The enhancement of mathematical problem-solving skill and self-efficacy achievement through thinking actively in a social context learning model

W Septiyana*, E C M Asih and D Dasari
Department of Mathematic Education, Universitas Pendidikan Indonesia, Bandung, Indonesia

*Corresponding author’s e-mail: wiekaseptiyana@student.upi.edu

Abstract. Mathematical problem-solving skill becomes the main tool of learning mathematics to develop thinking habits and establishes students' self-efficacy in their skill to face problems. Thinking actively in a social context (TASC) learning model is expected to enhance this skill. This research was quasi experiment by non-equivalent control group design with seventh grade students in one of Bandung Junior High School as a research subject. The number of participants was 52 students. The instruments that used were problem solving skill essay and self-efficacy questionnaires. This research generated the enhancement of problem-solving skill students who receive TASC learning model are higher significantly than students who receive scientific approach learning. Looking back for the whole piece of learning is not already become a student habit at the evaluate stage. Less accuracy of the students in understanding part of the problem indicated errors resulted from inappropriate strategy.

1. Introduction
In the 21st century, schools are increasingly required to develop students' competencies, including on problem solving skills, critical thinking, communication, collaboration and self-management [1]. Problem solving skill becomes the essence of mathematics learning which positively affects mathematical thinking [2]. Minister of National Education Regulation number 22/2006 listed problem solving skill as one of the objectives of mathematics learning in primary and secondary schools. An issue in mathematics is considered a problem depending on the student's point of view on a question. Problems are relative to individual abilities [3].

PISA defines problem solving process as a form of situation that confronts problems with an unclear solution, so the problem in question has an irregular problem [4]. There are types of problem. Non-routine problems are challenging problem and requires creativity and ability to solve, while routine problems relate to problems compiled as an exercise, so that solved with some commands and algorithms [5]. Two other categories of problems include well-structured solutions that include known solutions and data provided in the form of important data that will produce similar solutions, whereas ill structured problems include problems that contain many solutions, important data are not available and many methods can be used because it can generate judgments about the different required solutions. In addition, the problem can be closed ended and open ended depending on the range of solutions. Closed ended problems contain one solution, while the problem contains multiple solutions, so that the teacher
will get more information from the settlement process. Based on the description, the problem-solving skill involves solving non-routine problems.

In the problem-solving process, it is possible for students through four common phases to solve problems, including understanding the problem phase, strategizing, executing the strategy and examining the solutions already obtained [6]. The phase of understanding a problem is identifying the presented information, recognizing the matching notation, modeling the problem in the form of diagrams or drawings and making illustrations of data in the form of definitions. Furthermore, the already understandable problem becomes the provision of strategy by developing the data given based on the known rules, then restating the problem into operational form until determining the rules that can be used in dealing with the problems encountered. A predetermined strategy can be implemented with due regard to every step taken. Solutions that have been obtained then checked again the validity of the argument of every step taken to ensure the suitability of the solution to the problem. The process of problem solving requires reasoning and knowledge [7]. Another essential skill are conceptual and procedural understanding [8].

In the process of problem solving requires the aspect of self-efficacy in the form of self-belief and self-assessment of the student's capacity [9]. Self-efficacy has a positive correlation to intrinsic motivation [10], choosing activities [11], determining career [12], persistence [13] and grades to task [14] in academics. It shows that students with high self-efficacy able to pass academic activities with passion, work harder, and not easily giving up. because perseverance that is built based on confidence to complete tasks. Individuals interpret from four sources, including mastery experience, vicarious experiences, social persuasion and physiological states [15]. Aspects of mastery experiences derive from individual experience on achievements that have been achieved previously. The form of experience in learning activities can be done with students reflecting on and making estimates of the results obtained after completing the task. Furthermore, self-efficacy can be sourced from the experience of others through the observation of people around, such as peers and teachers. Another aspect is derived from social persuasion, the form of suggestion received by students as a form of encouragement from others such as peers, teachers and parents. The last aspects of student self-efficacy are emotional and physiological aspects such as anxiety, stress, anxiety, fatigue and mood.

The above description explains that students as social beings who need others in performing the task. Social interaction needs to establish cooperation and mutual help. The TASC learning model is developed based on a general framework of problem solving that prioritizes student activities in doing and thinking in learning activities. Students need to be involved, empowered and motivated. Stages of TASC learning model include; 1) Gather (organizing information related to the problem); 2) Identify (defining clearly the problem to be solved); 3) Generate (bringing up some possible ideas to solve the problem); 4) Decide (leads students to make decisions); 5) Implement (developing skills); 6) Evaluate (assessing quality of work); 7) Communicate (directs students to share experiences and knowledge); and 8) Learn from experiences (comparing with previous performance). Stages of learning can familiarize students perform systematic problem-solving process, as well as interaction that is interwoven can provide a space for students to interact with each other in learning.

