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STEM literacy profile of junior high school students in Lampung Province, Indonesia

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Abstract: The 21st-century learning paradigm emphasizes the ability of students to think critically, be able to connect science with the real world, master information technology, communicate and collaborate so everyone must have critical thinking skills, knowledge and digital literacy skills, information literacy, media literacy, and master information technology and communication. This study aimed to describe the literacy profile of STEM (Science, Technology, Engineering, and Mathematics) on junior high school students in daily life. The study was conducted on junior high school students in Lampung Indonesia involving 167 students from 13 public and private schools. The method used in this study was a mixed-method with Sequential Explanatory Strategy. The research instrument used a questionnaire and interview guidelines. The results showed that junior high school students had used or implemented STEM (Science, Technology, Engineering, and Mathematics) in their daily lives even though sometimes they were not aware of it. The lack of practice in learning to use or apply the four STEM domains causes students to find it difficult to use or apply STEM in daily life. Therefore, the STEM approach needs to be maximized in learning especially science so that students can connect the knowledge obtained with reality in daily life.

1. Introduction

The 21st century learning paradigm emphasizes the ability of students to think critically, be able to connect science with the real world, master information technology, communicate and collaborate [1]. The 21st Century learning requires teachers to direct students to have creativity in dealing with problems of everyday life [2], [3]. In addition, to face learning in the 21st century, everyone must have critical thinking skills, knowledge, and digital literacy abilities, information literacy, media literacy and mastering information and communication technology [4].

Literacy is a means for students to recognize, understand, and apply the knowledge gained in school because the meaning and scope of literacy include: (a) literacy as a series of reading, writing, speaking, arithmetic skills, and skills in accessing and using information; (b) literacy as a social practice whose application is influenced by context; (c) literacy as a learning process with reading and writing activities as a medium for pondering, investigating, asking, and criticizing the knowledge and ideas learned, (d) literacy as a text that varies according to subject, genre, and level of language complexity [5].



The ability of digital literacy, information literacy, media literacy and mastering information and communication technology actually includes science, technology, engineering, and mathematics which is currently called STEM literacy (Science, Technology, Engineering, and Mathematics). STEM literacy refers to the ability of individuals to apply an understanding of how intense competition in the real world requires four interrelated domains namely Science, Technology, Engineering, and Mathematics [6]. STEM literacy is not intended to separate the STEM components independently, in its implementation it does not separate the components of Science, Technology, Engineering, and Mathematics [7]. Therefore, teachers can develop, apply, and support STEM literacy in classroom learning by paying attention to three aspects, namely: (1) Science, Technology, Engineering, Mathematics should not be seen as separate content. (2) Personal, social and economic needs. (3) The cognitive, affective / attitude, and psychomotor domains [8].

Science is a subject that is closely related to STEM literacy because in science there is science in finding concepts, there is technology in using tools, there is engineering in designing/making tools, and there is mathematics in formulating equations/calculations when completing the problem. The integration of STEM education in teaching and learning can be carried out at all levels of education, from elementary school to university because aspects of STEM implementation such as intelligence, creativity, and design ability do not depend on age [9]. Teaching and learning processes at the junior high school level that integrate STEM literacy will ultimately make students able to compete in the new economic era based on knowledge [10]. But in reality, science learning in junior high school has not optimally integrated STEM literacy so students have not been able to apply science, technology, engineering, and mathematics consciously in their daily lives. STEM has not received special attention and the unknown reality that occurred in teacher at Indonesia about the application of STEM-based teaching materials [11].

Based on this explanation, it is necessary to conduct research to determine the STEM literacy profile of junior high school students. The purpose of this study was to describe the STEM literacy profile, especially junior high school students in science subject in daily life. The results of the study can be used as a guide in choosing a model or strategy that is appropriate in the application of science learning at the junior high school level.

2. Research Method

This research used a mixed-method. The mixed-method strategy used was the Sequential Explanatory Strategy. The study was conducted in several junior high schools in Lampung with research subjects class VII, VIII, and IX consisting of 167 students. Data collection used questionnaire instruments through Google forms and interviews. A questionnaire was given to 162 students from 13 public and private junior high schools in Lampung province.

