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Problem Solving Ability with Mathematical Modeling Strategy in Term of Mathematics Self-Efficacy on Generative Learning Model

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Abstract

Problem solving is an attempt to find a way out of a goal that is not so easy to achieve immediately. Problem Solving Ability (PSA) is the ability of students to determine how to solve a mathematical problems that have not yet known how to solve it. Abstract mathematical concepts become obstacles in solving mathematical problems. Mathematical Modeling Strategy (MMS) is one ways that can be used to improve students' problem solving ability. In addition, one learning model that can improve students' problem solving ability is Generative Learning Model (GLM). The purpose of this study is to (1) find out whether the results of the PSA test achieve mastery learning, (2) find out whether the results of the PSA test have improved, (3) find out the relationship between the level of Mathematics Self-Efficacy (MSE) on students' PSA, and (4) describe the PSA in terms of students' MSE. The research method that used is mixed methods with quantitative methods using Pre-Experimental Design that modela is One-Group Pretest-Posttest Design. The population in this study were all eighth grade students of Junior High School 41 Semarang in the 2018/2019 academic year. The research sample was chosen class VIII E as an experimental class taken based on the multistage cluster sampling technique, while the qualitative research subjects were selected using a purposive sampling technique. The results showed that; (1) students' PSA achieve a mastery learning, (2) students' PSA have increased, (3) there is a positive influence between the level of MSE on students' PSA, (4) students with high levels of MSE tend to have better PSA than students with moderate and low levels of MSE.

1. Introduction

Education is a very important factor in life. In the Law of the Republic of Indonesia Number 20 of 2003 it is explained that Education is a conscious and planned effort to create an atmosphere of learning and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by himself, society, nation and country. Education is also a very important factor for the progress of a nation. The progress of the retreat of a nation is determined by whether or not the education carried out. Developed countries have good education where the citizens have a better standard of living. In this case it appears that education can and must lead to a better life (Murtiyasa, 2016).

Mathematics is a universal science that is useful for human life and also underlies the development of modern technology, and has a role in various scientific disciplines and advancing human thought power. According to Santos, Belecina, & Diaz, (2015), The application of mathematics is proven not only in the field of education, but in almost every aspect that we can think of; when we budget our monthly income, manage our time, and even in the infrastructure that we see outside. Mathematics is also a source for the

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development of other sciences. Mathematics has the power of abstraction that is able to abstract problems that often arise both in mathematics itself and in everyday life so that they can solve problems quickly and accurately (Lubis & Surya, 2017).

Problem solving is one of the main skills developed in schools, especially in mathematics learning, this is in line with The National Council of Teachers of Mathematics (2000), which states that problem solving is an integral part of learning mathematics, so it should not be released from learning mathematics. According to Polya, (1973), problem solving is an attempt to find a way out of a goal that is not so easy to achieve immediately. Problem solving ability is the main goal of learning mathematics in accordance with what is stated in Permendikbud Nomor 58 Tahun 2014 namely; (1) understanding mathematical concepts, explaining the interrelationships between concepts and applying concepts or algorithms flexibly, accurately, efficiently, and precisely in problem solving; (2) solving problems that include the ability to deal with problems, design mathematical models, solve models and interpret the solutions obtained; and (3) having an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention and interest in learning mathematics, as well as being tenacious and confident in problem solving. The achievement of the objectives of learning mathematics can be seen from the results of learning mathematics achieved by students.

The importance of the ability to solve mathematical problems in Indonesia is still not in line with the level of students' mathematical problem solving abilities. In Indonesia, one of the ways to evaluate student learning outcomes is through a national exam. Based on data from the Research and Development Agency of the Ministry of National Education, the results of the analysis of the items as well as the absorption of the national exam 2017/2018 junior high school level showed the percentage of mastery of mathematics questions nationally by 43.34%. The percentage of mastery of mathematical problems in Central Java Province is 45.63%, in the City of Semarang is 54.43% and in Junior High School 41 Semarang is 49.01%. From these data shows that the ability to solve mathematical problems of students in Indonesia, especially in Junior High School 41 Semarang still needs to be improved.

