

## The effect of STEM approach on the mathematics literacy ability of elementary school teacher education students

J B Kelana, D S Wardani, A R Firdaus, D H Altaftazani and G D S Rahayu

Institut Keguruan dan Ilmu Pendidikan Siliwangi, Jl. Terusan Jenderal Sudirman, Cimahi 40526, Indonesia

Email: [jajang-bayu@ikipsiliwangi.ac.id](mailto:jajang-bayu@ikipsiliwangi.ac.id)

**Abstract.** This study aims to determine the effect of the STEM approach on mathematics literacy abilities of elementary school teacher education students. The method used in this research is pre-experimental with One-Group Pretest-Posttest Design with a population of semester 2 PGSD students with a total of 188 students. The sample in this study was 50 students. The instruments used include: mathematics literacy ability tests, interviews, and observation instruments. The results showed that: 1) there was an effect of the STEM approach on the mathematics literacy ability of elementary school teacher education students; 2) to further optimize learning it must be prepared more thoroughly and planned, 3) the role of educators or lecturers in applying models or approaches must be adapted to the demands of 21st-century skills

### 1. Introduction

Mathematics is a subject that is commonly found from elementary to tertiary levels. Basically, the concepts in mathematics have links and applications that are not far from human life. mathematics teaches people to be able to solve problems through a scientific approach so that students can understand more meaningfully [1-7]. Given the importance of mathematics, it is necessary to optimize teaching.

Based on the results of the Trends in International Mathematics and Science Study (TIMSS) study and the Program for International Student Assessment (PISA) Indonesian students obtain unsatisfactory results. Here is a comparison of the TIMSS and PISA surveys on mathematical ability.

**Table 1.** TIMSS and PISA results in Indonesia

Results	Year	Indonesia's position	Number of Countries	Score	Average score
TIMSS	2003	35	46	411	467
	2007	36	49	397	500
	2011	38	42	382	500
	2015	44	49	397	500
PISA	2003	38	40	360	500
	2006	50	57	391	498
	2009	61	65	371	496
	2012	64	65	375	494
	2015	62	70	386	490
	2018	72	78	379	489



Table 1 shows that Indonesia's ability has not been able to penetrate the average score set. One of the capabilities measured in TIMSS and PISA is mathematical literacy ability. Literacy words initially limited to read-write-count [8]. With the development of science, understanding of literacy is becoming increasingly widespread. Included in mathematical literacy. The OECD / PISA defines mathematical literacy as the capacity of individuals to formulate, use, and interpret mathematics in various contexts [9]. Mathematical literacy is a person's ability to formulate, use, and interpret mathematics in the problems of everyday life efficiently [10]. It can be concluded that mathematics literacy is the ability to formulate, use, and interpret mathematics related to daily life. The domain of mathematical literacy includes: analyzing, thinking, and communicating ideas effectively as they propose, formulate, solve, and interpret mathematics in various situations [11,12].

Considering how important mathematics literacy skills are, it is very important to teach elementary school teacher education students. Those who later will dive into the field become elementary school teachers. At least, when given knowledge about mathematical literacy, they can improve the quality of mathematics learning itself. One other effort to improve mathematical literacy is to use the STEM approach.

The STEM approach provides opportunities for prospective teacher students, especially elementary school teachers, to realize that the concepts and principles of science, technology, engineering, and mathematics are used in an integrated manner in the development of processes, products, and systems used in everyday life. This definition of STEM education was later adopted by Reeve [13] as an interdisciplinary approach to learning in which students use science, technology, engineering, and mathematics in real contexts that connect schools, the world of work, and the global world to develop STEM literacy that can make students able to compete in the new knowledge-based economic era. This is supported by research conducted by Han et al. [14] that the integration of STEM in learning can improve achievement and scientific literacy, mathematics literacy, technology, and engineering students. Learning in the STEM approach in higher education can equip students in the ability to think logically, critically, and creatively and have the ability to work together in problem-solving, communication, reasoning, connections, and mathematical representation, where the five abilities are the competencies of mathematical literacy.

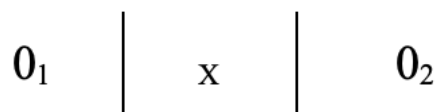
Research on the implementation of the STEM approach in learning aimed at building mathematical literacy has not been done much in Indonesia. Some research on STEM approaches is more focused on STEM literacy as a whole and is still a study of methods or learning processes that can build STEM literacy. Among these studies, Zollman [15] suggested that to develop STEM literacy in classroom learning it should be emphasized that STEM learning cannot be separated based on its constituent content. Meanwhile, Persaud & Sharma [16] suggested a method for introducing STEM literacy to students including through the engineering process which is one way to apply mathematics and science to problems.

Several studies focusing on the development of one component of STEM literacy have also been carried out, but there is still not much found about the relationship between STEM approach and mathematical literacy. These studies include Robinson & Kenny [17] who researched engineering literacy as a result of integrating the principles of engineering design and science in ninth grade students; Sullivan [18] who researched the effect of robotics activities on science literacy knowledge and skills; Kelana [19] who researched the effect of learning media and the ability to think creatively on the ability of students in scientific literacy in elementary schools. Thus, research that has built mathematical literacy using the STEM approach is still not much done.