The questionnaire instruments given included: (1) I can utilize the concepts of science in everyday life, (2) I can utilize technology in daily life, (3) I can apply scientific and mathematical principles to design things in daily life, (4) I can use mathematics to solve problems in daily life, (5) I study science using the STEM (Science, Technology, Engineering, and Mathematics) approach, (6) Learning with STEM approach in accordance with the curriculum 2013, and (7) Learning with STEM approach in accordance with the demands of the 21st century. The alternative answers provided were, strongly disagree, disagree, agree, and strongly agree. The questionnaire results were analyzed quantitatively by calculation the percentage of each answer and presented in the form of tables and graphs, then interpreted according to table 1.

Table 1. STEM Literacy Interpretation

Interval (%)	Criteria
$75 < x \leq 100$	Always
$50 < x \leq 75$	Often
$25 < x \leq 50$	Seldom
$0 < x \leq 25$	Never

Interviews were conducted with 5 students with questions including (1) How do you utilize the concepts of science in daily life? (2) How do you use technology in daily life? (3) How do you apply the principles of knowledge to create a design in daily life?, (4) How do you use mathematics in daily life?, and (5) What constraints are experienced when utilizing or applying science, technology, engineering, and mathematics in daily life? The results of the interview were then analyzed qualitatively descriptively. Student codes that were interviewed by researchers as in table 2.

Table 2. Students interviewed code

Code	Class
IR	IX
SN	IX
ND	IX
EM	VIII
DT	VIII

3. Results and Discussion

The results of the detailed research related to STEM literacy of junior high school students in Lampung Province are as follows:

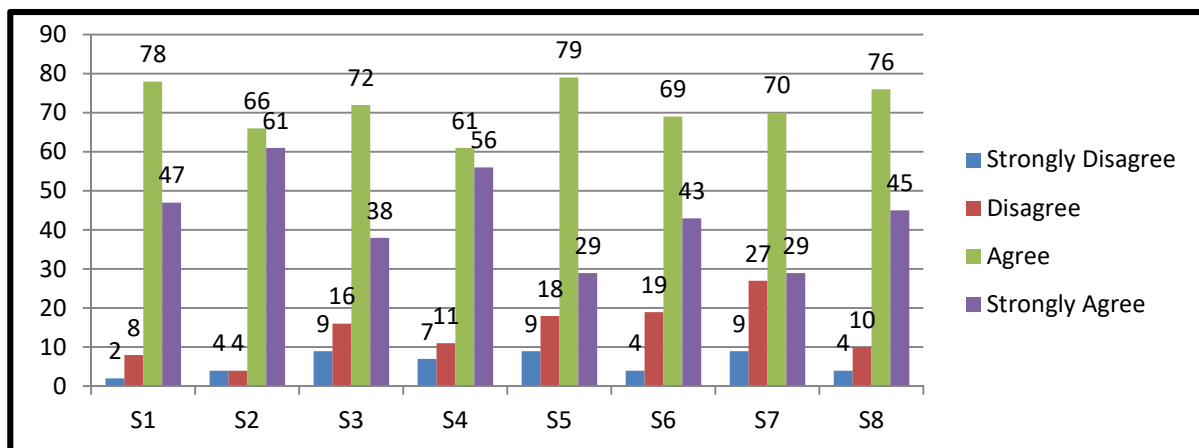
Table 3. Results of STEM Literacy Questionnaire on Students

No.	Statement	Strongly disagree	Disagree	Agree	Strongly Agree
1	I can utilize the concept of science in daily life.	2 1.48%	8 5.93%	78 57.78%	47 34.81%
2	I can use technology in daily life.	4 2.96%	4 2.96%	66 48.89%	61 45.19%
3	I can apply scientific and mathematical principles to design something in daily life.	9 6.67%	16 11.85%	72 53.33%	38 28.15%
4	I can use mathematics to solve problems in daily life.	7 5.19%	11 8.15%	61 45.19%	56 41.48%
5	I study science using the STEM (Science, Technology, Engineering, and Mathematics) approach.	9 6.67%	18 13.33%	79 58.52%	29 21.48%
6	Learning with the STEM approach in accordance with the 2013 curriculum.	4 2.96%	19 14.07%	69 51.11%	43 21.48%