Statistics material is one material with a percentage of mastery of the material that still needs to be improved. Based on data from the Research and Development Agency of the Ministry of National Education, the results of the analysis of the items as well as the absorption of the National Examination for the academic year 2017/2018 on statistics especially on indicators to determine the average value of other data if the average value of n overall data and average the average value of a person's data is known to show the results of mastery of national level material by 35.17%. Material mastery in Central Java Province is 35.19%, in Semarang City 47.32%, and in Junior High School 41 Semarang is 32.72%. In addition, according to the results of interviews with mathematics subject teachers, the problem solving abilities of students in that junior high schools are indeed still not optimal and need to be improved. Students are still difficult to identify problems, write what is known and asked, and determine the completion of a problem. Students also still have difficulty in solving problems that are different from what was previously demonstrated.

According to Yumiati (2011), the low achievement of mathematics students can be caused by many factors, such as the teacher and the mathematics learning process that has been designed. Current mathematics instruction, especially for junior high schools, still cannot expand students' ability to solve problems. Many students still cannot answer the question correctly which only changes the constants from the previous question. Students can only answer questions if the questions are the same as those taught by the teacher. This makes students feel difficulties in learning mathematics so students feel scared and unhappy with mathematics. As a result students feel worried considering mathematics is one of the subjects tested in the national exam. Students who felt disliked mathematics indicated that the Mathematics Self-Efficacy of students was still low.

Self-efficacy is a person's self-confidence in his ability to organize and carry out a series of actions to achieve the specified results (Bandura, 1997). Self-efficacy is related to the belief that a person has to do or complete a skill that he has in a certain situation or condition (Maddux, 2000). According to Somakim (2006), Self-efficacy can be explored from four sources, namely (1) authentic mastery experiences, (2) vicarious experience, (3) social or verbal approach, (4) index psychological, where physical and emotional status will affect one's abilities.

Research by Pajares & Miller (1994), Ulya & Hidayah (2016) dan Fajariah, Dwidayati, & Cahyono (2017) shows that there is a relationship between self-efficacy and problem solving abilities. Self-efficacy

is also a strong factor that can predict problem solving abilities. In general individuals with high levels of self-efficacy are happy to show the best results, use effective strategies and work hard to achieve targets. The low self-efficacy causes students to tend to avoid tasks related to mathematics because there is no belief that he has the ability in that field.

Realizing the importance of mathematical problem solving skills, teachers are also required to convey learning that makes students more active and free to express ideas and reasons for the problems given. Therefore, students will better understand the knowledge that shapes themselves and the learning process will be more optimal. One effort that can be done is through the application of generative learning models.

Generative Learning Model is a learning model based on constructivism learning theory. According to Wittrock (1974), Generative Learning is a learning model in which students do not passively accept information, but they are actively involved in learning it. According to Wena, (2009), the Generative Learning Model is a learning model based on the nature of constructivism, in which students learn actively participating in the learning process and in constructing the meaning of the information that is around it based on prior knowledge that has been previously owned and connecting with the concepts learned, students are finally able to construct new knowledge. In the Generative Learning Model, learning is centered on students who try to build their own understanding of concepts, the teacher is only a facilitator and motivator to help students find their own concepts. Learning like this can make learning more meaningful so that it can enter the long-term memory of students because students themselves who find the concept of the material. This is in line with research conducted by Khasanah & Dahlan (2001), Alba, Chotim, & Junaedi (2014) Sulistiawati (2017), dan Andriana, Ikhsan, Munzir, & Khairunnisak (2018) which shows that Generative Learning Model can improve students' problem solving abilities.

The application of generative learning models in this study uses the media of Student Worksheet. According to Trianto, (2010: 111), Student Worksheet is a guide for students to conduct fundamental activities to maximize understanding according to indicators of learning achievement. The use of student worksheet aims to help students understand the concept of the material to be taught. Student worksheet contains exercises that can help students understand the concept of the material to be taught.

In addition, abstract mathematical concepts sometimes become obstacles for students to solve mathematical problems because they are too difficult to understand. Though it should be that abstract mathematical concept, students can develop their thinking ability to understand the concept and then be able to apply it in solving problem solving problems. One way that can be used to improve problem solving skills is through learning with mathematical modeling strategies. According to Nursyarifah, Suryana, & Muiz (2016), Mathematical modeling is a process of thinking and the process of describing a mathematical relationship with real-world problems that are considered difficult becomes easier and clearer by pouring in the form of models or pictures. Based on research Santos et al. (2015), it is seen that by using mathematical modeling students' problem solving abilities can be increased. The application of mathematical modeling appropriately can enable students to experience more meaningful problem solving (Eric, 2009).

