Implementation of scientific literacy competencies PISA framework 2015 through lesson study: teacher knowledge and result discussion

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Abstract. The study was conducted to described teachers’ knowledge about scientific literacy science. The study also described the student’s achievement after the implementation of the scientific literacy framework PISA 2015 through lesson study. The research method that will be carried out is quantitative descriptive research, where the results of teacher interview explained clearly, and the description of meaningful numbers related to changes in students' scientific literacy abilities after the implementation. Data collection was carried out in five ways, namely observation, measurement of abilities, interviews, and field notes. The results showed that the teacher misunderstanding about the scientific literacy concept. The teacher almost did not know about scientific literacy. There were a significant increased of student achievement after the implementation of scientific literacy competencies framework PISA 2015 in science learning through lesson study. Improvement of students' scientific literacy skills can be done if applied in the learning process.

1. Introduction
Lesson study is a term in learning that has recently been discussed for the past few years. Lesson study comes from Japan, where in the Meiji era. The Meiji government tried to develop the quality of learning so that teacher candidates were required to practice mastering learning methods through criticized learning [1]. Lesson study is an ongoing process that is carried out collaboratively in order to build knowledge about teaching in the context of developing teacher professionalism [2]. Since it was discovered and implemented in Japan, lesson study has attracted the attention of several countries and has become a focus and has been applied in various other western and Asian countries [3]. By implementing lesson study, it can help the teacher to be able to observe students in more details, can see differences in expected student behavior with actual student behavior during the learning process, and find learning that suits the needs of students so as to obtain maximum results [4]. Lesson study proved to be an effective approach to improving teacher professionalism in learning. In addition to improving the quality of teachers as instructors, lesson study can also help in improving the quality of learning. Lesson study in its implementation consists of a cycle of plan, do and see that is carried out collaboratively. At each stage in the lesson study cycle, learning is prepared, implemented and evaluated by the community. Therefore, it can be concluded that learning is truly supervised so that the learning objectives and the quality of learning are truly what they want. Although in the end the planned learning may not be implemented optimally. But this is the purpose of lesson study, namely
the process that occurs continuously in order to improve teacher professionalism. Based on the objectives of the lesson study, it can be assumed that by increasing the quality of learning, it can also affect the quality of students in learning so that they get good results. Therefore, it was expected that the implementation of this research can provide new knowledge about how the implementation of scientific literacy competencies in the 2015 PISA framework and the effect that improved students' scientific literacy skills. With the implementation of this research, it was expected to provide knowledge for teachers in order to improve students' scientific literacy skills. This was important to know because of the low scientific literacy skills of students in Indonesia. It was common knowledge that Indonesia was one of the countries with a level of scientific literacy ability below average. This was evidenced by the results of the International Program for International Student Assessment study followed by Indonesia from 2000 to 2015, where Indonesia has always been the bottom 5 of the dozens of participating countries, with an average below the standard [5].

2. Method
The method used in this study was qualitative descriptive. Sampling was taken by using purposive sampling method with the rationale that schools are selected based on accreditation, as written in the PISA 2015 framework, which was participated in schools on each country selected from the superior schools representing participating countries. The selection of model teachers in the implementation of lesson study was also taken into account, namely teachers who had previously been accustomed to and often became model teachers in the previous lesson study activities. Teacher's knowledge of scientific literacy was described based on the results of interviews conducted on 6 science teachers in Padang City and Bandung City. The interviews were carried out following an interview guide that had been developed previously, where the interview guide contained questions that led to the implementation of scientific literacy aspects in the science learning process carried out by the teacher. This study described the average achievement of students' scientific literacy before and after the implementation of scientific literacy competency in the 2015 PISA framework through lesson study in science learning by comparing the average scores obtained by students in each of the scientific literacy competencies available in the PISA framework 2015.

3. Result and Discussion
This section presented the description of teacher knowledge about scientific literacy. The description was done by following interview guide.

3.1. Teacher Knowledge about Scientific Literacy
Based on the results of interviews conducted with 6 teachers who teach junior high school science in Padang City and Bandung, all teachers who were asked about scientific literacy students did not know what science literacy was. 3 of the teachers interviewed mentioned that when they heard the term scientific literacy, they thought about reading, they assumed that scientific literacy was the ability of students to read literature. The teacher assumed that scientific literacy was how a student was accustomed to reading books, this is because lately, the Indonesian government has been proclaimed actively reading books before learning began. However, based on the interview guide that has been prepared previously, where the questions in the interview lead to how usually science learning was carried out by the teacher, without them being aware, the scientific learning that the teacher did indirectly directs students to practice their scientific literacy skills. Although not all aspects of the scientific literacy competency of the 2015 PISA framework were complete, namely explaining scientific phenomena, evaluating and designing scientific research, and interpreting scientific data and evidence trained by students towards students. For example, when teachers were asked whether in their science learning they presented scientific phenomena that occurred in the surrounding environment as examples related to learning, all the teachers interviewed answered yes and explained how they exemplified scientific phenomena on certain scientific learning. Likewise, when these teachers were asked whether they directed students to be able to explain scientific phenomena related
to previous learning concepts at the end of learning, the teacher also answered that they implemented it and gave examples. But when the teacher was asked whether they present data or scientific evidence in the form of tables, graphs, or diagrams in learning, or students were directed to explain a graph, table or diagram, they were rare, even never carry out. In table 1 can be seen the recapitulation of the implementation of the 2015 PISA framework scientific literacy competency in science learning based on interviews.