Based on the description above, the researcher focused his study on "The Effect of the STEM Approach on the Mathematical Literacy Ability of Prospective Elementary School Teacher Students." This study aims to determine the relationship between the application of the STEM approach in lectures to the mathematical literacy abilities of prospective elementary school teacher students.

## 2. Method

The method used is pre-experimental with One-Group Pretest-Posttest Design. This design has a comparison between the results of the pretest and posttest. The design are as follows (Figure 1).



**Figure 1.** Research Design One-Group Pretest-Posttest Design

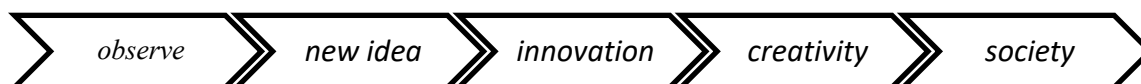
Information:

X = Treatment.

O<sub>1</sub> = pretest.

O<sub>2</sub> = posttest.

The study was conducted at IKIP Siliwangi with a population of all semester 2 PGSD students with a total of 188 students. The sample in this study was 50 students. The instruments used were tests of mathematical literacy skills, interviews, and observation instruments. The instrument was validated by experts and tested in the field. Data processing uses the help of excel and SPSS window applications 20. STEM learning is carried out in lectures following the steps as follows (Figure 2).



**Figure 2.** STEM Learning Steps

Mathematical literacy ability measured in this study is the ability to analyze competencies, give reasons, communicate ideas effectively, and interpret solutions based on calculations and data mathematically.

### 3. Result and Discussion

#### 3.1. Result

The results of research on the effect of the STEM approach on the mathematics literacy ability of elementary school teacher education students showed improvement. Here are the results of testing using the help of SPSS 20 (Table 2).

**Table 2.** Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre test	30.1917	50	8.51344	1.55386
	Post test	40.5892	50	9.71558	1.75272

Table 2 show the average value of the pretest is 30.19 and the posttest is 40.58. Std value deviation and std value. the mean error in the pretest was 8.51 and 1.55. While the value of std. deviation and std value. the mean posttest error was 9.71 and 1.75. Henceforth, the statistical test used in this study is the t-test. Processing using the T-test showed a pretest value of 30.19 <40.58 posttest. From these tests, it appears that there are differences in the average value. The T-test showed a correlation value of 0.682 with sig. 0.00. The hypothesis is:

H<sub>0</sub> = there is no difference in mathematical literacy skills between pretest and posttest.

H<sub>1</sub> = there is a difference in mathematical literacy skills between pretest and posttest.

Significance level ( $\alpha = 0.05$ )

sig. (2-tailed) <  $\alpha$ , H<sub>0</sub> is rejected.

sig. (2-tailed) >  $\alpha$ , H<sub>0</sub> received.

Sig value (2-tailed) 0,000 <0.05, it can be concluded that  $H_0$  is rejected and  $H_1$  is accepted. So it can be concluded that the STEM Approach can influence the ability of mathematics literacy of prospective elementary school teacher students.

### 3.2. Discussion

The average pretest score obtained by students is 30.19. One factor that causes the average value of student scores is low that students are not familiar with the questions presented. The paradigm that learning mathematics is a difficult and frightening lesson is still attached. Nearly 72% of the majority of students said so when interviewed. The observation results in the field show that students have less interest in learning mathematics. Researchers 'efforts to attract students' interest are by providing motivation, apperception, and games before the research is conducted. At the beginning of the learning process using the STEM approach, students at first were unfamiliar. Mathematical literacy ability that is seen in the average value of pretest is still low because there has never been applied models or approaches that can influence and enhance students' mathematical literacy abilities in the Basic Mathematics Concepts course. However, along with the application of the STEM approach in this study, students learn about patterns and relationships between equations, numbers, and spaces by using analytical skills, giving reasons, communicating ideas effectively, and interpreting solutions based on calculations and data mathematically which are then linked to aspects science, technology, and engineering. Thus, students learn by integrating two or more fields of science contained in STEM. This makes students able to solve problems in their way [20] and can increase the sensitivity of problems that exist in the real world and find and implement solutions with justification for various phenomena that occur in everyday life and have links concerning the concept of mathematical literacy.

In essence, learning mathematics is to build mathematical concepts with their own abilities through the process of internalization to form a meaningful new concept [21]. In line with the explanation above, the STEM Approach helps in scientific investigation and application of mathematics in the context of everyday life, so that it can be applied in the real world.

The effect of the STEM approach on the mathematical literacy ability of prospective elementary school teacher students can be seen in the increase in the average results of student pretest and posttest which shows that the research sample has increased by 10.39 with an average pretest 30.19 and posttest by 40.58. The data is processed using the SPSS 20. The results show that the value of sig. (2-tailed) 0,000 <0.05. So it can be concluded that the research hypothesis is accepted. So, the STEM Approach can influence the mathematical literacy ability of prospective elementary school teacher students.

### 4. Conclusion

Based on the results and findings of the study, it can be concluded that: 1) there is an influence of the STEM approach on the mathematics literacy ability of elementary school teacher education students; 2) to further optimize learning it must be prepared more thoroughly and planned, 3) the role of educators or lecturers in applying models or approaches must be adjusted to the demands of 21st-century skills.

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