Based on the description above, the purpose of this research are; (1) to find out whether the test results of students' problem solving abilities with mathematical modeling strategies on generative learning models can achieve mastery learning; (2) to find out whether the test results of students' problem solving abilities with mathematical modeling strategies on generative learning models have increased; (3) to knowing the relationship between the level of mathematics self-efficacy on students' problem solving abilities; and (4) to describe students 'problem solving abilities with mathematical modeling strategies in terms of students' mathematics self-efficacy in the generative learning model.

2. Method

This type of research used in this study is mixed methods research or mixed methods research which is a research approach that combines or associates qualitative and quantitative research forms. This approach involves philosophical assumptions, the application of qualitative and quantitative approaches, and mixing the two approaches in a study (Creswell, 2009).

The research design used in this study is a sequential design type sequential explonatory design. According to Creswell (2009:211), sequential design is a research procedure in which researchers

elaborate and develop research results from one method to another in this case a quantitative and qualitative approach in stages (sequentially). Sequential design The sequential explonatory design type is characterized by the collection and analysis of quantitative data at an early stage, and then followed by the collection and analysis of qualitative data in the second stage, in order to strengthen the results of quantitative research conducted in the first stage. The reason for choosing the research approach is that the two types of research are mutually reinforcing and complementary so that research results that are not only objective, structured and measurable will be achieved but also deep and factual research results will be achieved.

$$\mathbf{O_1 \; X \; O_2}$$

Figure 1. Quantitative Research Design

Information:

X : the application of mathematical modeling strategies to problem solving through Generative Learning Model

$\mathbf{O_1}$: pre-pest problem solving ability

$\mathbf{O_2}$: post-test problem solving ability

The population in this study were all eighth grade students of one of junior high school 41 Semarang in the 2018/2019 academic year. The research sample was taken based on the multistage cluster sampling technique to determine the experimental class that had previously been tested for normality and homogeneity in the population. Taking research subjects in qualitative research in this study using purposive sampling. Subject selection is done by considering the level of Mathematics Self-Efficacy students which are then categorized into three class groups according to Azwar (2009:109) as on table 1.

Table 1. Categorizing Mathematics Self-Efficacy Scores

MSE Score Scale	Category
$X < (\mu - 1{,}0\sigma)$	Low
$(\mu - 1{,}0\sigma) \leq X < (\mu + 1{,}0\sigma)$	Medium
$(\mu + 1{,}0\sigma) \leq X$	High

Information:

X : Student's Mathematics Self-Efficacy score

μ : Mean

σ : Standard Deviation

The variables in this research are the ability of problem solving and students' Mathematics Self-Efficacy. The data collection techniques using observation, questionnaires, tests and interviews. Quantitative data were obtained from students' problem solving ability test results and students' Mathematic Self-Efficacy questionnaire results, while qualitative data were obtained from students' problem solving ability test worksheets and the results of interviews with research subjects.

3. Results & Discussions

After the normality and homogeneity test, it is obtained that the initial population data is normally distributed and homogeneous, so that the experimental class can be determined by multistage cluster sampling technique. In this study, class VIII E was chosen as an experimental class. The results of the final data analysis show that the pre-test and post-test scores of students' problem solving abilities are normally distributed. Based on the results of calculations on the results of pre-test and post-test recapitulation is obtained as on table 2.

Table 2. Recapitulation of Test Results for Experimental Class Problem Solving Capabilities.