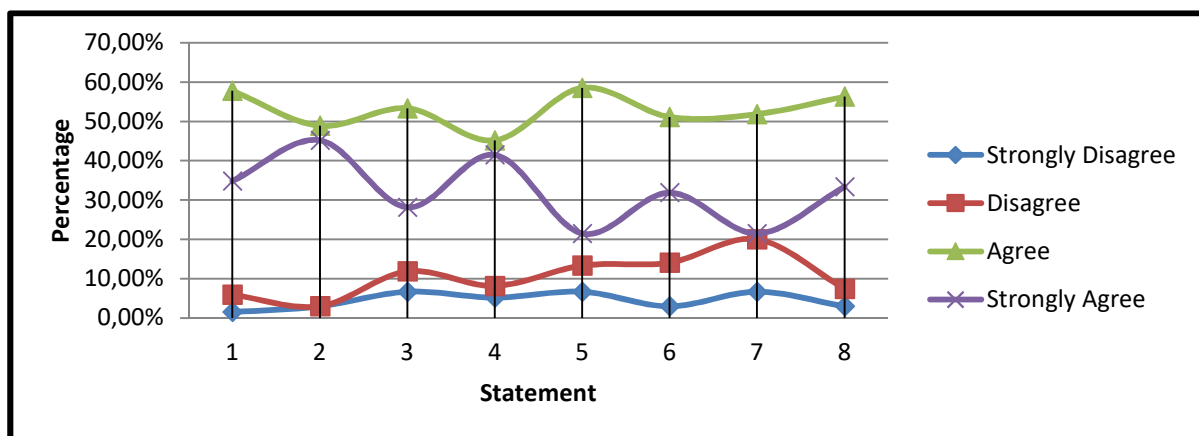
Continued from Table 3. Results of STEM Literacy Questionnaire on Students

No.	Statement	Strongly disagree	Disagree	Agree	Strongly Agree
7	Learning with the STEM approach in accordance with the demands of the 21st century.	9 6.67%	27 20.00%	70 51.85%	29 21.48%
8	In the 21st century, everyone must have critical thinking skills, digital literacy skills, information literacy, media literacy, and master information and communication technology.	4 2.96%	10 7.41%	76 56.30%	45 33.33%

Table 3 can be expressed in the form of bar and line graphs to make it easier to see the components of statement 1 (S1), statement 2 (S2), statement 3 (S3), statement 4 (S4), statement 5 (S5), statement 6 (S6), statement 7 (S7), and statement 8 (S8). The number of respondents "strongly disagree, disagree, agree, and strongly agree" can be seen from the high and low of bar charts, as in graph 1, while the tendency of respondents can be seen from the percentage of respondents as in graph 2 below.



Graph 1. Results of STEM Literacy Questionnaire on Students



Graph 2. Percentage results of STEM Literacy Questionnaire on Students

Based on graph 1, S1-S8 received a response of "agree" above 67 or above half of respondents except S2 and S4 got a response "agree" each of them got 66 and 61 respondents, but the response "strongly agree" both got 61 and 56 respondents more than others. This shows that junior high school students are able to utilize science, technology, engineering and mathematics in daily life, even for technology and mathematics more widely used by them. Responses of "strongly disagree and disagree" almost all got 20 respondents except S7 got 27 respondents. This means that most of them have used science, technology, engineering, and mathematics in their daily lives, while others have not understood the demands of the 21st century.

