of attitudes, skills, and knowledge of students facing the challenges of 21st century life, the teacher occupies an important position as an agent of learning which influenced the quality of the learning process. Therefore, it can be said that the quality of education cannot exceed the quality of teacher [6]. To be able to act as an agent of learning, the teacher must have the expertise and authority...
in carrying out the learning process. One's expertise and authority is determined by mastery of the learning approach to be able to lead students to achieve educational goals. To become an expert and dignified teacher requires mastery of three basic competencies, namely broad knowledge relating to the fields of study, human development and learning, and pedagogy [7]. Apart from these three basic competencies, factors that influenced process quality learning is self-efficacy, namely the teacher's involvement in the teaching of science [8].

The results of previous studies on the application of the scientific approach in learning concluded that there were differences in the implementation of the scientific approach to learning in elementary and middle school [9]. Other findings are many teachers who are confused, afraid, and do not open their minds to change [10], in elementary school many teachers lack of school science self-efficacy largely because of their inexperience with the subjects [11].

Based on the urgency of applying the scientific approach and the findings of previous research, this research aims to describe the understanding of elementary school teachers about the scientific approach and its implementation in the learning of natural and mathematical subjects.

2. Method
The method of this research applied quantitative descriptive research. This research does not provide treatment, manipulation or alteration in the independent variable, but describes a condition [12]. The study was conducted in Bogor City, West Java Province, Indonesia. The research sample was taken at four public elementary schools, namely Kebonpedes 1, Kebonpedes 3, Kebonpedes 5, and Pondok Rumput. Respondents consisted of 20 elementary school teachers, each school was taken randomly five teachers. Data collection techniques used questionnaire, interview, and observation. The type of data collected in the study was quantitative data, for which the data analysis techniques used descriptive statistics.

3. Results and discussion
Questionnaire were given to 20 elementary school teachers. The statements in the questionnaire amount to 30 items with a scale of lines 1 to 5. Based on data analysis, the highest score was obtained by four teachers, the average score was obtained by 15 teachers, and the lowest score was obtained by one teacher. The percentage of respondents' scores shows that 20% of teachers have already understood the scientific approach very well, 75% of elementary school teachers on average knew about the scientific approach, but there were 5% who did not understand the scientific approach.

To strengthen whether the data obtained through the questionnaire is correct, interviews were conducted with the teachers who had filled out the questionnaire. Based on the results of the interviews, the teachers' understanding of the scientific approach is generally only at the level of 'know' but has not been applied in the teaching learning process. In general, teachers argued that the scientific approach is only suitable for teaching science or mathematics. The answers of most teachers, the scientific approach was difficult to apply in thematic learning at elementary schools. This finding is similar to the findings that teachers do not open their minds to the change, as a results, the efforts to understand the nature of scientific approach are not maximal [10].

To obtain data on the implementation of the scientific approach carried out by the teachers, the researcher observed the teaching and learning process. Observation instruments are made in the form of a scale that is scale 1 to 5. Observation of the implementation of the scientific approach carried out by researchers included the subjects of Natural Sciences and Mathematics. Natural Sciences in third grade was about changes in the form of solid objects into liquid objects, and changes in the form of liquid objects into solid objects, in fifth grade was about healthy food. Mathematics in the fourth grade was about multiples of numbers, and in six grade was about the volume of cubes.

The stages of the Natural Sciences learning activities was carried out by the teacher, first described the experimental activities that students must conduct by utilizing the materials and tools that have been prepared. Second, students conducted experiments outside the classroom in groups, and the teacher guided the steps that must be done by students. Third, the teacher distributed worksheets that must be
filled out by students. Fourth, students were instructed by the teacher to enter the classroom, and the teacher carried out classical questions and answers about the conclusions which obtained from the experiments. The teacher asked the students, and there was no one to answer, then the teacher gave an explanation of the conclusion of the experiments. Fifth, students in groups reported the conclusions of the results of the experiments in front of the classroom and were guided by the teacher. The following documentation of students is conducting experiments outside the classroom as in figure 1.

The stages of the learning process that was carried out by the teacher in the subject of Natural Sciences has not yet followed the implementation stages of the scientific approach. The teacher has not helped students formulated questions as hypothesis in the scientific work stage and has not yet connected the concept with the findings of the experiments [5]. This finding is in accordance with the results of the study [2, 4, 8, 11, 13].

The stage of the Mathematics learning activities was carried out by sixth grade teacher is as follows. First, the teacher communicated the purpose and steps of the activities conducted in the experiments. The teacher communicated the relationship between the material to be discussed and the material that has been studied before. Second, the teacher divided students into five groups, and each group is assigned to prepare the equipment that will be used to conduct the experiments. Third, students were guided by the teacher to formulate questions about the cube. Fourth, students group worked to compile and arrange small cubes into a large cube. The teacher guided students in groups to prove the questions that have been formulated. Fifth, the teacher assigned each group to report the results of the experiments to find the cube volume formula. The stages carried out by sixth grade teachers in applying the scientific approach was in accordance with the opinions of Rusman and Ryan, M and O’Callagan A about the five stages of the scientific approach in teaching learning process. However, the findings of observations in the fourth grade in Mathematics learning about multiples of numbers, did not seem to take the five stages of the scientific approach systematically. Documentation of students in conducting inquiry of volume cube formula as in figure 2.

Figure 1. The students’ experiment activities.

Figure 2. Students’ activity discovers volume cube formula.
The highest score is obtained by one teacher who applies the scientific approach in learning systematically by applying the inquiry learning model to find the cube volume formula. The average score was obtained by 18 teachers who implemented the scientific approach only a few stages of activities, namely reading textbooks, analyzing problems through group discussions and working on worksheets, and reporting the results of group discussions in front of the class. Learning activities directed at formulating questions, conducting experiments, and producing products were not carried out by the teachers. The lowest score was obtained by one teacher, the observation results showed that the teacher did not apply the scientific approach.

Data shows that 90% of teachers have not applied the scientific approach systematically, and supported the results of interviews that the learning activities carried out by teachers were still monotonous. Activities in taking the scientific approach can be carried out through various alternatives [11]. Those are in accordance with the opinion that a teacher must have self-efficacy to become an intentional teacher [13]. Intentional teachers are teachers who try to apply a learning approach to be able to deliver students to have competencies. Effective teachers were teachers who have three basic competencies, broad knowledge base related to the field of study, human development and learning, and pedagogy [7]. Therefore, being able to apply the scientific approach is not only determined by understanding but also requires the efforts of teachers to seek other knowledge that can improve self-efficacy. Based on the teachers' recognition was obtained from questionnaires and observations, most teachers knew the scientific approach but did not understand how to apply in learning process according to the criteria of the scientific approach stages.

4. Conclusion
Based on the results of the research conclude that the teachers' understanding of the scientific approach is generally only at the level of 'know' but has not been applied in the teaching learning process, and 90% of teachers have not applied the scientific approach systematically.

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