The implementation of learning in schools with heterogeneous students occurs more dominant student than other students, especially in high-ability students. Therefore, the factors that affect the improvement of problem-solving skills and mathematical self-efficacy is not only a learning factor, but also different abilities of students. Learning should be able to accommodate each level of ability. Based on the above description, this study aims to assess the enhancement of problem-solving skills and self-efficacy through TASC learning model reviewed based on the overall students and groups of early mathematical ability (EMA).

2. Methods
The research method used was quasi experimental research. The research design was used to analyse the improvement of mathematical problem-solving skills using pre-test-post-test design, non-equivalent control group design and design used to analyse the achievement of mathematical self-efficacy by using
post response only, non-equivalent control group design [16]. This study consists of three variables, including independent variables, dependent variables and control variables. The independent variable is implementation of TASC learning model and learning with scientific approach, while the dependent variable is the improvement of problem-solving ability and the achievement of self-efficacy. The control variable to control other factors outside the research study is the early mathematical ability (EMA) are categorized into high, moderate and low levels. The values that become the reference for EMA grouping are obtained from the average of the students' mathematics score on the first semester report card value, the second semester test score and the second semester test. The value illustrates the average mathematical ability of students before learning.

Data collection technique is done by distributing the test of problem solving of mathematical problem as much as four items and self-efficacy mathematical questionnaire. The problem-solving test were given before learning and after learning during six meetings. Pretest and posttest using the same test and self-efficacy questionnaire developed refer to the Likert scale at 1-10 intervals for positive statements and intervals 10-1 for negative statements [16]. Data analysis techniques use descriptive statistics in the form of number of students (n), average score (X), maximum score (Xmax), minimum score (Xmin), and standard deviation (s). The calculation of the increase that occurs in the aspects of problem-solving skills using a normalized gain with interpretation as follows: a) High (N-gain> 0.7); b) Moderate (0.3 <N-gain ≤ 0.7); and c) Low (N-gain ≤ 0.3) [17]. The hypothesis of the proposed research is the enhancement of mathematical problem-solving skill and the achievement of self-efficacy of students who receive TASC learning is significantly higher than students who get the usual learning model reviewed whole students and early mathematical early ability (EMA).

3. Results and Discussion
Result of this research is N-gain data of mathematical problem-solving ability and the achievement of self-efficacy based on whole student and EMA level.

3.1 The enhancement of Mathematical Problem Solving
The enhancement of problem-solving ability obtained presented in descriptive statistic in Table 1.

| Level of EMA | Statistic | TASC Class | n | Scientific Class | n |
|--------------|-----------|------------|----|-----------------|---|
| High         | Xmax      | 1.00       | 0.82| 0.73            |
|              | Xmin      | 0.62       | 0.78| 0.05            |
|              | X         | 0.77       | 0.62| 0.40            |
|              | s         | 0.14       | 0.00| 0.10            |
| Moderate     | Xmax      | 0.79       | 0.80| 0.40            |
|              | Xmin      | 0.40       | 0.00| 0.24            |
|              | X         | 0.62       | 0.40| 0.60            |
|              | s         | 0.10       | 0.24| 0.60            |
| Low          | Xmax      | 0.31       | 0.07| 0.36            |
|              | Xmin      | 0.31       | 0.26| 0.09            |
|              | X         | 0.36       | 0.27| 0.82            |
|              | s         | 0.09       | 0.27| 0.00            |
| Overall Students | Xmax | 1.00       | 0.82| 0.31            |
|              | Xmin      | 0.31       | 0.00| 0.62            |
|              | X         | 0.62       | 0.41| 0.16            |
|              | s         | 0.16       | 0.27|                |

Information: Ideal maximum N-gain = 1

Table 1 explains that each category of the enhancement of problem-solving skill that occurs in students who have received learning with the TASC learning model scores is higher than students who received regular learning, except in the high-level EMA. The difference of N-gain score of high-level EMA of
students between both classes is 0.01. High-level students used scientific class tended to understand the problem by making the schematic in an operational form, while TASC class answered without representing into schematic diagram. The difference test result of N-Gain average of mathematical problem-solving skill at 0.05 significance level is presented in Table 2.

### Table 2. The Average Difference of N-Gain’s Mathematical Problem-Solving Skill’s Test Results.

| Level of EMA | P-value | Information       |
|--------------|---------|-------------------|
| High         | 0.349   | Ho accepted       |
| Moderate     | 0.001   | Ho rejected       |
| Low          | 0.214   | Ho accepted       |
| Overall Students | 0.001 | Ho rejected       |

H₀: \( \mu_{TASC} \leq \mu_{Scientific} \)
H₁: \( \mu_{TASC} > \mu_{Scientific} \)

Based on Table 2, explains that the enhancement of mathematical problem-solving skill of students who receive TASC learning model is significantly higher than students who receive scientific reviewed based on moderate EMA and overall students. High and low-level students from TASC class don’t show a higher increase. High-level students have maturity schemes that assist in the establishment of new schemes [18], so high-level students have the same initial equity in solving the problem. Unlike the case with low-level students, tend to be passive in learning and slow in understanding the material causes the students tend to lag in groups. Low-level students understand problems and define concepts, so they did not tend to answer or just copy the given problem. The differences of EMA level students are being helped by a TASC learning model that prioritizes student interactions, which gives space to exchange ideas and share between high-level and low-level. The interactions become significant factor to improve problem solving skill students due to positive interactions in groups [19]. Students’ diverse skill within a single class are accommodated by the interaction that exists between peers [20]. It is reinforced that actual and potential student development can be achieved through the help of teachers and friends [21].

