THE CHALLENGES OF LITERACY IN 21ST CENTURY'S ELEMENTARY EDUCATION BASED ON STEM LEARNING

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Abstract: Learning based on Science Technology Engineering and Mathematics (STEM) strongly supports the current era of educational development. One of the components that support the success of STEM learning is the ability of students' literacy in the field of science. This paper aims to reveal the proficiency profile of science literacy that supports the achievement of the STEM. The method used is qualitative participatory where the participant is the students of grade 6 primary school in Bandung. The instruments used are test of scientific literacy and triangulation literature by using technical interviews. The results of the study showed that: (1) science literacy skills supporting STEM based in gender an average grade of achievement in the previous class, (2) the majority of the students still had low STEM literacy skills, and (3) students rely on compulsory textbooks as a source of scientific literacy as well as STEM. This study concludes that the ability of science and STEM literacy in basic school students in Bandung is still low. Based on analysis and conclusions, this study recommends that for the challenges of the 21st century STEM literacy learning needs to be developed through science learning and contextual integrated learning in elementary schools.

Keywords: Science Technology Engineering and Mathematics (STEM), Technology product, STEM learning, and Visualization

1. Introduction

The development of science and technology in the 21st century has made the development of the world progress more rapidly (Isabelle, 2017). The speed of this development is indicated by the many increasingly sophisticated and varied technology products. So that variations in technology products make all areas of human life easier, faster and lighter. The subsequent impact was the encouragement of adjusting and combating the education curriculum. Parts of the curriculum that will be affected include the structure of the curriculum, material, and learning methodology. The education curriculum must support the development of science, technology, engineering, and mathematics (STEM). Methodology, processes and learning media should also be able to support the development of this STEM. With STEM learning, students are expected to be more literate about the challenges of the 21st century (Ahmed Ibrahim, 2017). In addition, students can master the skills needed in the 21st century.

Some studies state that 21st century skills are important to be applied in learning at school. Learning that uses the scientific concepts of engineering technology and mathematics strongly supports learners mastering the challenges of the 21st century (Weintrop, D. et al., 2016). In some countries, STEM learning can encourage students to have critical and mathematical thinking skills (Christensen, R., & Knezek, 2015). STEM learning that is applied in the middle class can be strong in solving everyday technological problems. Similarly STEM can improve digital literacy and computers. Other findings concluded that there was a relationship between the basic abilities of science and mathematics with mastery of STEM. In Indonesia, data is obtained that the scientific and mathematical abilities of elementary school students are still low. In another perspective, students' ability to recognize basic concepts of science and technology products is still low. So the problem arises whether the literacy skills of elementary school students in Indonesia can be seen from the STEM's abilities? In addition, how to anticipate that elementary school students have the ability or literate to science and technology. This issue is important, because STEM learning is closely related to learning methods.

The study of the ability of science and technology concepts in elementary school students can be done in stages. The first stage is to map the existing conditions of scientific literacy of students. In addition, the challenges faced by students in doing technology-based learning or Science Technology Engineering and Math (STEM). Next, make recommendations to find solutions to solve scientific literacy problems through daily learning at school.

2. Methodology

The research method used is a participatory qualitative approach. Participants in this study were 51 high school students in one of the elementary schools in Bandung. Participants consisted of 18 male students and 33 female students. To obtain data on literacy skills, 9 written questions were used about Science Technology Engineering and Math (STEM). The question consists of 2 parts, namely the first part about science, technology, engineering, and four questions about math and two other questions about the attitude of participants to the impact of using technology.

The research was conducted through several stages, namely: providing literacy test instruments to students; processing literacy data, and analyzing the results of data processing. Data obtained from the answers of 51 participants 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 processing participant literacy data, the next step is triangulation of several participants. Triangulation aims to explore the answers given by participants (Cavlazoglu, B., & Stuessy, 2017) . Triangulation was carried out by interviewing several superior participants and lower. The results are described and interpreted so that they can complement the analysis of the research data. Based on the analysis and conclusions, the last step is to formulate recommendations..

3. Results and Discussion

The results of the research data analysis consisted of the distribution of literacy abilities of students based on qualifications and gender, participant's literacy ability based on technology products, profile of technology products based on visualization, and description of STEM literation capabilities based on triangulation.

a. Distribution of literacy abilities

Based on the data obtained from the instrument about STEM literacy skills, the distribution of participants was based on the qualifications of STEM literacy skills, literacy abilities of four STEM abilities based on the type of STEM component and based on gender in the following chart table.