	$\bar{x}$	s	Min	Max
Pre-Test	52	8,751	40	70
Post-Test	74,56	14,326	53	95

Hypothesis 1 test was conducted to find out whether students' problem solving abilities with mathematical modeling strategies in the Generative Learning Model can achieve mastery learning or not, that is complete in Minimum Completeness Criteria (MCC) or Classical Completeness. MCC completeness test is conducted to find out whether the average value of the results of the post-test of students' problem solving abilities after being given the application of mathematical modeling strategies in problem solving through Generative Learning Model can achieve the MCC value. The MCC value in this study uses the calculation of the actual completeness limit from the results of daily tests of the previous material. From the results of daily tests in the experimental class obtained an average value of 64.40 and a standard deviation of 1.96, so we can get the results of the actual completeness limit calculation of 64.89. Based on the calculation of the actual completeness limit, the MCC value obtained for this study is 65. MCC completeness test in this study uses the average test of one side, namely the left side. To test the classical completeness in this study is to use the left side proportion test. This proportion test is used to find out whether the percentage of mastery learning in class meets classical completeness or not. The percentage of the proportion used in this test is 75% of students completed MCC 65, while the data used is the post-test value data of problem solving ability. Based on the results of the post-test the problem solving abilities of students after obtaining the application of mathematical modeling strategies on problem solving skills through the Generative Learning Model obtained an average value of 74.30 with a standard deviation of 14.36. After passing the average test of one side, namely the left side, the value of $t_{count} = 3{,}663 > t_{table} = -1{,}696$, so that H_0 is accepted. From these tests it can be concluded that the average value of the results of the post-test students' problem solving ability is more than or equal to 65. In addition, through the test of the proportion of one side, namely the left side, the value of $z_{count} = 0{,}408 > z_{table} = -0{,}125$, so H_0 is accepted which means that the proportion of students who get the value of the results of the post-test problem-solving abilities of students more than or equal to MCC 65 is more than or equal to 75%. Through the average test of one side (left side) and the proportion test of one side (left side) it can be concluded that the ability of problem solving with mathematical modeling strategies in the Generative Learning Model has reached the mastery of learning both the completeness of MCC and classical completeness.

Hypothesis 2 test was conducted to determine whether students' problem solving abilities have improved after being subjected to the application of mathematical modeling strategies to problem solving abilities through the Generative Learning Model. The data used are pre-test and post-test students' problem solving abilities. To test Hypothesis 2 in this study using the difference test of paired observation average and gain normality test. Different test of paired observation average is used because the pre-test and post-test scores of students' problem solving abilities are interconnected. This test is used to determine whether there is a difference between the pre-test and post-test average scores in problem solving ability. Gain normality test in this study is used to determine the magnitude of the increase in the results of pre-test and post-test students' problem solving abilities after getting the application of mathematical modeling strategies in problem solving through Generative Learning Model. Based on the difference test the average paired observations obtained $t_{count} = -11{,}168 < -t_{table} = -2{,}039 < t_{table} = 2{,}039$ (t_{count} is outside the reception area), so H_0 rejected. So there are differences in the average value of the results of pre-test and post-test the abilities of problem solving students after getting the application of mathematical modeling strategies in problem solving through Generative Learning Model. Furthermore, based on the normality gain test an increase in students' problem solving abilities by 0.467 is included in the moderate improvement category.

Hypothesis 3 test was conducted to determine whether there is an influence between Mathematics Self-Efficacy with students' problem solving abilities. The data used in this test are the Mathematics Self-Efficacy scores and the results of the post-test of students' problem solving abilities. To test hypothesis 3 in this study using a regression test. The influence of Mathematics Self-Efficacy on the ability of problem

solving can be known through regression tests. From the regression test, the regression equation form is as follows

$$\hat{Y} = -7{,}370 + 1{,}601X \quad (1)$$

Through the linearity test and the significance of the regression it can be seen whether there is a linear relationship between Mathematics Self-Efficacy with students' problem solving abilities. From the calculation results obtained $F_{count} = 39{,}780 \geq 4{,}149 = F_{table}$, which means there is a linear relationship between Mathematics Self-Efficacy with the results of the post-test students' problem solving abilities. Meanwhile, to see how much the relationship between Mathematics Self-Efficacy with students' problem solving abilities is done the calculation of the correlation coefficient and the coefficient of determination. Based on the calculation results obtained by the correlation coefficient of 0.755 and the coefficient of determination of 0.570. The value of the correlation coefficient of 0.755 indicates a fairly high relationship between Mathematics Self-Efficacy with problem solving ability. The coefficient of determination of 0.570 shows that Mathematics Self-Efficacy has an effect of 57% on problem solving ability, while the remaining 43% is influenced by other factors.

