Mathematical literacy: How to improve it using contextual teaching and learning method?

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Abstract. Having mathematical literacy is defined as the ability of an individual to formulate, apply, and interpret mathematics in various contexts. Mathematical literacy enables the student to do, understand, and apply mathematical concepts not only in the classroom but also in daily life. However, in reality, the mathematical literacy abilities of Indonesian students from the results of the assessment of mathematical rankings internationally can be said to be less satisfying compared to the other countries. Therefore, a learning method that can be used as a solution to improve students' mathematical literacy abilities is needed. Contextual teaching and learning is a method that helps teachers to connect students with the real world. By applying the contextual teaching and learning, the teacher could possibly help students to improve their mathematical literacy. By theoretical study, this article attempts to describe some contextual teaching and learning components to improve students' mathematical literacy. It was found that the literature supports that there were connections between the learning steps and the components of contextual teaching and learning with some indicators on mathematical literacy.

1. Introduction
In the 21st century, learning requires students to have knowledge, thoughts, abilities, and skills in the field of media, technology, and information. Media and information technology has an important role in supporting the acceleration of increased knowledge. Trilling and Fadel [1] also said that 21st century skills focus on critical, analytical and innovative thinking skills. This is appropriate with what is explained by the Ministry of Education and Culture that based on the public’s view, learning in 21st century is learning that emphasizes the ability of students to gather multiple sources, formulate problems, think analytically, and cooperate in solving problems [2]. Therefore, with education, the student is expected to have the ability to think creatively and analytically, skilled, flexible and innovative to be successful in work and everyday life.

This ability can be developed through mathematics. In school’s learning, mathematics is one of the subjects that is still considered as difficult for students, this is following several research results that show the process of learning mathematics in schools still does not provide satisfactory results, both physical and psychological results. Ganal and Guiab [3] said that the results of mathematics subjects were unsatisfactory. This is due to the attitude of students towards mathematics, especially the negative
attitude. One of the negative attitudes of students towards mathematics is that they assume mathematics has no benefit for students' daily lives. This attitude can make students confidence in working on math problems to be reduced so that it causes poor performance for students.

In addition, Nurzaili [4] said that students in his research class had problems in terms of basic mathematical concepts, lack of involvement of people around students in helping students to realize the benefits of mathematics in daily life, and the learning methods applied in class were not appropriate, so these things cause the results of student achievement in mathematics are still unsatisfactory. Some of the opinions above state that it is important to improve positive results from students regarding mathematics. Mathematics is expected not only to equip students with the ability to count or apply formulas to work on test questions but also to implicate their reasoning skills and analytical skills in solving daily problems. This is following the opinion of NCTM (National Council of Teaching Mathematics) that makes problem-solving, reasoning and proofing, communication and presentation as standard processes in learning mathematics [5].

Problem-solving skills in solving everyday mathematical problems can be developed through several learning methods. Learning methods that are suitable and can support the objectives of daily mathematics learning is contextual teaching and learning (CTL). According to Berns and Ericson [6], CTL is a learning method that helps teachers to make a connection between learning the material and the real world. This method motivates students to arrange their own understanding of the connections between knowledge and its application in everyday lives as family members, citizens, and workers. Also, according to Regulation of the Minister of Education and Culture of the Republic of Indonesia No. 22 The year 2016 concerning Content Standards for Elementary and Secondary Education, contextual teaching and learning are compulsory for mathematics teachers starting from elementary school to high school [7]. In other words, CTL is a learning method that facilitates teachers to connect students with subjects.

Mathematics is one of the subjects that are needed by society today. The needs of people in this globalization era are not only able to understand science but are also able to process and utilize knowledge and knowledge that exists in everyday life. The ability to process and utilize knowledge in daily life is called literacy [8], [9]. The ability of literacy that focuses on everything related to mathematics is called mathematical literacy. In the Program for International Student Assessment (PISA) [10], mathematical literacy is the capacity of an individual to formulate, use, and interpret mathematics in a variety of problem contexts. Mathematical literacy guides students to acknowledge the role of mathematics in life and makes good decision-making and judgments needed by people who are constructive, and reflective. According to NCTM [11], mathematical literacy is an important part of mathematics education. Furthermore, Ojose [9] said that someone who has good mathematical literacy ability also has the sensitivity to mathematical concepts that are appropriate to the problem.

