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Missouri Mathematics Project learning model with strategy Everyone is a Teacher Here to towards mathematical problem-solving and self-efficacy ability

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Abstract:
Every student must acquire mathematical problem-solving skills and self-efficacy to assist them in the learning process and solve different mathematical problems. This study seeks to explore the impact of implementing "the Missouri Mathematics Project (MMP) learning model with the Everyone is a Teacher Here (ETH) strategy on the mathematical problem-solving skills and self-efficacy of learners". This study employs a quasi-experimental design with a 2×2 factorial research scheme. In this research, tests of mathematical problem-solving skills and self-efficacy questionnaires were utilized to collect data. The method of data analysis employed the Normality test, the Homogeneity test, and the Multivariate Analysis of Variance (MANOVA) hypothesis tests. Based on the outcomes and MANOVA test calculations, it was determined that implementing the MMP learning model with the Everyone is a Teacher Here strategy affected students' mathematical problem-solving skills. The deployment of the MMP learning model with the Everyone is a Teacher Here strategy also affects students' self-efficacy. Implementing the MMP learning model with the Everyone is a Teacher Here strategy impacts learners' mathematical problem-solving skills and self-efficacy.

Keywords: Everyone is a Teacher Here, Learning Model, Mathematics, Missouri Mathematics Project, problem-solving, self-efficacy

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Introduction

Problems are realities or situations in everyday life that require resolution. Problems are situations that contain difficulties for someone and encourage them to find solutions (Janah et al., 2019; Komarudin & Permana, 2019). The problem is fundamentally a question that requires a response. A question's likelihood of eliciting a correct response depends on its formulation and organization (Akbar et al., 2020; Jatisunda & Nahdi, 2020). Solving a problem necessitates certain skills for those who wish to resolve the issue (Desti et al., 2020; M. Sari et al., 2020). With a rising focus on creative mathematical thinking in mathematics education, there has been a corresponding increase in the requirement for determining how to evaluate creative thinking skills (Chairani, 2016). A problem-solving thought is specifically targeted toward the implementation, or a means out of a particular issue (Chairani, 2016). Mathematical problem-solving is fundamental to acquiring fundamental abilities (Puspita et al., 2020). Therefore, in solving problems, it is necessary to develop an understanding of issues, produce mathematical models, apparent up problems, and interpret answers (Mariam et al., 2019).

The ability to solve mathematical issues is a process of using existing knowledge and skills to answer further questions and problems (Agustiana et al., 2018). Problem-solving skills can be viewed as the effort to discover an answer to an issue (Fitri et al., 2020; Huda et al., 2020). Problem-solving abilities require students to solve a problem presented by the teacher and the process of combining their skills (Rahmmatiya & Miatun, 2020). Students can contemplate the process of solving a mathematical problem and can discover new ways to apply previously-learned rules by combining previously-learned rules in unusual manners (Fauziah et al., 2018). However, in reality, some learners have been unable to solve a mathematical issues (Novitasari & Masriyah, 2020). In addition to mathematical abilities, another aspect that is no less important is also to be developed by students, namely the affective aspect in the form of students' Self-Efficacy.

Self-efficacy or self-efficacy is a notion that every student has regarding challenging demands in believing in his abilities (Mukuka et al., 2021; Noer et al., 2020; Utami et al., 2019). Self-efficacy affects people's feelings, thoughts, and actions (Putra et al., 2021). Self-efficacy can determine how strong we are in persevering when faced with a difficulty or a failure and how success or failure in a particular task affects our behavior in the future (Firdaus et al., 2021). Self-efficacy levels can increase or inhibit motivation to act (Meiliati et al., 2018). Students usually select to do more challenging tasks with high self-efficacy (Tarumasely, 2021).

Characteristics of learners who have high self-efficacy have confidence in their skills and that they can solve the issues they are facing by addressing these problems wisely, being diligent in completing existing assignments, doing assignments carefully, and responding to a problem as a challenge, not a threat (Indrawati & Wardono, 2019; Suri et al., 2021). Students with high self-efficacy will be happy with new things because new things will add new experiences, do not give up if their efforts fail, try to rise above failures, and remain confident that they can solve existing problems (Johanda et al., 2019; Warsiki & Mardiana, 2019).