Based on graph 2, the percentage of "agree" was at the top followed by "strongly agree", "disagree", and "strongly disagree". This shows that junior high school students often use science, technology, engineering and mathematics in daily life and some of them always use it in daily life even though the percentage has not met the expected criteria. But there are some of them who rarely use or never use it in their daily lives. The highest percentage was on S5 which was 58.52% "agree" which shows the STEM approach is often used in science learning, followed by S1 of 57.78% "agree" which shows science is often utilized in everyday life. The percentage of "strongly agree" was high in S2 and S4, 45.19% and 41.48% respectively which shows that most of them always use technology and mathematics in daily life. The percentage of "disagree and strongly disagree" was high in S3, S5, and S7 which shows the application of engineering and STEM approaches in learning must continue to be developed so that they understand the needs of STEM in 21st-century life. In addition, to see trends STEM utilization in daily life can be shown in the following table 4.

Table 4. Mean Scores and Standard Deviations of Survey Items

No.	Statement	M	SD
1	I can utilize the concept of science in daily life.	3.26	0.63
2	I can use technology in daily life.	3.36	0.69
3	I can apply scientific and mathematical principles to design something in daily life.	3.03	0.82
4	I can use mathematics to solve problems in daily life.	3.23	0.81
5	I study science using the STEM (Science, Technology, Engineering, and Mathematics) approach.	2.95	0.79
6	Learning with the STEM approach in accordance with the 2013 curriculum.	3.12	0.75
7	Learning with the STEM approach in accordance with the demands of the 21st century.	2.88	0.82
8	In the 21st century, everyone must have critical thinking skills, digital literacy skills, information literacy, media literacy, and master information and communication technology.	3.20	0.70

Table 4 shows that there are almost all item with mean score higher than 3.00 (agree) and S3, S4, S7 are obtain a high standard deviations (0.82; 0.81; 0.82). This shows the tendency of junior high school students to use scientific and mathematical principles to design and mathematics to solve problems. They tend to be aware of the STEM learning approach according to the needs of the 21st century because everyone must have critical thinking skills, digital literacy skills, information literacy, media literacy, and master information and communication technology in the 21st century [4].

Table 3 and Table 4 are reinforced by student interviews. Field of science: students have used science in everyday life such as how to fertilize plants, make crafts, weigh, regularly at rest (IR, SN, ND), make lanterns, make flowers from marble paper, cook (EM, DT). Therefore students must be encouraged to create their own visual forms to represent their understanding of the underlying concepts [12]. Field of

technology: students have utilized technology such as cellphones, laptops, PCs, calculators (IR, SN, ND, EM, DT). The learning process based on the STEM approach students will need the types of tools and materials that can help students to carry out the investigation process related to solutions to real-world problems [13]. Engineering field: students have applied the principles of knowledge and mathematics such as designing signboards, miniature houses and cars, hats (IR, SN, ND), embroidering, making miniature houses (EM, DT). Engineering or designing can be a motivator as a natural way to learn how to integrate STEM concepts because real-world engineering problems are often complex and require the application of mathematics and science [14]. Field of mathematics: students have applied mathematics in everyday life such as counting money in shopping, distributing things, measuring bamboo for kites (IR, SN, ND, EM, DT). STEM is the use of science, technology, engineering, mathematics, and related practices, to create student-centered learning environments where students investigate and design solutions to problems, and build evidence-based explanations of real-world phenomena [14].

In addition, students also have obstacles or difficulties in applying science, technology, engineering, and mathematics because they do not understand the four domains in daily life even though they have indirectly utilized them. This is due to the lack of explanation and practice in learning. If STEM was seen as a potential practical solution for the development of the quality of future learning especially in 21st-century era, then the effort to combine STEM-based strategies into the learning process needs to be considered [15]. Therefore the STEM approach needs to be maximized in learning especially science so that students can connect the knowledge gained with reality in daily life because students receive an education with the STEM approach considered able to think logically and utilize technology independently to solve problems, innovate, and create [14].

4. Conclusion and Suggestion

Based on the results and discussion it can be concluded that junior high school students had been used or applied STEM (Science, Technology, Engineering, and Mathematics) in their daily lives even though sometimes they are not aware of it. The lack of practice in learning to apply the four STEM domains causes students difficulty to use or apply STEM in daily life. Therefore, the STEM approach needs to be maximized in learning especially science so that students can connect the knowledge obtained with reality in everyday life.

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