Based on some concrete data that already exists, mathematical literacy skills need to be possessed by each student to solve problems in everyday life. However, the quality of education in Indonesia, especially in terms of literacy is still considered as low. This could be seen from the results of several surveys conducted by Trends in International Mathematics and Science Study (TIMSS) and PISA. In addition to TIMSS and PISA, the Indonesian Student Competency Assessment (AKSI) for the Elementary School-High School Level in 2017 also stated that the ability to read literacy, scientific literacy and student mathematics literacy is still low. Based on the three fields measured, mathematical literacy occupies the lowest position while reading literacy occupies the highest position.

2. Method
This article using a literature review method about knowledge, ideas, or findings contained in the literature. So that it can provide theoretical and scientific information related to CTL methods to improve mathematical literacy. Data were collected and analyzed in the form of literature learning mathematical literacy and the CTL method. In this article, we will exemplify some steps in CTL that can improve indicators in mathematical literacy. Data is obtained from scientific journals and some author experiences. Data were analyzed throughout several steps. First, reducing existing data and chooses ideas about the use of CTL methods to improve mathematical literacy. In the second step, the author identified the steps of
3. Discussion

3.1. Contextual Teaching and Learning

According to Sears [12], CTL is a learning method that helps teachers to make a relation between existing subjects and real-world situations. CTL can motivate students to lead or take over their own learning and to make relations between knowledge and its application in diverse contexts in their daily life. According to the Ministry of National Education in Indonesia [13], contextual learning is a learning method that helps teachers to connect the material that has been taught with phenomena or concepts that encourage students to connect knowledge possessed with its application in everyday life. In addition, Johnson [14] states CTL is a learning process that utilized to assist students in seeing the meaning of a subject academically about matters relating to their daily life be it personal, social, or cultural circumstances.

Learning is said to be contextual learning if the learning contains components in contextual learning. According to the Ministry of National Education in Indonesia [14], contextual learning has several components, including constructivism, inquiry, asking questions, discovering, learning communities or group study, modeling, and actual assessment. The same thing also conveyed by Johnson [15], that contextual learning has seven components are, 1) constructivism; 2) inquiry; 3) questioning; 4) learning community; 5) modeling; 6) reflection; 7) authentic assessment. Based on the description above it can be concluded that contextual learning has seven components: constructivism, asking questions, discovering, learning communities, modeling, reflection, and actual assessment. These components will be the basis for implementing the contextual learning method in the classroom.

Sears [12] said that there are several learning methods used in contextual learning in general. These learning steps include, 1) connecting learning with students' lives; 2) group learning; 3) learning in various contexts. Meanwhile, the steps of contextual learning according to the Ministry of National Education in Indonesia [13] are as follows, 1) Developing children's thinking that learning is more meaningful can be done by finding and discovering themselves, and constructing new knowledge and skills themselves; 2) Carry out the discovery activities as far as possible; 3) Develop the nature or curiosity of students by asking questions; 4) Create learning communities or study groups; 5) Present "models" as examples in learning; 6) Reflect at the end of each learning meeting; and 7) Perform actual assessments during the learning process. Crawford [15] also suggested learning strategies used in contextual learning are: 1) relating; 2) experiencing; 3) applying; 4) cooperating or study group; and 5) transferring (REACT). These steps certainly have relevance to the components that exist in mathematics literacy skills.

From several studies that have been carried out, we conclude that the learning strategies used in contextual learning are the steps or learning strategies from Crawford [15] that we have mentioned before. According to CORD (Center for Occupational Research and Development) in the United States, the REACT strategy is one of the strategies that can be used in using contextual models in which learning does not only prioritize linkages with experience or real-life but also prioritizes the interrelationships between concepts outside of the scientific discipline.

3.2. Mathematical Literacy

According to PISA, mathematical literacy has a meaning as an individual's capacity to formulate, use, and interpret mathematics in many kinds of contexts. This includes uses procedures, concepts, facts, and mathematical tools to explain, describe, and predict phenomena [10]. This can lead students to recognize the role of mathematics in daily lives, both in making judgments and in decision making. Steen & Turner [8] also explained that mathematical literacy is the ability to use mathematical knowledge and understanding in facing the challenges of everyday life effectively. In other words, someone who has contexts mathematical literacy skills is not enough to just utilize his mathematical knowledge and understanding, but also be able to use it effectively in daily lives. Thus, a person with a mastery of
mathematical literacy can reflect his mathematical logic to play a role in his life, community, and society effectively.

Ojose [9] said that someone who has good mathematical literacy also has the sensitivity in mathematical concepts that are appropriate to the problem. Also, someone who has good mathematical literacy will be able to guess, interpret data, reason, solve everyday problems, and communicate them with mathematics. Stacey and Turner [16] state that one part of good mathematical literacy is that one can produce in-depth solutions about a complex problem as long as the thought arises from a realistic context. Then if the problem is solved seriously students describe, explain and predict everything about the context.

