Science literacy on science technology engineering and math (STEM) learning in elementary schools

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Abstract. Science in Engineering Technology and Mathematics (STEM) strongly supports the current era of educational development. The component that strongly supports the success of STEM mastery is student literacy towards science concepts. This study aims to reveal the profile of scientific literacy skills that support the achievement of STEM. The method used is qualitative participatory. The participants of this study were 26 grade 6 elementary school students in Bandung. The instrument used is a test of understanding of several technology products around the environment where students live. Triangulation through interviews was conducted to explore students' answers. The results showed that: (1) there were variations in students' scientific literacy skills on technology products, (2) the ability of science concepts related to STEM abilities, and (3) the still strong role of learning resources derived from books, the internet and other social media. This study concludes that science skills and STEM literacy of elementary school students in Bandung are still low. This research recommends the need for literacy programs that are united with an integrated teaching and learning process.

1. Introduction

Science literacy is an important part of understanding the rapid development of Science and Technology. These developments encourage people to be ready to accept, use and develop science and technology. However, in education circles there are still many students who have difficulty understanding various technology products. To be able to understand science technology it requires the ability of basic concepts of science. Therefore the ability of Science Technology Engineering and Math (STEM) students in basic education in various parts of the world in the 21st century is very important. STEM capabilities for students in Indonesia can and help students in facing various challenges in the future. In addition, STEM's ability also supports world community programs that must be literate to STEM [1]. That is why STEM is a superior program that must receive support in the curriculum, especially in basic education. The existence of STEM content in the school curriculum provides certainty to citizens in obtaining various skills in both scientific literacy skills, technology literacy and mathematical literacy. But in various countries, including in Indonesia the achievements of literacy in science, mathematics, and technology are still low and find various obstacles. The low ability is caused by various factors both human and academic factors [2]. Academic factors including mathematical abilities and scientific literacy influence STEM achievements. These mathematical and scientific factors determine the quality of STEM achievements. However, to date there is still a lack of studies on the profile of students' scientific abilities at the elementary school level. Even though students get science material
academically at school. Meanwhile, students are always faced with various technological products in their surrounding environment. So that problems arise how the profile of students' ability to understand the concepts of science and maternal concepts on technology products that are around is associated with STEM capabilities in basic education [3].

Several studies related to the basic abilities of science and mathematics as well as the application of STEM to basic education. The application of STEM in the learning process in high school elementary schools is influenced by students' scientific and mathematical abilities [2]. Students' scientific and mathematical knowledge is reflected in their ability to recognize technology products and identify various technological products in their environment. In addition to understanding the basic concepts of technology, participants' abilities about STEM are also determined by the way they work and the benefits of technological products that they recognize or use in everyday life. It is known that the presence of technology products such as mobile phones, refrigerators, and televisions provide different experiences of STEM students' knowledge and skills [4]. There are students who are more familiar with television on the grounds that television is more often watched and followed than other products. While many students are more often associated with mobile phones because technology products are more often used to communicate with family or other people. However, often students can only use technology products without knowing the scientific and mathematical concepts used in them [5]. Like the still weak ability to apply mastery of scientific and mathematical concepts to understand technology products.

Mastery of students' scientific and mathematical concepts of technology products influences their achievement of STEM understanding [6]. With regard to mastery, each student has a level of ability and awareness of the understanding of STEM inherent in technological products. Some STEM dimensions on technology products such as the introduction of traits, characteristics, ways of working, benefits, physical dimensions or impacts and attitudes towards the surrounding environment. The understanding of STEM on technology products can increase intelligence on one's environment (environmental intelligence) [7-9]. This can also increase awareness of social relationships, can also strengthen the quantity and quality of relationships between individuals and someone with others. The ability or literacy of science and mathematics among students associated with this technology has not been widely studied. Even though this problem is an important part in increasing the success of STEM programs in schools and communities. Therefore a study of the relationship between Early Literacy abilities and students' social abilities becomes very important [10]. Therefore this research is directed to get an overview of STEM's initial capabilities and their relation to scientific literacy skills.

