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To cite this article: N R Dewi *et al* 2021 *J. Phys.: Conf. Ser.* **1968** 012019

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# Mathematical problem solving ability based on self-efficacy in ICT-assisted preprospec learning model

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**Abstract.** Mathematical problems solving ability is the main goal of learning mathematics. In addition, students in Mathematics Education study program need one affective ability called self-efficacy. Self-efficacy enables students to have efficacy through the experiences they have. If students have high self-efficacy, they can confidently carry out steps to solve the given mathematical problems. One learning model that can facilitate the enhancement of these two abilities is ICT-Assisted Preprospec Learning (I-Pre) Model. Thus, the main purpose of this research was to analyze comprehensively mathematical problem-solving ability based on self-efficacy in I-Pre Learning model. To do so, it used quantitative methods with all students in the mathematics department of one of universities in Central Java, Indonesia as the population. Moreover, the sample was randomly taken from groups of students in the Study Program of Mathematics Education who enrolled in Integral Calculus course, while their data were collected using two instruments, including Test of Mathematical Problem-solving Ability and self-efficacy scale. After that, the data were analyzed using t test and linear regression. From the findings, it can be concluded that the enhancement of the students' Mathematical Problem-solving Ability based on self-efficacy gains no different result.

## 1. Introduction

Mathematical problem-solving skill is one of the learning outcomes in the study program for mathematics education. It becomes the core and main objective of mathematics learning [1-4]. Polya argues that solving mathematical problems is realized by the utilization of the previously learned mathematical principles. [5]. Once students own strong problem-solving skills, they are considered to have sufficiently consistent capacity both within and outside mathematics to solve any problems. This one is not automatically obtained, but needs to be sharpened.

Problem-solving is one of the objectives of mathematics learning and the core of mathematics itself [6]. Obviously, issues evaluation and solution application would be easily done by those who come up with good problem-solving skills. It is further mentioned that the ideal criteria of being able to address problem-solving in mathematics comprise problem understanding; determination of the best solution; the application of the determined solution; and the evaluation of the problem-solving process [7].

Furthermore, college students majoring in the mathematics education require affective skills, namely self-efficacy. Self-efficacy helps them to have an effect through the interactions they have. If students have high self-efficacy, the steps to solve mathematical problems given to them can be carried out confidently.

To enhance the mathematical problem-solving skills and self-efficacy of students, a lecturer is required to provide students with opportunities to be involved in learning and develop their own



mathematical concepts. One possible approach to do is to build a learning model designed specifically for the study of mathematics.

I-Pre Learning Model is a learning model that can promote the development of the previous two skills and specifically designed for mathematics learning. This learning model is based on constructivism theory [8]. There are five stages to be carried out in implementing this model such as planning, problem-solving material provision, presentation, assessment, conclusion in which all these stages are supported by ICT. ICT supports the model by providing graphics and pictures commonly found in daily life to illustrate the abstract mathematical concepts. Similar to other learning models, I-Pre Learning Model uses student worksheet along with the utilization of ICT since Petocz & Smith [9] assume that student worksheets can facilitate students solving difficulties in understanding mathematical concept.

Preparation is the first thing to be done in implementing I-Pre Learning Model. This stage requires students to memorize preliminary contents of materials to study. Following this, questions regarding those materials will be given to check their comprehension. Besides, learning outcomes and concept maps of the materials to study are also given at the preparation stage aiming at preparing the students to be ready to study. It is the planning process which is at the next stage and takes place during the learning. Within the learning, materials are accessible via the websites, facebook, telegram or whatsapp applications.

Students are given problems associated with the content being studied at the problem-solving stage. In Student Worksheet, problems are given in form of questions to let students create their own learned concepts. Additionally, the worksheet is in form of PowerPoint accessible via the aforementioned online platforms. Based on the problems attached in the worksheet, students debate the issues in groups, while lecturer monitors the success of students and offer support if necessary. The lecturer's support is performed deliberately and thoroughly.

Regarding the above description, this research aimed to comprehensively examine problem-solving ability to deal with mathematical problems based on self-efficacy in I-Pre learning model. Thus, student's mathematical problem-solving ability was expected to improve the application of the I-Pre Learning Model.

## 2. Methods

This thesis utilized quantitative methods with all students from one of the universities in Central Java, Indonesia, in the mathematics department as the population. For more, the sample consisted of groups of students enrolled in Integral Calculus courses in the Mathematics Education Study Program with the sample group chosen randomly.