Based on overall students, TASC learning model can help students in getting used to solve problems systematically starting from the process of understanding the problem, strategize, execute the strategy and re-examine the results already obtained. In the learning stages, students are given the opportunity to evaluate performance outcomes to check the results of the work before it is collected and improve the results on the next performance achievement. The evaluation form is given as in Figure 1.

![Figure 1. Results of Student Work in Evaluating Student Worksheet.](image-url)
the less category. It is customized to in still a student's confident attitude toward his work and familiarize students to check their work. Here is given one example of mathematical problem solving problems in Figure 3 and student works in answering the problem in Figure 4 and 5.

Syifa has an equilateral triangle paper with its perimeter of 42 cm to make handicrafts. She cuts each corner to form 3 equal-sized triangles. The design of the cutting paper as in Figure 2. If the total number of perimeter of the three pieces of cut-triangles is 18 cm. What is the perimeter of the shaded area?

**Figure 3. Mathematical Problem**

Based on the student answers in Figure 4 shows that the process of completion of each step done systematically accompanied by a formula and a clear reason. In the process of completing the computation process is not found error, but the students TASC class forgot one part of the problem in determining the circumference of the shaded area to sum the shortest side of the wake. One part of the problem causes the wrong end result. Figure 5 shows the result of the completion of the scientific class students get the correct end result, but in the process of completion found the error of computation translation. Students write the process of finding the longest side of the shaded wake in the form 14 - 4 = 10 × 3 = 30, the student should simply write 14 - 4 = 10, so 10 × 3 = 30. It caused by the students did not accustom to solve problems systematically.

3.2. The Achievement of self-efficacy

The achievement of self-efficacy mathematically obtained after six meetings of learning is presented in Table 3.

**Table 3. Descriptive Data of Mathematical Self Efficacy Achievement.**

| Level of EMA      | The average of achievement |
|-------------------|---------------------------|
|                   | TASC Class | Scientific Class |
| High              | 148.50     | 145.67          |
| Moderate          | 130.61     | 114.69          |
| Low               | 135.67     | 125.00          |
| Overall Student   | 135.15     | 120.88          |

Information: Ideal Maximum Score = 200

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**Figure 2**

**Figure 4. Sample of TASC Class Student’s Answers in Solving Mathematical Problems.**

**Figure 5. Sample of Scientific Class Student’s Answers in Solving Mathematical Problems.**
Table 3 describes that each category is outperformed by students who have received TASC learning model. Furthermore, the data were tested inferentially to answer the research hypothesis presented in Table 4.

**Table 4.** Average Difference Test Results Achievement of Mathematical Self Efficacy.

| Level      | P-Value | Information     |
|------------|---------|-----------------|
| High       | 0.398   | Ho accepted     |
| Moderate   | 0.012   | Ho rejected     |
| Low        | 0.098   | Ho accepted     |
| Overall Students | 0.004 | Ho rejected     |

Based on the results of the test in Table 4, it is shown that the mathematical self-efficacy of the students who received TASC learning model is significantly higher than the students who received the scientific study based on moderate-level and overall students. However, students in high and low-level did not show the highest achievement. These results confirm that EMA students are gaining a positive influence on their beliefs through group interaction with high and low-level. The results of the analysis of each source of self-efficacy are presented in Figures 6, 7, 8, and 9.

Figures 6 and 7 illustrate that students with the TASC learning model are superior in obtaining a source of self-efficacy derived from social persuasion and physiological states. The form of persuasion given to the TASC learning is emphasized in the communicate and evaluate stages that shape the mutual support attitude of the group's friends, assess and improve performance outcomes. In physiological state aspect also students with TASC learning model tend to be more calm in facing problem solving problem because student accustomed to face learning before explained by teacher like learning on scientific. The four sources of self-efficacy show the tendency of students with TASC learning models that are more likely to be very convinced, but students who acquire scientific learning tend to approach an uncertain response.
4. Conclusion
This study obtained some conclusions, including: 1) Improving students' mathematical problem-solving skills students who receive TASC learning model is significantly higher than students who receive scientific learning reviewed moderate-level and overall students; 2) The achievement of mathematical self-efficacy of students who acquired TASC learning model significantly higher than students who received scientific learning reviewed EMA being and overall students. This research gives some suggestion especially on whole part of learning from looking back at evaluate stage not yet become student habit, so need to be given more attention.

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