2. Methods
This research is participatory exploratory using a mixed method. The participants in this study were class VI students from elementary schools in Bandung as many as 26 people. The instrument used was a STEM test consisting of 8 questions. The type of test is free entry. In addition to the test instrument, a triangulation interview guide was used to explore the answers of several students to the science concepts related to STEM. Like the question: "What concepts of science concepts exist in the technology products that you choose (illustrate)" and "Have you learned the concept of science concepts at school, explain"
The example of the instrument is as follows:

![Instrument Image]

**Figure 1.** Instrument.

**Table 1.** Questions in instruments.

| Indicator       | Description of Early STEM                                                                 |
|-----------------|-------------------------------------------------------------------------------------------|
| (1) Technology  | Look at the following list of tools or inspections: radio; television; refrigerator; rice cooker; fan; blender; air conditioning; computer; mobile; microwave; gas stove; electric stove; electric iron; telephone; magic jar; hair dryer; vacuum cleaner |
| (2) Math        | 5 (five) tools or inspections besides those in your home and most recognizable.            |
| (3) Technology  | Draw one (only one) tools in box 2 that you understand best.                                |
| (4) Science     | Briefly describe the features of the toolkit that you drew:                                |
| (4) Engineering  | How do you work with the tools you choose (box 3)                                         |
| Technology      | Mention the benefits of the tool in box 3 (as many as possible)                            |
| Math            | Write an estimate of the size of the tool that you drew ... length = ... cm, width = ... cm; height = ... cm; the area of one side is = ...; the volume of tool is = ... |
|                 | Mention the measurements in the tools that you draw! (such as voltage size, current strength, and what do you and your family feel with the tools (mention the tool)? |

Data obtained from the answers of 26 students were processed using rubric, namely score 4 for correct and complete answers, score 3 for correct and incomplete answers, score 2 for minimum answers, score 1 for wrong answers, and score 0 for not answering /blank. After obtaining a recapitulation of STEM capability data, followed by analysis and interpretation. Then triangulation of answers was conducted to several participants from the superior and lowers groups. The purpose of this triangulation is to
explore student answers based on the type of technology product. Based on the recapitulation, analysis, interpretation, and triangulation of all data, recommendations and recommendations are concluded.

3. Results and discussion
The results of the research data analysis consist of profiles of technology products that are most often used and recognized around the student's residence and the following STEM abilities and Social Literacy Abilities.

3.1. Profile of technology products
Of the various types of technological products presented, students choose the products they know best (around their residence and level of use), can be illustrated in Figure 2.

![Figure 2. Distribution of selected technology products.](image-url)

Figure 2 shows the technology products most often referred to as students around the neighborhood are mobile phones (23), television (19), and refrigerator (20). Whereas the least mentioned technology product is air conditioner (1). All technology products presented as options get the opportunity to be chosen.

As for the many technology products chosen, students have been able to describe the product. There are only 4 (four) technology products selected as images of objects, which can be shown in the following figure 3.

![Figure 3. Distribution of illustration of technology production.](image-url)
Figure 3 shows the technology products chosen by students to be drawn on the answer paper. Of the 17 types of technology products presented, only 4 types of technology products were chosen by students to be drawn. Consecutive technology products chosen by students are Mobile (11) and Television (10), Refrigerator (8), and Hair Dryer (2). So the most widely drawn type of technology is Mobile and Television.

Based on the description of pictures 3 and 4, it is illustrated that all types of technological products presented can be chosen by students. But only 4 (four) types of technology products they can select and draw. Allegedly, the type of cellphone, television, refrigerator and hair dryer are the types of technology most often used. Besides that, the type of product is easier to visualize by students. Visualization of a product makes it easy for children to imitate or describe [11]. Besides that the more often an object or product of technology, the more familiar students are [12,13].

