Mathematical problem-solving ability using flipping classroom with relating, experiencing, applying, cooperating, and transferring learning strategy

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Abstract. Problem-solving is one of the abilities that elementary school students must possess. Students' mathematical problem-solving skills are still low will affect the ability to solve everyday problems. This study examines the theoretical framework of the flipped classroom learning model with the REACT strategy to improve mathematical problem-solving in elementary school students. The method used in this research is a literature study. Data is collected from articles published in various scientific journals and other related sources. The results showed that to improve students' mathematical problem solving can be done through the teaching of mathematics learning for students. The flipped classroom learning model with the REACT strategy is an innovation that uses a learning approach by utilizing technological developments with the concept of learning carried out in pre-class, in-class, and after-class so that learning is student-centered, more flexible, collaborative, active, and meaningful.

1. Introduction
Education is the foundation of development progress in the future. Education can develop students' potential. Students can apply what is learned in school to deal with problems that will be faced in their daily lives in the present or future [1]. The role of education in welcoming the arrival of the ASEAN single market is actually to prepare skilled, sensitive, and critical resources [2]. Next, they explained that this ability was integrated through problem-solving in mathematics learning activities in schools. Mathematics has an important role in the world of education and with problems of everyday life [3]. Mathematics has a big role in developing human thought [4]. Phonapichat [4] also states that mathematics can bring strategic and systematic thought processes that are useful in problem-solving abilities.

According to students mathematics is difficult, boring, not interesting, and does not appear to be related to everyday life [5]. Also, students have students' problem-solving problems including identifying problems, setting goals, finding alternative solutions, and evaluating the results of resolution [6]. The decrease in student enthusiasm for learning mathematics in class also affects students' problem-solving abilities. There are still many students who consider mathematics to be a frightening lesson and to solve mathematical problems becomes difficult [7].

Students can use mathematics and mathematical thinking patterns in everyday life [8]. Mathematics really needs to be studied because mathematics is a tool for clear and logical thinking, a tool for solving daily problems, a means of recognizing patterns of relationships and generalizing experiences,
a means of developing creativity, and a means of raising awareness of cultural development [6]. In line with the general objectives of learning mathematics formulated by the National Council of Mathematics, namely: 1) mathematical communication, 2) mathematical reasoning, 3) mathematical problem solving, 4) mathematical connection and, 5) positive attitudes toward mathematics [9].

The ability to solve problems is very important in solving everyday problems. In this article, we will discuss developing a flipped classroom learning model that is integrated with REACT to improve problem-solving skills.

2. Methods

Data in the articles were collected using the literature review method. A literature review can be in the form of combining literature, setting them up into a series of interrelated topics, and summarizing them by showing the central issues. In this article, the literature review method aims to collect all relevant information from written documents such as journals and books published in 2010-2020. Documents are tracked by websites such as google scholar, eric journal, and ScienceDirect. This reviewed articles and books on the keywords "mathematical problem solving" and "REACT strategies.

3. Results and discussion

3.1. Mathematical problem-solving

The ability to solve mathematical problems is one of higher-order thinking skills. Problem-solving is the interaction between knowledge and error that uses the process of applying cognitive and affective factors in problem-solving [10]. Student mistakes in solving problems are concept errors, operating errors, and careless mistakes [9]. Kastolan mentioned that errors in mathematics are divided into 3 types, namely conceptual errors, procedural errors, and technical errors [11].

Problem-solving is also a very important part of learning mathematics, it is because problem-solving is a means to hone careful, logical, critical, analytical, and creative reasoning [12]. Problem-solving is not simply a process that ends when an answer is found. It is a scientific process that evolves from understanding the problem of evaluating the solution [13]. Through mathematical problem solving, it is hoped that students will be more analytical and creative in solving a problem in their lives.

The characteristics of problem-solving: 1) starting with a problem that is not routine, 2) has a different solution, 3) to be able to solve a problem someone must have a lot of experience. Problem-solving can also make someone able to evaluate [13]. The same article also said how to choose to learn with problem-solving has characteristics: 1) applying the understanding of knowledge in life, 2) choosing problems related to real situations in life, 3) developing scientific traits such as honesty, conscientious, open, professional and hard work.

Associated to solve problems in learning mathematics has been stated by several experts, among others, developing students' thinking skills, developing the ability to determine in using problem-solving strategies, develop attitudes and beliefs in solving problems, develop students' ability to solve problems in a cooperative learning environment and develop students' ability to find correct answers to various problems [14].

There are four main stages in the process of solving mathematical problems: 1) understanding the problem, 2) determining the problem understanding strategy plan, 3) implementing the problem-solving plan, 4) re-checking the answers obtained [12][15].

