Mathematics learning based on multiple intelligences with scientific approaches: How are their roles in improving mathematical literacy skills?

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Abstract. Having mathematical literacy skills have become a necessity for the 21st century. This ability is important to support the increasingly complex ability to solve everyday mathematical problems. Mathematics teachers must be able to choose the right learning approach to improve students' mathematical literacy skills. The approach currently recommended is Scientific. However, not every child is intelligent in logical-mathematics. Therefore, the scientific approach needs to be implemented in the mathematics class based on the theory of multiple intelligences. This article discusses how mathematics learning based on multiple intelligence theories with a scientific approach can improve students' mathematical literacy skills. Through a study of several theories and supported by relevant research results it can be concluded that the combination of learning based on multiple intelligence theories and scientific approaches has the potential to improve students' mathematical literacy skills.

1. Introduction
Mathematics is one of the subjects with universal science that is useful for human life and also underlies the development of modern technology and has an important role in various disciplines and advancing human thinking [1]. Mathematics has a close relationship with everyday life. When students involve mathematics in the real world can develop knowledge, understanding, and skills, and reflect the characteristics of mathematics [2]. One of the mathematical abilities that apply mathematical knowledge in a variety of problems and contexts is the ability of mathematical literacy. In this globalization era, mathematical literacy skills can help students to solve problems around them with mathematics [3]. The ability of mathematical literacy is currently important and in the field is still a problem. Research on mathematical literacy has been widely carried out. As has been defined by PISA, mathematical literacy is the ability of individuals to formulate, use, and interpret mathematics in various contexts. This includes communication, mathematical, representation, reasoning, and argument, designing strategies to solve problems, the use of symbols, formal language, technical, and operations, the use of mathematical tools [4].

Active and effective learning needs to be designed so that it can help students improve their mathematical literacy abilities. Since the entry into force of the 2013 curriculum the recommended learning approach is scientific. In a scientific approach, the teacher facilitates students to produce, test, accept or reject scientific statements and theories with students actively building their knowledge [5]. The scientific approach is one of the approaches in the learning process which consists of five main learning experiences namely, observing, asking questions, gathering information, associating, and
communicating [6]. The scientific approach is also a learning process created to enable students to develop concepts, laws or principles through the stages of observing, formulating problems, proposing or formulating hypotheses, collecting data with different techniques, processing data, making conclusions and communicating concepts, laws, or principle found [7].

Research on the scientific approach has been done a lot, but there is one aspect that must be considered by teachers, namely the diversity of students. Related to the diversity of these students, Gardner has emphasized that each individual has a combination of nine intelligences which are summarized in multiple intelligences. Gardner defines savagery as the ability to solve a problem, create a product of cultural value, and divide intelligence into nine multiple intelligences, namely extension, linguistic, spatial, logical, kinesthetic, musical, naturalist, interpersonal and intrapersonal [8].

2. Method

Literature review can be a combination of literature, then arranged into a series of topics related to each other, and summarized by highlighting the main problems [9]. This article is a literature review that can provide information or theoretical feedback on learning approaches that have the potential to improve mathematical literacy skills. The data in this article was collected in the form of literature obtained from several relevant research results, related scientific journals, and educational books published in 1983-2019. A literature search is performed using web site searches such as Elsevier, Researchgate, Springerlink, and Google Scholar by entering the keywords "multiple intelligences", "scientific approach", and "mathematical literacy skills".

3. Result and Discussion

3.1 Scientific Approach

A scientific approach is a approach that is often used by scientists to analyze problems and find solutions scientifically [10]. The scientific approach seems to be an important part of science in a system to find out whether or not an opinion/answer is useful in life now and in the future [11]. The scientific approach also emphasizes scientific reasoning as an explicit argument which becomes an exercise in evaluating that reasoning [12]. The scientific approach used in the 2013 curriculum currently basically refers to the scientific method used by scientists in studying a scientific problem. Characteristics of a scientific approach that is student-centered learning involves science thinking process skills in constructing concepts, laws, and principles, involves potential cognitive processes in stimulating intellectual development, especially students higher-order thinking skills, and can develop students character [13].

The steps of the scientific approach are derived from the standard processes in the 2013 Curriculum, which are 5 steps including observing, asking, gathering information, reasoning, and communicating [14]. For more details, the steps of the scientific approach in the 2013 Curriculum supported by several experts will be explained as follows [6]: (1) observing, in learning activities students observe objects to be learned by reading, listening, seeing (without or with tools), (2) asking students after making observations to find out information that is not understood or to obtain additional information, (3) gathering information, through this activity students explore and gather information through various sources so students can read books or conduct experiments in order to gather a number of information, (4) reasoning (associating) can be said as a logical and systematic thought process of facts that can be observed to obtain conclusions in the form of knowledge, (5) communicating, in this activity students are given the opportunity to communicating what they have learned.

