

Implementation of STEM and Scientific Literacy's Aspects Through Lesson Study on English for Science Course: Pre-Service Science Teacher's Initial Knowledge and Plan Stage

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ABSTRACT

This research was carried out with the aim of knowing how aspects in Science, Technology, Engineering, and Mathematics or known as STEM and scientific literacy were applied in English for Science lectures so that they can improve the quality of lectures and can instill knowledge and attitudes from STEM and scientific literacy. This research was a qualitative descriptive study which described the process of developing lesson plans and teaching materials based on STEM and Science Literacy in the English for Science course and describes the results of interviews with prospective science teacher students on their initial knowledge of STEM and scientific literacy. The sample was selected using a random sampling technique so that 41 students of the science education study program were selected in their first semester. The results of this study show how teaching materials and lesson plans were developed following aspects of STEM and scientific literacy at the plan stage through lesson study. In addition, the knowledge of prospective science teachers about STEM and scientific literacy was still in the low category.

Keywords: *STEM, Literacy, Pre-Service Science.*

1. INTRODUCTION

These Various policies and efforts made by the Government of Indonesia in order to improve the quality of education in Indonesia in order to improve the quality of human resources of course must also be followed by changes in implementation in classroom learning. So far, we have often heard the phrase that learning should be student-centered or Student Centered Learning (SCL) so that teachers and lecturers only function as facilitators who are able to facilitate students to think critically, collaborate, and communicate. But in reality, in the field this is only a theory and unconsciously there are still many who have not been able to maximally apply it. The Directorate of Resources of the Directorate General of Higher Education in Indonesia called Kemdikbud-ristek was aware of this beforehand so that it took the initiative to improve the quality of learning and carried out a paradigm shift so that learning could be Student Centered Learning (SCL). One of the initiatives carried out by the

Directorate General of Higher Education (Kemdikbud-ristek) was Lesson Study Technology Guidance to improve the competence of LPTK Lecturers. Teacher candidate education institutions or LPTK play an important role in building a quality education and learning system in Indonesia. The development of education in Indonesia, which was marked by changes in curriculum and policies, creates gaps in the implementation of learning in schools. Therefore, LPTK as educational institutions for prospective teachers must always innovate and improve the quality of their lectures. Likewise, lecturers as facilitators in lectures, need to be equipped with effective and efficient strategies or steps to improve the quality of lectures, one of which can be done through Lesson Study [1]. Lesson Study is an approach used to improve the quality of learning and the quality of teachers in teaching which originally came from Japan in 1868 in the Meiji era [2]. Lesson study is a collaborative process carried out by a group of teachers to identify problems in learning, to design a learning

scenario, carry out learning following the scenarios that have been prepared, evaluate and revise learning scenarios, carry out corrected scenarios, evaluate again and share the results with students [3]. Therefore, the authors assume that lesson study is one approach that can be used to implement scientific literacy and STEM competencies and attitudes in learning.

2. RESEARCH METHOD

This research method used descriptive quantitative research methods, which aim to describe and reveal a problem, situation, event as it is or reveal facts in greater depth regarding the process of implementing lesson study on increasing competence and attitudes of science literacy and STEM science teacher candidates in English lectures. Lesson study implementation process consists of three stages, namely Plan, Do, and See. However, this article only describes the results of the Plan stages in lesson study. At the Plan stage, several analyses were carried out on students' prior knowledge consisting of: students' initial knowledge of STEM and Science Literacy and students' initial knowledge of English concepts for science. This descriptive study only tries to describe clearly and sequentially to the research questions that have been determined before the researcher enters the field and there was no special treatment or hypothesis as a guide to the direction of the research.

The sample in this study was selected by purposive sampling method according to the needs of the researcher in carrying out the research. The selected sample was a student candidate for science teacher at the Department of Science Education, Faculty of Mathematics and Natural Sciences, State University of Medan, who was attending lectures in semester 1 of the 2019/2020 academic year.

3. RESULT AND DISCUSSION

3.1. Initial English Skills of Science's Pre-Service Teachers

One of the steps taken by the author at the Plan stage in Lesson Study was to identify and analyze the needs of prospective science teacher students for concepts and skills in English. To find this out, the researcher conducted an initial test before the lecture was carried out so that researchers could develop instructional designs and lecture materials according to the needs of prospective science teacher students. The test results obtained can be seen in Figure 1 below.