Table 1. Distribution of Participant based Qualification of STEM Literacy

Qualification	Range Score	Frequency	Percentage (%)
Low	Average < 20	2	3.9
Less	$20 \leq$ Average $< 3,0$	16	31.4
Enough	$30 \leq$ Average $< 3,8$	22	43.1
High	$3,8 \leq$ Average	11	21.6

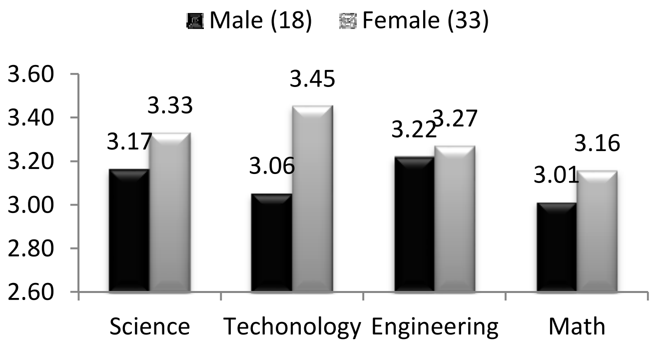

Fig. 1. Score Qualification of STEM Literacy Aspect

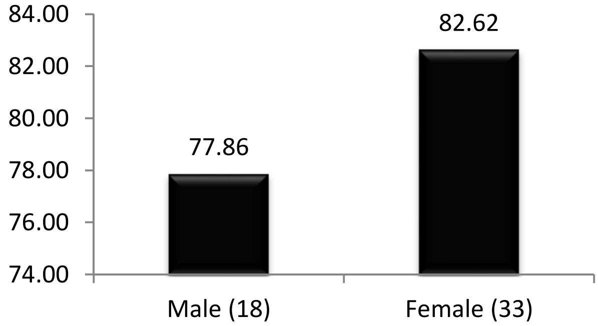

Fig. 2. Percentage Qualification of STEM Literacy

Table 1 shows the distribution of the number of participants based on STEM literacy skills. Of the 51 participants, the majority of participants had sufficient literacy skills to be low (78.4%). Only 21.6% of participants have high qualifications. While Fig. 1 shows the average score in each STEM component, namely literacy science, technology, engineering, and mathematic. In all components of STEM literacy, the average literacy ability score seen by female groups was greater than the male group. The highest score for the male group is in the engineering component (3.22). While the highest average score in the female group is in the technology component (3.45). The biggest difference in average scores is found in the technology component, namely (0.39). While the smallest score difference is in the engineering component (0.05). As for Fig. 2 description of the percentage of STEM literacy qualifications for male and female groups. Female groups 33 people the percentage of literacy ability was 82.62%. While the percentage of male group literacy ability is 77.86%

Literacy skills towards Science technology engineering and math that are still low occur in various countries. STEM literacy is influenced by the low level of scientific literacy in subjects in school. There is an influence of gender differences on literacy skills(Han, S., Capraro, R., & Capraro, 2015). Different ways of thinking and acting in learning science are different. In some countries the ability to think critically, collaboration or communication among women's groups is higher than that of men. Significant differentiation occurs in the technology aspect compared to the concepts of science, engineering and mathematics. To improve STEM literacy skills in students it needs to be given a contextual approach and learning method (Kennedy, T. J., & Odell, 2014). Curricula that relate a lot of material to technology can be done in basic education. In addition, learning that often introduces technology for male and female students can be done in a balanced manner (Huang, C. S., Su, A. Y., Yang, S. J., & Liou, 2017).

b. Distribution of Product Technology

Based on data obtained from instruments about technological products presented and identified by participants, it can be shown in the following figure 3..