In several studies, including Lidinillah discussed that problem solving is considered difficult to teach and learn so that Lidinillah only presents a discussion of problem-solving learning strategies in elementary schools based on several experts [16]. Apply the learning model of Multi Representation Discourse (DMR) which is part of cooperative learning to condition learning in groups. But in this DMR model, the role of the teacher is not seen, and it seems that the activity only crosses students, the teacher seems to be passive [17]. To improve the problem-solving ability of mathematics learning with generative learning models that make students more active in learning and easy to remember the
subject matter [18]. In this generative learning model, there are times when the teacher acts as an encouragement, direction, motivation; there are times when a teacher becomes a facilitator. This Generative learning model applies its learning through four stages of exploration, focusing, challenges, and application.

3.2. Flipped classroom

The term flipped classroom is more about reversing the process of learning activities. Flipped Classroom is a model wherein the learning process, students are given the subject matter and learn it at home, of course, before the class starts, while teaching and learning activities in class are in the form of assignments, discussion of material or problems that have not been understood [19]. In line with the previous opinion that flipped classroom is the latest modern teaching method, which is reversing traditional classes. In a traditional classroom learning is initially carried out in the classroom and assignments at home. Student can complete their learning before learning in the classroom, whereas in later classes students learn to master and absorb knowledge in the classroom [20]

Flipped classroom learning is usually marked by changes in usage inside and outside the classroom [21]. Time activities in the classroom that are traditionally considered homework, activities outside the classroom that are traditionally considered in-class, activities in the classroom that emphasizes active learning and peer learning, pre, and post-class activities, and the use of technology [22].

A flipped classroom is a reform in learning. A flipped classroom is a change in the use of time in the classroom and outside the classroom. Changes in learning not only in the classroom but outside the classroom are facilitated by advances in educational technology such as e-learning [21]. Teachers can now provide subject matter before class meetings via video [23]. Changes to the Facility can be used in flipped classrooms by loading teaching material in the form of learning videos into the LMS framework. Students can learn and combine knowledge learned through the internet. This flipped classroom model is not just learning to use learning videos, but rather emphasizes using time in the classroom so that learning is more quality and efficient [24].

The flipped classroom learning model is very good in increasing active learning centered on children and collaborative with peer learning. A flipped classroom is a student-centered activity that forms students to solve problems and understand unknown information [22]. A flipped classroom can improve the interaction between students and teachers and the learning environment that aims to produce a change in behavior, the teacher can be more interactive with students and be able to create happy conditions and situations in learning both at home and in the classroom [25].

The characteristics of the flipped classroom learning model that distinguishes it from the usual model are; 1) changes in the use of class time, 2) changes in the use of time outside the classroom, 3) doing activities that have traditionally been considered homework in class, 4) carrying out activities traditionally considered in the classroom outside the classroom, 5) activities in the classroom emphasizing active learning, peer learning and problem-solving, 6) pre- and post-class activities, 7) use of technology, especially video [21].

Based on figure 1, the flipped classroom learning model, divided into three activities: 1) before the class starts (pre-class), 2) when class starts (in-class), 3) after class ends (out of class) [26]. In the same learning that was stated before the class started, participants prepared themselves for the class meeting by studying the material to be discussed, at this stage, it was hoped that it could improve students' abilities to remember (remember) and understand (understand) the material, when the class started students could apply (applying) and analyzing (analyzing) the material through various interactive activities in the classroom, then continued by evaluating and doing project-based special assignments as an after-class activity (making). The sequence of processes is the link between the flipped classroom and Bloom's Pre-class Taxonomy (remembering and understanding), In-class (applying and analyzing), and out of class (evaluating and creating) [27].
3.3. **REACT**

The Center of Occupational Research and Development (CORD) conveys five strategies for educators in the context of applying learning which is the development of Contextual Teaching Learning (CTL), namely, REACT [28]. The REACT strategy was first developed by Micheal L, Crawford in the United States [8]. REACT is an acronym or abbreviation of Relating, Experiencing, Applying, Cooperating, and Transferring. According to Crawford, the REACT strategy is the development of CTL which has five components. The five components are Relating, Experiencing, Applying, Cooperating, and Transferring [29].

In this REACT strategy students are required to find out for themselves about the concept given, trying to understand the concept, work together, and be able to apply the knowledge gained in real life [1]. In the REACT, strategy students find meaningful relationships between abstract ideas and practical applications in real-world contexts [30]. REACT learning strategies require students to engage in a variety of ongoing activities, think and explain their reasoning, know the relationship between themes and concepts, not just memorize and read facts repeatedly and hear lectures from the teacher [8]. The REACT strategy can be seen in figure 2 as follows.

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**Figure 1.** Flipped Classroom learning model.