According to De Lange [17], the ability of mathematical literacy is not only limited to arithmetic aspects of mathematics, but more broadly, namely the spatial, numerical, and quantitative abilities. There are four objects that are important in mathematical literacy, namely space, form, quantity, change, relationships, and uncertainty. The four objects are then grouped again into three important abilities, namely spatial literacy, numerical literacy, and quantitative literacy.

There are seven indicators of mathematical literacy ability that students need to have [18]. These indicators include, 1) communication, in this case, students are able to understand a problem such as reading, translating, and interpreting a statement so that solutions can be presented and presented appropriately; 2) mathematical, students are able to draw up, make mathematical concepts and conjectures, formulate mathematical models, and solve problems using mathematical solutions; 3) representation, students are able to represent mathematical objects and situations by involving interpretation and translation using various forms of representation such as graphs, tables, pictures, etc. so that problems are more easily understood; 4) reasoning and argument, students are able to involve or use logical processes to reason and argue in exploring a problem in order to draw a conclusion or look for the truth of a statement; 5) develop strategies to solve problems; 6) using symbols, students are able to use their understanding to interpret, manipulate, and utilize symbolic expressions by understanding definitions, rules, and algorithms; 7) using mathematical tools, students are able to utilize mathematical tools in the process of solving mathematical problems.

3.3. The relations between contextual teaching and learning and mathematical literation.

CTL is a learning strategy that helps teachers to connect existing subjects with real-world situations [12]. This learning strategy emphasizes the full involvement of students in learning to relate the material to everyday life as well as learning strategies that encourage students to be able to use concepts in their daily lives. In CTL strategies, the problems raised by teachers are real, logical, and interesting world problems, so students are trained to solve contextual problems that require students' creative and critical thinking abilities. On the other hand, the questions given by PISA are contextual. There are three domain aspects that must be present in the matter of mathematical literacy abilities, the three aspects are process, content, and context [19]. Aspects of the process are the process carried out by individuals in solving problems related to mathematics. The content aspect is the type of content targeted for use in assessment, for example, space and shape, data, measurement, etc. The context aspects are the context of the real problems used in the problem, for example, work, scientific, social, etc. These three aspects are aspects that must be present in the questions used to measure students' mathematical literacy abilities.

At each stage of the CTL method, students are encouraged to develop mathematical critical thinking skills starting from aspects of making assumptions, making conclusions, making deductions, interpretations, and evaluating the arguments that have been presented. All aspects of critical thinking are done both when solving mathematical problems and the discussion process is ongoing. This absolutely will have a positive influence on indicators of students' mathematical literacy abilities. This is in accordance with a research by Sulianto [20] that the components of contextual learning and learning steps in it are able to improve students' critical and creative thinking skills. The ability to think critically itself has eight descriptions that can also be called critical thinking. These capabilities include the ability to test, connect, evaluate all aspects of a problem, focus on one problem situation, collect and organize information, validate and analyze information, reason or not make sense of an answer or information.
draw valid conclusions, and has good analytical and reflexive skills [18]. This ability will later become part of every step of contextual learning.

The steps of contextual learning certainly have relevance to the components that exist in mathematics literacy skills. Before going to the steps of contextual learning, there are important strategies that the teacher must use during learning. This strategy is commonly referred to as Relating, Experiencing, Applying, Cooperating, and Transferring (REACT). In addition, according to Crawford [15], REACT is an acronym that represents methods used by the best teachers and also methods supported by research on how people learn best. Crawford also explained that the REACT strategy had an influence on student motivation and student learning outcomes in mathematics and science. Crawford [15] suggested the understanding of each strategy as following.

1. Relating is the process of linking learning with the context in which a person lives and connecting the context with prior knowledge. In this strategy, the teacher provides material related to students' daily lives.
2. Experiencing is learning based on students' knowledge and experience which is then brought into the classroom. This learning is usually done by learning by doing. So at this stage, students are given exercises so that students are accustomed to solving problems using the knowledge they have.
3. Applying is learning done using concepts to do. At this stage, students apply concepts in problem-solving activities. On the other hand, the teacher motivates by providing logic and relevant exercises.
4. Cooperating is a situation where students work in a group through discussion activities, expressing opinions, and communicating with each other. In this activity, the teacher forms an effective group and then prepares relevant tasks, observes them well and provides the information needed by students.
5. Transferring is the use of knowledge in new contexts or situations. At this stage, students are given the context of a problem or a new situation to be solved.