3.2 Multiple Intelligences

Multiple Intelligences is the development of intellectual intelligence, emotional intelligence, and spiritual intelligence. Indeed multiple intelligences are present in each individual, but each individual will have one or more multiple intelligences that have the highest level of multiple intelligences.
Multiple intelligences theory aims to transform schools so that later schools can accommodate each student with various kinds of intelligence possessed by students. There are 9 (nine) kinds of intelligence that were conceived by Gardner, namely [8]:

Table 1. Howard Gardner’s Multiple Intelligences

| Multiple Intelligences       | Description                                                                                                                                 |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Verbal-linguistic intelligence | The ability to use language to describe events, build trust and closeness, develop logical and rhetorical arguments, or express expressions and metaphors. |
| Logical-mathematical intelligence | The ability of individuals to process numbers appropriately and accurately, reasonably well. Including sensitivity to patterns and logical relationships, can declare a causal relationship. |
| Musical intelligence         | The ability to develop, express, and enjoy musical forms and sounds, such as sensitivity to rhythm, melody, and notation, the ability to play an instrument, the ability to sing and compose songs, music, and singing. |
| Spatial intelligence         | The ability to recognize spatial patterns accurately, interpret graphic and spatial ideas and translate spatial patterns appropriately.              |
| Body-kinesthetic intelligence | The ability of individuals to use the whole body to express ideas and feelings and the agility in using one's hands to create or change things.        |
| Intrapersonal intelligence    | The ability to assess the strengths or weaknesses, talents, self-interest and use it to set goals, develop and develop concepts and theories based on self-examination, understand feelings, intuition, temperament, and use them to express personal views. |
| Interpersonal intelligence    | The ability to organize others and communicate what needs to be done, empathize with others, differentiate and interpret various types of communication with others, and understand the intentions, desires, and motivations of others. |
| Naturalistic intelligence     | The ability to recognize and classify and describe various features that exist in the environment.                                             |
| Existential intelligence      | The ability of individuals to answer questions about human existence.                                                                           |

3.3 Mathematical Literacy Ability

Mathematical literacy is the ability to formulate, use, interpret, and understand how the benefits of mathematics in various contexts of everyday life problems efficiently in decision making [15]. The process refers to mathematical skills such as problem-solving, mathematical reasoning, argumentation, and communication; in this case, refers to the context that we often find in our daily lives [16]. Mathematical literacy is displayed through uses that involve the role of mathematics by making judgments based on knowledge and understanding of the importance of the use of mathematics in the necessities of life [17]. Mathematical literacy is also an effort to solve problems from various contexts. Mathematical literacy is the ability to solve problems in context [18]. The context in question is a state-related to real life. Thus, mathematical literacy emphasizes the problems of the real world context [19]. Mathematical literacy is the ability to solve problems of everyday life by formulating, using and interpreting mathematics in various contexts of solving problems in everyday life effectively [20].

The ability of mathematical literacy in the 2012 PISA assessment was analyzed in three correlated domains, namely process, context, and content [4].
Table 2. PISA Mathematics Assessment Categories

| Content Domain          | Context Domain | Process Domain |
|-------------------------|----------------|----------------|
| Change & Relationship   | Personal       | Formulating    |
| Space & Shape           | Occupational   | Employing      |
| Quantity                | Societal       | Interpreting   |
| Uncertainty & Data      | Scientific     |                |

3.4 The Role of Learning Mathematics based on Multiple Intelligences with Scientific Approaches in Improving Students’ Math Literacy Ability

Scientific Approach is an implementation of learning that has been widely used as research material or used to be applied in the learning process at school, but in scientific approach combined with a multiple intelligences it is quite interesting to study, seeing that teachers need to pay attention to the characteristics and intelligence of students in learning.

Mathematical literacy has three process indicators, namely formulating, employing, and interpreting [4]. The stages of learning with a scientific approach based on multiple intelligences can have the potential to improve students' mathematical literacy abilities. Students can observe phenomena in various forms according to the combination of intelligence possessed by students and can gather information in heterogeneous groups. At this stage, students can recognize, identify, and form mathematical structures of aspects of real-world context problems in a variety of ways.

At the stage of processing the information that has been collected by the intelligence of the students and then submit conclusions in oral form, diagrams, or other media, students do the employing and interpreting process. Students can apply concepts, facts, mathematical procedures and provide reasons for obtaining conclusions. Students can also reflect on solutions to interpret the results of discussions or opinions into the context of real problems in a variety of ways, according to the combination of intelligence they have. Gouws [21] states that by caring about students' intelligence, it is the same as creating opportunities for students and encouraging them to think about making the learning process better and conducting assessments in different ways, namely in terms of meeting the needs of various student intelligence.

Research conducted by [22] concluded that the multiple intelligences approach in problem-based learning is effective in terms of student achievement, connection skills and self-esteem. Furthermore, the results of research conducted by [23] showed that there was an increase in students' ability to understand concepts and self-confidence in learning mathematics based on Multiple Intelligences. Research conducted by [24] also shows the same results that problem-based learning with multiple intelligences approaches can improve the ability to understand concepts and the ability to think creatively.

Based on the research results described above, the application of learning with a multiple intelligences-based scientific approach has the potential to improve mathematical literacy. More clearly, the link between learning with a scientific approach based on multiple intelligences with mathematical literacy ability is explained in the illustration below.
4. Conclusions
Based on the results and discussion above, mathematics learning based on multiple intelligences with a scientific approach can improve mathematical literacy skills. In the step of observing phenomena in various forms and formulate questions, it has the potential to increase the ability to formulate and interpret. Furthermore, at the step of gathering information in diverse ways and heterogeneous groups, it has the potential to increase the ability to formulate. And in the step of processing information that has been collected by the intelligences possessed and delivering conclusions in oral form, diagrams or other media, has the potential to increase the ability in employing and interpreting. And based on the results of research conducted by [25] said that the mathematical literacy ability of students who get learning with a scientific approach is higher than students who get learning with conventional approaches. This is because the scientific approach to learning activities is applicable so that it can apply mathematical concepts in real problems.

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