**Table 1. Teachers interview results.**

| Scientific Literacy Aspects/Teacher | Teacher 1 | Teacher 2 | Teacher 3 | Teacher 4 | Teacher 5 | Teacher 6 |
|------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Explaining phenomena scientifically | √         | √         | √         | √         | √         | √         |
| Evaluating and designing scientific enquiry | -         | -         | √         | -         | -         | -         |
| Interpreting data and evidence scientifically | -         | -         | √         | -         | -         | -         |

Based on the table 1, we can see that of the 6 teachers interviewed, only a teacher has directed students to be able to evaluate and design scientific research as well as interpreting aspects of scientific data and evidence. This result is contrary to the results of research conducted by Yalcin et al. [6]. This study examined the level of scientific literacy of prospective teachers at every level of their education. The results of this study showed that the mean score of the first year students' scientific literacy was 39.15; the mean score of the second year students' scientific literacy was 39.72; the mean score of third-year students and fourth-year students were 39.92, and 41.69. According to these findings, it can be concluded that pre-service science teachers' scientific literacy level was very high. So it can be concluded that each teacher has high scientific literacy skills, but they did not know the concept of scientific literacy and what aspects were measured in the 2015 PISA framework scientific literacy. So they did not apply it to science learning. But this conclusion cannot be used as a full reference because the number of samples is not enough so that it is expected that further research can involve more teachers.

3.2. Results Discussion Before and After The Implementation

This section discussed the achievement of students' scientific literacy skills in each aspect of the 2015 PISA framework science literacy. Based on the PISA framework 2015, students were said to have the ability of science literacy when students were able to master the competence of scientific literacy, knowledge in scientific literacy and attitudes toward science. The assessed competencies were explaining scientific phenomena (K1), evaluating and designing scientific research (K2), and interpreting data and scientific evidence (K3) [5]. Achievement of students' scientific literacy in each aspect of scientific literacy competency can be seen in Figure 1. Student achievement in each of the scientific literacy competencies namely 60.3 in the competence of explaining scientific phenomena (K1), 44.8 in the competence to evaluate and design scientific research (K2), and 57.4 on the competence to interpret scientific data and evidence (K3) with the highest score of 100. Based on the category proposed by Purwanto in Hardinata [7], the achievement of scientific literacy of students in K1 can be categorized as fair, while in the categories of K2 and K3 were categorized as poor and enough. While the achievement of students' scientific literacy after carrying out scientific literacy based learning, where learning is carried out based on the lesson plan that has been developed and follows the lesson study stages can be seen in Figure 2.
Figures 1 and 2. Student’s performance on each competence of scientific literacy before and after the implementation.

Students' scientific literacy skills in the competence of explaining scientific phenomena are 78.7, evaluating and designing scientific research, namely 75.5, and interpreting scientific data and evidence of 76.8. Students' scientific literacy ability after implementation through lesson study shows a good category.

Based on the above data it can be concluded that the implementation of scientific literacy of students in the 2015 PISA framework through lesson study in science learning can be said to be effective because it can improve students' scientific literacy skills. Therefore, to improve students' literacy skills, appropriate teaching methods and materials are needed so that they can trigger and foster attitudes towards students' scientific literacy. This was in accordance with what Stiegler and Hiebert said that in order to get maximum results, in addition to focusing on students, we must also focus on teacher development and instructions arranged in such a way as to obtain maximum results, in this case students' literacy skills [8].

4. Conclusion
The Teacher did not know about scientific literacy, but unconsciously did the competencies PISA framework 2015 in their learning process. The implementation was possible to do, which can be
approved by seeing the results of student achievement. The result showed that student’s ability was significantly increased after the implementation of competencies of scientific literacy framework PISA 2015 in science learning.

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References
[1] Makinae, N 2010 The origin of lesson study in Japan. In Y. Shimizu, Y. Sekiguchi, K. Hino (Eds.), The 5th East Asia Regional Conference on Mathematics Education: In Search of Excellence in Mathematics Education, Tokyo, 2010 (Vol. 2, pp. 140–47). Japan Society of Mathematics Education.
[2] Sadia and Wayan 2008 Lesson Study (Suatu Strategi Peningkatan Profesionalisme Guru). Jurnal Pendidikan dan Pengajaran. UNDIKSHA, Edisi Khusus TH. XXXI May 2008.
[3] Doig B and Susie Groves 2011 Mathematics Teacher Education and Development, v13 n1 p77-93 2011 P 2011.
[4] Dudley P 2011 Lesson study: what it is, how and why it works and who is using it, www.teachingexpertise.com.
[5] OECD 2013 PISA 2015. Draft Science Framework (Paris: OECD Publishing)
[6] Yalçın et al 2011 Procedia Social and Behavioral Sciences 15 (2011) 783–787.
[7] Hardinata A and Permanasari A 2018 International Conference on Mathematics, Science, and Education.
[8] Stigler J. And Hiebert, J. 1999 The teaching gap: best ideas from the world’s teachers for improving education in the classroom, New York, Free press.