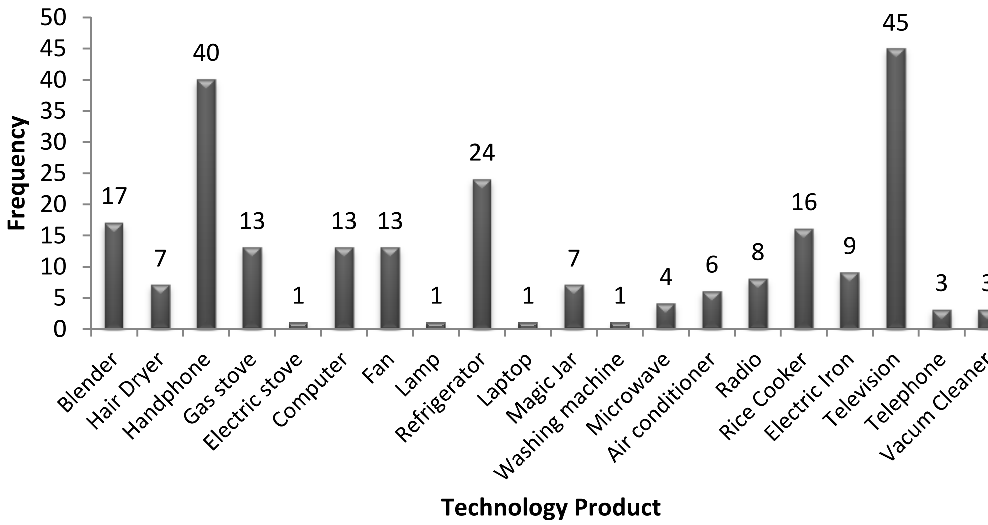

Fig.3. Distribution of Product Technology

Fig. 3 shows the distribution of the number of technology products chosen by 51 participants. Technology products that are included by many participants are blenders, refrigerators, rice cookers, televisions, and cellphones. The most chosen technology products by participants were television 45 times (88.2%) and mobile phones 40 times (78.4%). While the most selected technology products chosen by the participants were electric stove, lamp, laptop, and washing machine (2.0%).

Based on Fig. 3 it shows that not all students can recognize technology products that are around them (Altun, 2017). Learners recognize better only real products around their homes. Many technology products can be recognized by students from a variety of media, both cool media and electronic media. The level of understanding of students about product technology will depend on the presence or absence of the product in their place of residence. The frequency of using technology products also affects their understanding. Usage activities such as turning on the television, adjusting the channel, increasing the volume, adjusting color etc. will affect STEM literacy. However, it is still rare for students to question the concepts of science, technology, and other dimensions of technology products. The weak ability of students to ask questions shows a weak ability to think critically. In addition, they rarely communicate scientific matters related to the technology products they use.

c. Profile Visualization of Product Technology

Based on data obtained from instruments about technology products selected and drawn by 51 participants can be shown in the following figure 4.

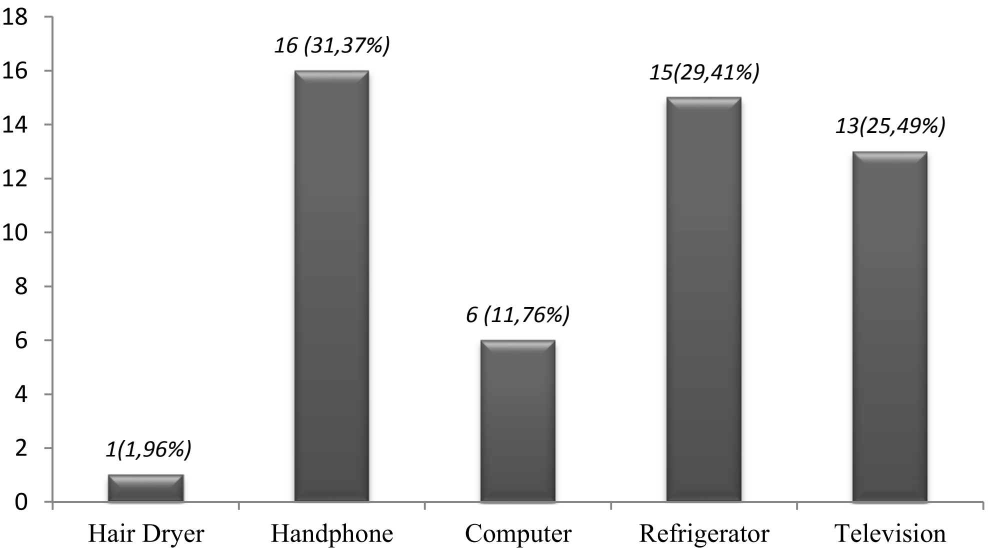

Fig.4. Profile Visualization of Product Technology

Fig. 4 shows that the most drawn technology products by participants involved are mobile phones, refrigerators, televisions, computers, and hair dryers. The number of technology products drawn is 5 out of 20 types that must be chosen (25%). Mobile is the most widely chosen and drawn technology product by participants, namely by 16 people (31.37%). While the least drawn is a hair dryer (1 or 1.96%).