**Figure 2.** REACT Strategy.
This REACT strategy is suitable to be applied in mathematics learning [1]. According to Muslich [31], this REACT is described by COR (Center of Occupational Research) in America which of the five strategies that must be visible: 1) Relating (linking) learning by linking material that is the context of real-life experience or knowledge that is previous; 2) Experiencing (experience) is learning that makes students learn by doing math activities (doing math) through exploration, discovery, and search. Various classroom experiences can include manipulative use and problem-solving activities; 3) Applying (applying) learning by applying the concepts that have been learned to use, by providing realistic and relevant exercises; 4) Cooperating (collaborating) learning is conditioned so that students work together, share, respond, and communicate with other students; 5) Transferring (menstruating) learning that makes students feel compelled to learn to use the knowledge that has been learned into new contexts or situations that have not been studied in class based on understanding [30].

3.4. Implementation flipped classroom with REACT to develop problem solving ability

This article will combine the flipped classroom learning model with REACT to improve problem solving ability. Learning activities take place in three stages pre-class, in-class, and out of class. Flipped Classroom provides a relatively more flexible time in learning, they can repeat the material to learn it at any time. Flipped classroom when pre-class is done online using video with the help of the LMS application. REACT requires students to be active in learning activities so that students can find out for themselves about concepts and understand concepts, work together, and be able to apply the knowledge gained in real life. This REACT is carried out during classroom learning activities.

![Figure 3. The framework of a flipped classroom with the REACT strategy.](image)

Based on the chart from figure 3, it can be described learning activities or the implications of a flipped classroom with REACT learning strategies having stages of learning. In brief, the learning process that will occur in flipped classroom learning is as in table 1.

Table 1 shows that face-to-face and online learning are interrelated. When face-to-face discussions occur in the form of clarification by the teacher and in online activities, students explore to deepen the material and knowledge or discussion in groups by utilizing the media and references that have been provided or other source links.

In a flipped classroom students can learn according to their needs, if they feel they are still lacking students can repeat it to understand the concepts given by the speed of absorption individually. After mastering concepts, students can draw relationships between given material concepts. In this process students have passed the stage of understanding the problem, can choose what strategies will be used in solving problems, carry out the planned strategy to solve the problem, and re-examine the results of the work. These stages have passed, it can be said that the ability to solve problems is high. This is in line with the theory of problem-solving [32]. Flipped classrooms can be assisted by video learning
media. Videos can be more interesting, more concrete, and clear in showing a problem, it will be easy to understand everyday problems. After understanding the problem, students can design problem-solving strategies. So that the problem-solving ability increases [23].

Table 1. The flipped classroom learning process with REACT.

| Execution time                  | Learning Activities                                                                 |
|---------------------------------|--------------------------------------------------------------------------------------|
| Before class beginning (Pre-class) (Online) | Students in groups study the subject matter in the form of videos, as well as various materials that have been given and collect several questions. The teacher prepares to learn the material and uploads it to the LMS (google classroom) that has been prepared. |
| Beginning of class (Pre-class) (Online) | Students in groups have prepared certain questions after studying the material that was given at the time before class began. The teacher prepares a discussion room to facilitate possible questions that arise to be resolved. |
| As the class progresses it blends with the REACT learning strategy (Face to face - In-Class) | Students discuss in class with friends and teachers and practice to improve their abilities in accordance with the abilities expected. The teacher as a facilitator facilitates students during the learning process by providing clarification of learning material from questions that arise from students. |
| After class (Out of Class/After-Class) (Online) | Students continue to apply their knowledge in solving problems after clarification and feedback from the teacher. The teacher posts additional subject matter in LMS (google classroom) again to increase students' knowledge and problem-solving skills. |
| Outside class hours             | Students are encouraged to always find out what things they do not understand. The teacher always guides students to deepen students' problem-solving abilities. |

In the face-to-face process that applies the REACT strategy requires students to engage in a variety of ongoing activities, think and explain their reasoning, know the relationship between themes and concepts, not just memorize and read facts repeatedly and hear lectures from the teacher. This causes an active interaction in a discussion as a stage of sharpening understanding and applying everyday problems. Then students can choose their problem-solving strategies so that their problem-solving abilities increase. REACT in student-centered learning (interactive). This will more easily help in understanding concepts, developing strategies, and implementing strategies in understanding the application of everyday problems. Learning activities also become optimal. Problem-solving ability increases.

Based on the previous discussion flipped classroom combined with REACT will improve students' problem-solving abilities more than usual. In each pre-class, in-class (REACT), and out of class activity, it has been familiarized with the stages to improve problem-solving abilities.

4. Conclusions
The flipped classroom learning model gives students more free time to learn and understand the material provided and can be seen repeatedly and ultimately accustomed to solving existing mathematical problems. In the face-to-face stage, students have also prepared themselves with questions that will be brought into a class discussion so students can better understand concepts, choose problem-solving strategies to apply problem-solving in daily life. The application of the
REACT learning strategy when face to face accelerates the improvement of the process of understanding and applying mathematical problem-solving.

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