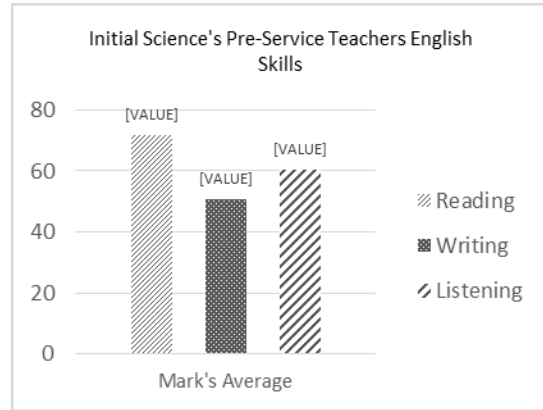


Figure 1. Initial science pre-service teachers English skills.

Based on the picture above, it can be seen that the average score of prospective science teacher students on reading skills was 71.43 in the "Good" category, but for writing and listening skills the average scores were 50.45 and 60.25 which were included in the "Enough" category. The condition of the English language skills of prospective science teachers certainly affects the level of their scientific literacy skills. scientific and technological literacy, language, and mathematics have a very strong relationship. someone who has scientific and technological literacy skills and mathematics performs critical, rational, and systematic thinking using symbolic language. Likewise, people who have language literacy skills will be able to communicate and use symbolic language and interpret scientific phenomena in solving problems [4]. Therefore, the results of this initial measurement can be used by researchers as a reference for developing instructional designs, lecture media, teaching materials and others which can then be tested at the Do stage in lesson study.

3.2. Initial's knowledge of STEM and Scientific Literacy science's pre-service teachers

The NRC (2014) has defined each of the four STEM disciplines and their respective roles [5], namely:

1. Science is a body of knowledge that has accumulated over time from a scientific examination that produces new knowledge. The science of science plays a role in informing the engineering design process,
2. Technology is the whole system of people and organizations, knowledge, processes, and devices that then create objects and operate them. Humans have created technology to satisfy their wants and needs. Much of modern technology is the product of science and engineering,
3. Engineering is a body of knowledge about the design and creation of man-made objects and a process

for solving problems. Engineering utilizes concepts and science, mathematics and technological tools, and

4. Mathematics is the study of patterns and relationships between numbers, numbers, and spaces. Mathematics is used in science, engineering, and technology.

In addition to the initial ability to speak English, researchers and the Lesson study team also need data on the initial knowledge of prospective science teacher students on STEM terminology and scientific literacy. Therefore, the researchers conducted interviews with interview guides that had been previously validated to obtain information on the extent to which science teacher candidates had knowledge of STEM and scientific literacy, some of the results of interview questions can be seen in Table 1.

Table 1 Data from the Interview Results of the Candidate Science Teacher's Initial Knowledge about STEM and Scientific Literacy.

Questions	Answer		
	Yes	No	Not Sure
1. Do you know the definition of the term STEM?	5	38	0
2. Have you ever taught using a STEM approach?	0	43	0
3. Did your teacher at your previous school teach with a STEM approach?	2	11	30
4. Do you know the definition of the term Scientific Literacy?	2	30	11
5. Have you ever taught using a scientific literacy approach?	0	43	0
6. Did your teacher at your previous school teach with scientific literacy approach?	0	10	33

Based on the results of the interviews above, it can be concluded that in general more than 90% of prospective science teacher students do not know the definition of the terminology of Science, Technology, Engineering, and Mathematics (STEM) and Science Literacy. This is, of course, a fact that cannot be ignored. Therefore, based on the results of this study, it is important for researchers to design instructional designs and teaching materials in order to instill STEM competencies and attitudes and Science Literacy from the start so that these prospective science teachers can also teach science with a STEM approach and scientific literacy. Kelley et al say that integrated STEM education is an approach to teaching two or more STEM fields in order to improve students learning [6]. Therefore, this competency must first be possessed by the teacher before the teacher can apply it in student learning.

3.3. Initial STEM and Scientific Literacy Competency of Science Pre-service Teachers

To be able to design instructional designs, lecture media, and appropriate teaching materials to instill STEM competencies and attitudes and scientific literacy in science teacher candidates, of course, a needs analysis of prospective science teacher students is needed. This needs analysis is carried out so that the development of instructional design and lecture media can be right on target and not too broad in the discussion. Therefore, the researchers and the lesson study team developed an instrument for measuring the level of competence and attitudes of STEM and scientific literacy of prospective science teacher students, the results of which can be seen in Figures 2 and 3.