The preliminary study's results were founded during the learning process and still used conventional learning models with the method lecture. Then students would be given a few questions that work for them. In class learning processes, it can be observed that teachers must be less passive than learners. Learners have tended to be quiet, listen, and accept what the educator conveyed. The result was students being passive, not daring to express opinions, not daring to ask questions when they did not understand the lesson, hesitant when speaking in front of the class, and silent when the subject educator appointed them to come forward in front of the class, students did not believe that they were capable. In making decisions, students tended to get bored learning in class. It caused a low ability for mathematical problem-solving and self-efficacy for students.

As an essential component of the learning process, educators must enhance the quality of classroom instruction (Ulva & Suri, 2019). The accuracy of selecting instructional strategies affects students' mathematical problem-solving skills and self-efficacy (Sari et al., 2020). The alternative cooperative learning model for enhancing these skills is the MMP learning model with the ETH strategy.

Some research on the MMP learning model and ETH strategy has been done before by several researchers. The findings obtained from the MMP learning model can improve students' mathematical communication (Astiswijaya, 2020), (Astiswijaya, 2020) in improving students' conceptual understanding abilities (Anggraini et al., 2020), and are influential in increasing students' problem-solving abilities (Sunanto et al., 2020). Next, research on the ETH strategy obtained the results that the ETH strategy had an impact on developing students' conceptual understanding skills (Apriyanti et al., 2021), influenced improving students' critical thinking skills (Yusuf, 2018), and influential in improving student learning outcomes (Halidin, 2020). The difference between these studies and the research that researchers will do is that researchers use the MMP learning model with the ETH strategy for students' mathematical problem-solving abilities and Self-Efficacy. The MMP learning model with the ETH strategy is expected to be able to train students' mathematical problem-solving abilities and Self-Efficacy.

Regarding these findings, this research aims to determine the influence of the MMP learning model with the ETH strategy on students' mathematical problem-solving abilities and Self-efficacy. Research to improve students' mathematical problem-solving skills and Self-efficacy deliberately uses the MMP learning model with the ETH strategy in the experimental class for updates from previous research.

Research Methods

This study utilized a quasi-experimental design employing a 2x2 factorial research design. It consisted of two classes: an experimental class and a control class. The research design employed a Post-test and Only a Control Group Design. The primary objective of this study was to examine the impact of implementing the MMP (Mathematical Modeling Project) learning model with the ETH (Exploration, Transformation, and Hybridization) strategy on students' mathematical problem-solving skills and self-efficacy.

The research sample for this study consisted of two classes from SMA Negeri 11 Bandar Lampung: Class X MIPA 1 and Class X MIPA 2. Class X MIPA 2, comprising 28 students, served as the experimental (treatment) class and received instruction using the MMP learning model with an active learning strategy known as ETH. On the other hand, Class X MIPA 1, consisting of 28 students, served as the control class and received instruction using a conventional learning model.

The specific topic covered in this study was the "Linear System of Equations with Three Variables" (SPLTV). The topic of SPLTV was chosen for this study to investigate the effects of implementing the MMP learning model with the ETH strategy on students' mathematical problem-solving skills and self-efficacy. The choice of this specific topic allows for examining how students engage with and apply mathematical concepts in a complex and multi-variable setting. Linear systems of equations with three variables presented unique problem-solving challenges because they required students to analyze and solve equations with multiple unknowns simultaneously. By focusing on this topic, the study aims to explore how implementing the MMP learning model with the ETH strategy can enhance students' ability to understand and solve such systems of equations.

Furthermore, studying linear systems of equations with three variables provides an opportunity to assess students' critical thinking skills, logical reasoning abilities, and capacity to apply mathematical concepts to real-world scenarios. Understanding and solving these equations are fundamental skills in various fields, including mathematics, physics, engineering, and economics. Overall, investigating the impact of the MMP learning model with the ETH strategy on the topic of linear systems of equations with three variables offers insights into the effectiveness of the instructional approach in enhancing students' problem-solving skills and self-efficacy in a challenging mathematical context.