Why are mobile phones the most chosen as current technology products? Some studies show that one of the most developed technology products is mobile phones. Develop quality (Wong, A. Y., & Daud, 2017), varieties and quantity of technology are mobile phones (Wong, A. Y., & Daud, 2017). On mobile phones various information is almost unlimited (Rambitan, 2015). v (Porter, G et al, 2016). In addition, literacy of mobile phones and their use must be a program for educators. Mobile phones can improve children's critical thinking skills(Rambitan, 2015) In addition, literacy of mobile phones and their use must be a program for educators. Mobile phones can improve children's critical thinking skills

d. Description of Participant Triangulation Results in STEM Literacy

Based on the analysis of participant answers when triangulation of STEM literacy, it can be described through the following table 2.

Table 2. Description Triangulation of Participant on STEM Literacy

No	Indicator of STEM	Description of Participant
1	**Science**: Briefly describe the features of the Toolkit that you drew	▪ Participants in general regarding science concepts from knowing to using science concepts to mobile phone technology products ▪ Participants have not explicitly explained their scientific concepts ▪ Participants have not explicitly explained the scientific concepts of television
2	**Technology:** Mention the benefits of the tool in box 3 (as many as possible)	▪ Participants have started to express clearly how they work from their mobile phones ▪ Participants have begun to clearly communicate the workings of the refrigerator from plugging in the power cord to storing food and others to keep it cool (cold) ▪ Participants have started to express clearly how the television works, from plugging in the power cord to the use of a remote control with a choice of television programs
3	**Engineering:** How do you work with the tools	▪ Participants have explained the basic functions of mobile phones, refrigerators and televisions ▪ Explanation of the benefits of selected products can be described by students simply so that readers can understand easily
4	**Math:** The size of the tool that you drew. Length = ... cm; Width = ... cm Height/High=..... cm. The area of one side is = .. The volume of the tool= .... Mention other size (such as voltage size, current)	▪ Participants generally can identify and determine the sizes of technological products ▪ Most participants are able to calculate the magnitude, but there are still many who greet in calculating the volume of volume ▪ A small number of participants who are able to read other major found in technology products

Table 2 shows that the participant's answers to the four STEM components are quite varied. In the science component, participants' explanations for technology products are still simple. Based on the results of the interview, information obtained from several variations of the answers. In general participants respond with simple sentences. The technology component, participants have begun to explain ways to turn on, use, and close product technology, such as television. Likewise in the engineering component, participants can explain the technical functions of a mobile phone, refrigerator, and television correctly. Whereas in the mathematic component, participants in general can identify and determine the measurements of technological products. Most participants are able to calculate the extent, but many still miscalculate the volume. A small number of participants are able to read other quantities / dimensions contained in technology products.

Based on the description in table 2, the quality of explanations for high school elementary school students is still low. The ability of students to communicate knowledge of technological products is still low (Tsai, C. W., Shen, P. D., & Lu, 2015). In addition to communication, students are also still weak in collaborating information on technology products. Information that is numerical (mathematical) cannot be understood and processed properly. In fact, to face the challenges of the 21st century, students must have technological literacy skills. In addition, someone needs to have mathematical literacy skills(Kettler, 2014). However, studies show the ability to operate mathematical equations is one of the difficulties experienced by students in elementary school. However, studies show the ability to operate mathematical equations is one of the difficulties experienced by students in elementary schoolsr (Ramirez, G et.al, 2016).

4. Conclusion

The challenge for students in basic education is the weak literacy skills of science technology engineering and math. This challenge is at the same time a challenge in facing the 21st century (Ronald W. Marx, 2006; Tang Wee Teo & Ke, 2014) Technological and mathematical literacy is programmed massively on the program of successful implementation of the current education curriculum. To perfect the findings of this study, it is necessary to study more deeply about the learning model that is literate towards science technology engineering and math. Strengthening contextual, cooperative learning and product technology involvement needs to be done in priority(Altun, 2017). This study recommends that educational institutions face the 21st century to develop integrated learning from the elementary school level.

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