Based on Figure 2, it can be seen that the ability of prospective science teacher students in solving problems of science and mathematics phenomena as a measuring tool in problem solving is in the "Good" category with a score of 72 and 75. As for competence in the field of technology and engineering in science, students are still difficulty in solving these problems, this can be proven from the results of the average score of students who are in the "Enough" category with a score of 64 and 65. This data can then be used by research as a reference in developing instructional designs and lecture media to improve STEM competencies and Science literacy of prospective science teacher students at the Do stage in Lesson Study.

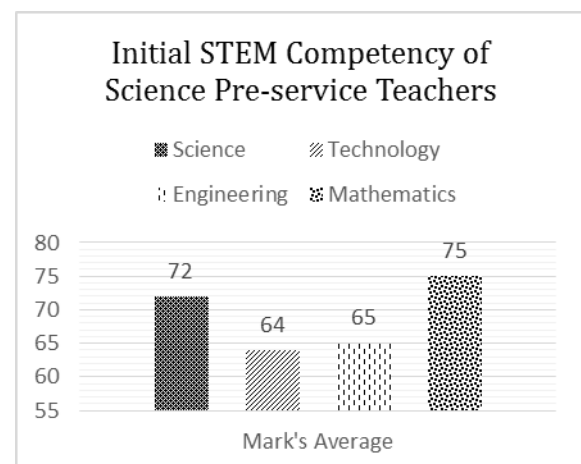


Figure 2 Initial STEM competency of science pre-service teachers.

Then the results of further research regarding the initial scientific literacy ability of prospective science teacher students. Based on Figure 3, it can be seen that the ability of prospective science teacher students in solving scientific phenomena problems and interpreting data to explain scientific phenomena was in the "Good" category with a score of 72.5 and 76.6. Meanwhile, students' ability to evaluate or carry out engineering designs in

solving scientific problems in general was still in the "Enough" category with an average score of 61.8. In general, the results of this study were in line with the results of Hardinata A's research which found that the scientific literacy ability of students in middle high school before being given science literacy-based learning in the competence to explain scientific phenomena, interpret data, and evaluate and design designs to solve scientific problems was at category "Enough" [7]. This could have happened because the sample in this study was student teacher candidates in their first semester and they had just finished their education at the senior high school level. However, to find out this correlation and the level of scientific literacy development of middle high school to senior high school students, further research is certainly needed.

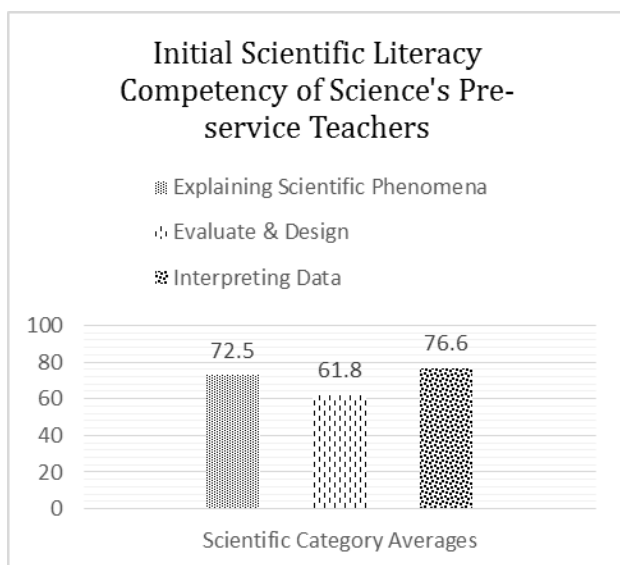


Figure 3 Initial scientific literacy competency of science pre-service teachers.

4. CONCLUSION

Based on the results of previous research and discussions, it can be concluded that the students' initial English proficiency was still in the sufficient category. Likewise, with the initial competence of STEM and scientific literacy of prospective science teacher students, several aspects of the competence of STEM and scientific literacy of prospective science teacher students were still in the enough category. Therefore, the results of this initial needs analysis can then be used by researchers as reference data to carry out further research at the do and see stage in lesson study.

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