3.1. Analysis of Problem Solving Ability in Terms of Mathematics Self-Efficacy.

The results of the analysis of problem solving ability with mathematical modeling strategies in terms of the Mathematics Self-Efficacy obtained from seeing the results of interviews and post-test results of students' problem solving abilities.

3.1.1. Low Mathematics Self-Efficacy

From the results of the Mathematics Self-Efficacy questionnaire that has been given, there are 7 students who are included in the category of Low Mathematics Self-Efficacy. The results of the 7 students' problem solving abilities test as shown in table 3.

Table 3. The Result of Problem Solving Ability Test for Students with Low Mathematics Self-Efficacy.

Student Code	Pre-Test Score	Category	Post-Test Score	Category
E-02	48	Medium	55	Low
E-04	43	Low	65	Medium
E-06	43	Low	53	Low
E-11	40	Low	53	Low
E-25	48	Medium	65	Medium
E-26	50	Medium	58	Low
E-32	40	Low	53	Low
Average	44,29		57,14	

Based on the test results of the problem solving ability, it is seen that students with low Mathematics Self-Efficacy tendency to have low problem solving abilities.

From 7 students in the low Mathematics Self-Efficacy category, 3 students were selected as subjects in this study, namely E-04 as S-01, E-25 as S-02, and E-26 as S-03. After going through a qualitative data analysis of the results of written work and the results of interviews with research subjects with the category of Mathematics Self-Efficacy low obtained results as in table 4.

Table 4. The Result of Qualitative Analysis from Written Job Results and Interview Results of Research Subjects in the Low Mathematics Self-Efficacy Category.

Subject		S-01				S-02				S-03			
KPM Indicator	SPM Step	Question Number											
		1	2	3	4	1	2	3	4	1	2	3	4
Understand ing the problem	Define variables and assign symbols	√	√	√	√	×	√	√	×	×	√	√	√
Devising a plan	Build mathematical models	√	√	√	×	×	√	√	√	×	√	√	√
Carrying out the plan	Finishing the model	√	√	×	×	×	×	√	√	×	×	√	√
Looking back	Interpretation and problem solution	×	√	×	×	×	×	×	×	×	×	×	×

Information:
√ : able
× : unable

From the results of the qualitative analysis of the results of written work and the results of interviews on research subjects with the category of Mathematics Self-Efficacy it is seen that there are still many indicators of problem solving abilities and mathematical modeling steps that have not been met. This shows that students in the category of Mathematics Self-Efficacy have a low ability to solve problems that are still relatively low.

3.1.2. Medium Mathematics Self-Efficacy

From the results of the Mathematics Self-Efficacy questionnaire that was given, there were 17 students who were included in the moderate Mathematics Self-Efficacy category. The results of the 17 students' problem solving abilities test as shown in table 5. Based on the results of the problem solving ability test, it appears that students with medium Mathematics Self-Efficacy have an average problem solving ability score that is better than students with low Mathematics Self-Efficacy.

From 17 students in the medium Self-Efficacy Mathematics category, 3 students were selected as subjects in this study, namely E-07 as S-04, E-08 as S-05, and E-09 as S-06. After going through a qualitative data analysis of the results of written work and the results of interviews with research subjects in the category of Mathematics Self-Efficacy are being obtained results as in table 6.

Table 5. The Result of Student Problem Solving Ability Test with Medium Mathematics Self-Efficacy.

Student Code	Pre-Test Score	Category	Post-Test Score	Category
E-01	48	Medium	75	Medium
E-03	43	Low	73	Medium
E-07	48	Medium	53	Low
E-08	58	Medium	90	High
E-09	45	Medium	55	Low
E-10	45	Medium	80	Medium
E-12	40	Low	68	Medium
E-14	55	Medium	73	Medium
E-17	55	Medium	88	Medium
E-21	40	Low	88	Medium
E-22	40	Low	65	Medium
E-23	53	Medium	73	Medium
E-24	68	High	83	Medium
E-27	58	Medium	68	Medium
E-28	58	Medium	70	Medium
E-29	53	Medium	88	Medium
E-31	58	Medium	70	Medium
Average	50,62		73,82	

Table 6. The Result of Qualitative Analysis from Written Job Results and Interview Results of Research Subjects in the Medium Mathematics Self-Efficacy Category.