3.2. Early STEM ability and science literacy

The ability of Science Technology Engineering and Math students in class VI can be shown in Figure 4.

Figure 4 shows the profile of the STEM ability of Early Grade VI students. The highest scores were obtained by FAH (35), AZZ and SPY (32 each). While the score is low by LED (17). While the average score of STEM Early ability in this class VI is 25.6 (71.22%).

If analyzed from the average score of the acquisition of STEM abilities with scientific literacy skills can be obtained as shown in the following Figure 5.

Figure 5 shows the profile of the STEM ability of Early Grade VI students. The highest scores were obtained by FAH (35), AZZ and SPY (32 each). While the score is low by LED (17). While the average score of STEM Early ability in this class VI is 25.6 (71.22%).

If analyzed from the average score of the acquisition of STEM abilities with scientific literacy skills can be obtained as shown in the following Figure 5.
Figure 5 shows the average score of all class VI students on the components of the Early STEM ability and Literacy Science Ability. The average of all students has an average ability of Early STEM of 2.9 and scientific literacy skills of 3.0. The relationship between the ability of Early STEM and non-parametric scientific literacy skills was 0.37 or the low to moderate category. This shows that their understanding of STEM is based on the understanding of technology products is still low [4].

The description of students' mathematical abilities is still very low. Figure 6 follows examples of student answers to the mathematics component.

![Figure 6](image)

**Figure 6.** Example of student answers to the mathematics component.

Figure 6 shows 2 examples of student answers to the research instrument. Answers (a) and (b) indicate students have estimated the size of the refrigerator. But the amount, width and height are still far from reality. This shows that students have not been able to recognize the magnitudes of everyday technological products. Likewise, for derivative quantities in the form of area and volume, almost all students are wrong in calculating area and volume. The math skills of grade 6 students are still low.

Mathematical abilities related to STEM abilities [14] An overview of the ability of Early STEM in class VI students that reached 77.22% showed that students could recognize technology around their homes well. Similarly, the average STEM Early Learning ability and Science Literacy (3.0) at a maximum score of 4.0). Class VI students who recognize and use technology products have the ability to use scientific concepts in technology products.

The qualitative description of students' scientific literacy skills can be described in Table 2.

| What concepts of science concepts exist in the technology products that you choose (illustrate) | Superior Group: concepts of electricity, light, waves, colors, sounds, and energy | Lower group: electricity and sound |
| Have you learned the concept of science concepts at school, explain. | Superior Group: have been studied, explained by the teacher, are in textbooks, newspapers and magazines, reading books in the library, information from television at home | Lower group: have been studied, explained by the teacher and the chest in the textbook |

Table 2 shows through interviews with students from superior groups answering questions what are the concepts of science concepts that exist in the technology products you choose (describe). They can answer more fully than the lower group. Likewise when they are asked about whether the concept of science concept that you have learned before in school and its explanation, the superior group can
explain various sources of information more comprehensively about the technology product they choose compared to the lower group.

Based on the descriptions of figures 4 and 5 and table 2, qualitatively there is a correlation between STEM ability and science literacy abilities of grade VI students in elementary school [15]. The ability to STEM is influenced by understanding the scientific concepts learned [16]. The main sources of science concepts are obtained from teachers and textbooks. As for information about STEM originating from television, social media, magazines, library books can provide an introduction to student STEM mastery [17,18].

4. Conclusion

STEM ability in elementary school students is influenced by the presence of technology products around their homes and the use of technology products. Likewise students better understand STEM based on their understanding of the basic concepts of science. Sources of information on science concepts and technology products come from the learning process in the classroom, textbooks and print media and electronic media and other social media. Likewise, students who better understand the characteristics and functions and uses of technology products will be more concerned and aware of the benefits and impacts of these technological products [6,19].

This study recommends that the introduction of technology products as a preliminary understanding of STEM must begin at the elementary school level both directly and through examples of application of science concepts in learning [2,3,20].

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