Based on the opinion above, it can be concluded that the steps of CTL can be known from the REACT learning strategy. In the first step, the teacher provides material related to students' daily lives. It aims to develop or construct student knowledge. This step entered into the component of constructivism. This component has a relationship with the mathematics literacy component in the part determining the problem-solving strategy. This is consistent with what was stated by Suprijono [21] that constructivism requires the ability to remember and express experiences, the ability to compare, the ability to make decisions and the ability to like one from another. The statement implies that there is a strong connection or influence from providing material related to students' daily lives to the ability to make decisions in determining a problem-solving strategy.

The second step is that students are given exercises to make students accustomed to solving problems using the knowledge they have. This activity is included in the Inquiry component. The stages of inquiry include formulating or identifying problems, observing, presenting, and communicating. Learning by using the inquiry method will also provide a real and active experience for students [19]. With inquiry, students will be able to take their own initiative, are trained in how to link and connect material in mathematics, solve problems, make decisions and acquire various skills. Therefore, the components and steps of inquiry have a strong influence on the mathematical process, determining problem-solving strategies, using symbols and using tools during the mathematical problem-solving process.

In the third step, students apply concepts in problem-solving activities and motivate teachers by providing realistic and relevant exercises. In this step, also included in the inquiry component as with the second step. By providing realistic and relevant exercises, students will be able to identify problems, observe, present, and communicate the answers to the problems given. According to Tsivitanidou et al. [19], students who are accustomed to being given training will also be accustomed to planning, managing, and conducting investigations to get evidence of the problem. So this step influences the process of mathematization, determining problem-solving strategies, using symbols and using tools during the mathematical problem-solving process. In addition to the inquiry component, this step is included in the
modeling component of contextual learning. Modeling in this context is a learning process by
demonstrating something relevant as an example emulated by students. By providing models or examples
of concepts to students, it can indirectly develop the ability of representation and the ability to use tools to
solve mathematical problems.

In the fourth step, the teacher forms an effective group then prepares relevant assignments, observes
well and provides the information needed by students. This step can develop students' curiosity by asking
questions. The step is included in the third component of contextual learning, namely questioning. Asking
questions is one component of contextual learning that can improve students' communication skills and
mathematical reasoning. This is consistent with research conducted by Bernard [22] which states that
asking questions and students' curiosity can improve students' communication skills and mathematical
reasoning which are indicators of mathematical literacy abilities.

In addition, this step is also included in the learning community component with group discussions.
This step is included in the contextual learning component, namely the learning community that has the
potential to improve communication indicators and student mathematical punishment. The community
learns students to conduct group discussions to improve students' communication and reasoning skills.

In the fifth step, students are given the context of the problem or new situation to be solved. This step
is included in the modeling component. In this step, students return to solve mathematical problems,
where the problem is given is a new problem where the knowledge to solve the problem has been given in
the previous steps. In addition to solving new problems, in this step students are asked to convey any
concepts or material obtained by students during learning and show or demonstrate the results of student
activities, which indirectly train students' communication and reasoning skills.

Based on some of the research results outlined above, the application of contextual learning has the
potential to improve mathematical literacy because contextual learning and mathematical literacy have a
lot of connections between the steps and components of learning with indicators of mathematical literacy
abilities. The following is an illustration of the relationship between the steps of CTL and mathematical
literacy.

![Contextual Teaching and Learning (REACT) vs. Mathematical Literacy Skills](image)

**Figure 1.** Illustration of the relationship between the steps of CTL and mathematical literacy

Based on the illustration above, CTL can be used to improve mathematical literacy. The strategies
that can be used are, 1) the teacher provides material related to students' daily lives; 2) students are given
exercises so that students are accustomed to solving problems using the knowledge they have; 3) students apply concepts in problem-solving activities. On the other hand, the teacher motivates by providing realistic and relevant exercises; 4) the teacher forms an effective group and then prepares relevant tasks, observes them well and provides the information needed by students; 5) students are given the context of a problem or a new situation to be solved.

4. Conclusions

Based on the study described above, in theory, contextual learning can improve students' mathematical literacy. This can be known from studies explaining that there are connections and effects between the learning steps and contextual learning components with indicators on mathematical literacy. The conclusion of the discussion of the relationship of contextual learning and mathematical literacy are, 1) Relating steps can improve mathematical literacy in the Apply section; 2) Experiencing steps can improve mathematical literacy capabilities in the Formulate and Apply sections; 3) Applying steps can improve mathematical literacy in the Formulate, Apply and Interpret sections; 4) Cooperating steps can improve mathematical literacy in the Apply and Interpret sections; and 5) Transfering steps can improve mathematical literacy to Formulate, Apply and Interpret sections.

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