Subject		S-04				S-05				S-06			
KPM Indicator	SPM Step	Question Number											
		1	2	3	4	1	2	3	4	1	2	3	4
Understand ing the problem	Define variables and assign symbols	×	√	√	√	√	√	√	√	√	√	√	×
Devising a plan	Build mathematical models	×	√	√	√	√	√	√	√	√	√	√	×
Carrying out the plan	Finishing the model	×	×	√	×	×	√	√	√	√	√	×	×
Looking back	Interpretation and problem solution	×	×	×	×	×	√	√	√	×	×	×	×

Information:
√ : able
× : unable

From the results of the qualitative analysis of written work and interview results on research subjects in the Mathematics Self-Efficacy category, there are still many indicators of problem solving ability and mathematical modeling steps that have not been fulfilled, but this shows that indicators of problem solving abilities are met by students with medium Mathematics Self-Efficacy category is more than students with low Mathematics Self-Efficacy.

3.1.3. High Mathematics Self-Efficacy

From the results of the Mathematics Self-Efficacy questionnaire that has been given, there are 8 students who are included in the category of High Mathematics Self-Efficacy. The results of the 8 students' problem solving abilities test as shown in table 7. Based on the results of the problem solving ability test, it appears that students with high mathematics self-efficacy have an average score of problem solving ability test better than students with low and medium mathematics self-efficacy.

Table 7. The Result of Student Problem Solving Ability Test with high Mathematics Self-Efficacy

Student Code	Pre-Test Score	Category	Post-Test Score	Category
E-05	60	Medium	90	High
E-19	68	High	83	Medium
E-16	58	Medium	93	High
E-20	58	Medium	90	High
E-30	55	Medium	95	High
E-13	58	Medium	93	High
E-15	70	High	85	Medium
E-18	60	Medium	95	High
Average	60,63		90,91	

From 8 students in the high Mathematics Self-Efficacy category, 3 students were selected as subjects in this study, namely E-13 as S-07, E-18 as S-08, and E-20 as S-09. After going through a qualitative data analysis of the results of written work and the results of interviews with research subjects with the category of Mathematics Self-Efficacy high obtained results as shown in table 8.

Table 8. The Result of Qualitative Analysis from Written Job Results and Interview Results of Research Subjects in the High Mathematics Self-Efficacy Category.

Subject		S-07				S-08				S-09			
KPM Indicator	SPM Step	Question Number											
		1	2	3	4	1	2	3	4	1	2	3	4
Understand ing the problem	Define variables and assign symbols	√	√	√	√	√	√	√	√	√	√	√	√
Devising a plan	Build mathematical models	√	√	√	√	√	√	√	√	√	√	√	√
Carrying out the plan	Finishing the model	√	×	√	×	×	√	√	√	√	×	√	×
Looking back	Interpretation and problem solution	√	×	√	×	×	√	√	√	×	×	×	×

Information:

√ : able

× : unable

From the results of the qualitative analysis of the results of written work and the results of interviews on research subjects with high category of Mathematics Self-Efficacy, it seems that there are still indicators of problem solving ability and mathematical modeling steps that have not been fulfilled. Indicators that are able to be met by subjects with high Mathematics Self-Efficacy more than subjects with low and medium Mathematics Self-Efficacy.

4. Conclusion

Based on the results of research on the ability to solve problems with mathematical modeling strategies in terms of students' Mathematics Self-Efficacy through Generative Learning Model which is carried out on statistics material class VIII at One of junior high school 41 Semarang, the following conclusions are obtained; (1) The ability of students 'problem solving with mathematical modeling strategies through Generative Learning Model in class VIII statistical material achieves learning completeness, (2) The ability of students' problem solving with mathematical modeling strategies through Generative Learning Model in class VIII statistical material has increased, (3) There is a positive influence between the level of Mathematics Self-Efficacy on students' problem solving abilities, (4) Students with high levels of Mathematics Self-Efficacy tend to have better problem solving abilities than students with moderate and low levels of Mathematics Self-Efficacy and students with Mathematics levels Medium Self-Efficacy tends to have better problem solving skills than students with low Self-Efficacy Mathematics levels.

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