## 3. Results and discussion

The implementation of I-Pre Learning Model has been done in Integral Calculus course. Students were given learning experiences in such a way that they could achieve the learning outcomes and expect to develop mathematical problem-solving ability. After being given learning experiences with I-Pre Learning Model, students took a test of Mathematical Problem-solving Ability and filled out self-efficacy scale. The following are the research data.

**Table 1.** The normality test data of mathematical problem-solving ability score and self-efficacy score.

Statistic	MPS	SE
N	40.000	40.000
Kolmogorov-Smirnov Z	1.124	0.687
Asymp. Sig. (2-tailed)	0.174	0.816

From table 1, it can be seen that the significance value of all data was more than 0.05 and made  $H_0$  rejected. This meant that the data on the problem-solving ability and score of self-efficacy were normally distributed.

**Table 2.** The homogeneity test of mathematical problem-solving ability score viewed from self-efficacy

Statistic	Levene's Test For Equality of Variance	
	F	Sig
Levene's Test	0.239	0.637

Table 2 describes the significance value for the homogeneity test got 0.637 or exceeded 0.05, so  $H_0$  was accepted. In other words, those data obtained homogeneous variants.

**Table 3.** The mean difference test of mathematical problem-solving ability score viewed from self-efficacy

Statistic	Mean	t	df	Sig (2-tailed)
Upper	75.978	-0.632	38	0.577
Middle	81.337			

It was found that results of mean from the difference test using the t-test in Table 3 obtained a significance value of 0.577 or more than 0.05 that caused  $H_0$  accepted. However, there was no significant difference between the student's mathematical problem-solving ability based on self-efficacy.

**Table 4.** The correlation test of mathematical problem-solving ability score and self-efficacy score.

Model	R	R Square	Adjusted R Square	Std Error of The Estimate
I-Pre	0.365	0.132	0.113	11.892837

From Table 4, the researchers found that the correlation between mathematical problem-solving ability score and self-efficacy score (R) was 0,365 or in the low category. Furthermore, in terms of coefficient of determination (R Square) it could be said that self-efficacy affected mathematical problem-solving ability by 13.2%, while the remaining 76.8% was influenced by other factors.

**Table 5.** F Test of linier regression

Model	Sum of Square	df	Mean Square	F	Sig
Regression	826.644	1	856.895	5.960	0.018
I-Pre Residual	5278.654	38	168.698		
Total	6237.535	39			

According to table 5, it was found that the value of  $F=5,960$  with the significance value of 0,018 or lower than 0,05. That meant the regression model could be used.

**Table 6.** Test of linier regression

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
I-Pre (Constant)	6.407	30.247	0.369	0.212	0.833
Self-Efficacy	0.680	0.278		2.449	0.019

From this table 6, it was found a regression formula:  $\hat{Y} = 6,407 + 0,680X$ , with  $\hat{Y}$  is Mathematical Problem-solving ability score and  $X$  is Self-Efficacy Score. These results indicated that the relationship between Mathematical Problem-solving Ability and self-efficacy was directly proportional. In other words, if skill self-efficacy increases, Mathematical Problem-solving Ability will increase, and vice versa.

The success of I-Pre Learning Model on Mathematical Problem-solving Ability based on self-efficacy is in line with several previous research results. The achievement of students' mathematical problem-solving abilities who received I-Pre Learning Model as a whole and for this type of initial mathematical ability was better than students who received conventional learning [10]. In the Problem-solving stage, students could explore themselves to present the results of the answers to the problems given.

Furthermore, the use of ICT in learning had a good influence on students' problem-solving abilities. In the Problem-solving stage, students got problems given by the lecturer through worksheets that have been shared through ICT online platforms such as websites, facebook, telegram or whatsapp. Furthermore, students could have discussions with other students through these ICT media. The use of the web in Brain-Based Learning could improve mathematical thinking skills at high-level where one of the components of this ability is problem-solving ability [11]. The use of other ICT which has an impact on improving problem-solving abilities has also been suggested by Umam, et al [12] through their research results that the ICT-assisted Think Pair Share Cooperative Learning Model has a positive impact on students' mathematical problem-solving abilities and obtains a significant difference in mean statistics of students' mathematical problem-solving abilities between the experimental class and the control class. Salmaini, et al [13] also states that the ability of students to solve math problems learning through ICT-assisted Contextual Teaching and Learning (CTL) learning is better than students taught through conventional learning.

#### 4. Conclusion

By referring to the findings of the study, the researchers conclude that there is no increase in the students' Mathematical Problem-solving Ability seen from self-efficacy. The regression formula of mathematical problem-solving ability based on self-efficacy is  $\hat{Y} = 6,407 + 0,680X$  with  $\hat{Y}$  representing mathematical problem-solving ability score and  $X$  representing self-efficacy score.

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