The data collection techniques of this research were in the form of tests of mathematical problem-solving abilities and self-efficacy questionnaires. The test of hypothesis after a prerequisite test was first carried out on the results of the ability test of the math problem-solving ability, Self-efficacy for students in each treatment class. The problem-solving indicators are: Identifying the problem, creating a solution, acting on the solution, and returning to check the results (Suherman et al., 2019). The test was 5 items. Self-efficacy was assessed using a seven-item Self-efficacy Scale (Harini & Rosyad, 2021). The scale employed a Likert format, where participants indicated their level of agreement on a scale ranging from 1 (disagree) to 5 (strongly agree). In this study, Cronbach's alpha coefficient for the scale was calculated to be 0.77, indicating satisfactory internal consistency. Data analysis techniques used in this research are the normality test, homogeneity test, and statistical hypothesis testing Multivariate Analysis of Variance (MANOVA) with a significance level of 5%.

Results and Discussion

In this research, mathematical problem-solving ability assessments and self-efficacy questionnaires were administered to the learners in the experimental class (the class that implemented the MMP learning model with the ETH strategy) and the control class. The experimental class demonstrated significant gains in mathematical problem-solving ability and self-efficacy. The outcomes of mathematical problem-solving assessments and the Self-efficacy questionnaire are described in Table 1, assuming that the data are homogeneous.

Table 1. Posttest Observation Data Description Mathematical Problem-Solving Ability

Group	X_{max}	X_{min}	Centrally Density Size			Group Size Variance	
			$\bar{x}$	M_o	M_e	R	sd
Experiment	100	70.45	86.44	95.45	86,36	29.55	8.87
Control	100	52.50	76.48	70.00	72.50	47.50	11.23

Based on Table 1, the results of the experimental class' on math problem-solving abilities obtained maximum and minimum values, respectively, 100 and 67.50. During the class control, it values the maximum and minimum, respectively, 100 and 52.50. Then the average values, mode, and median in the experimental class are respectively 84.29, 85.00, and 85.00, during the average values, mode, and median of the class control are respectively 76.39, 70.00, and 72.50. The conclusion of the results on mathematical problem-solving abilities in the experimental class that applied the MMP learning model with the active learning strategy ETH is higher than the results of problem-solving abilities to the class had controlled on applying conventional learning models.

Table 2. Description of Self-Efficacy Observation Data

Group	X_{max}	X_{min}	Centrally Density Size			Group Size Variance	
			$\bar{x}$	M_o	M_e	R	sd
Low Self-efficacy							
Experiment	55	52	53.83	54	54	3	1.17
Control	46	39	43.71	45	45	7	2.63
Moderate Self-efficacy							
Experiment	65	57	60.07	58	59	8	2.87
Control	60	47	53.93	57	55	13	4.36
High Self-efficacy							
Experiment	74	68	69.63	68	69.00	6	2.07
Control	64	60	62.00	63	62	4	1.41

Table 2 shows the outcomes of the low Self-efficacy questionnaire in the experimental class obtained the maximum and minimum values of 55 and 52, respectively; the control class amounted to 46 and 39. Then the average value, mode, and median in the experimental class are respectively 53, 83, 54, and 54, while in the control class, the average values, mode, and median are respectively 43, 71, 45, and 45. Furthermore, the results of the Self-efficacy questionnaire are in the experimental class. The maximum and minimum values obtained are respectively 65 and 57, while in the control class, the maximum and minimum values are respectively 60 and 47. Then the mean values, mode, and median in the experimental class are respectively 60.07, 58, and 59, while in the control class, the average value, mode, and median are respectively 53.93, 57, and 55.

Next, the high Self-efficacy questionnaire results in the experimental class obtained maximum and minimum values, respectively, 74 and 68. In contrast, the class control obtained maximum and minimum values, respectively, 64 and 60. Then the average value, mode, and median in the experimental class are respectively 69.63, 68, and 69, while in the class control, the average values, mode, and median are respectively 62.00, 63, and 62. The conclusion of the Self-efficacy questionnaire results are low, moderate, and high in the experimental class applies the MMP learning model with the ETH active learning strategy is higher than the results of the low, medium, and high self-efficacy questionnaires in the class control applies the conventional learning model.

The data will be collected from the test scores of mathematical problem-solving abilities and the self-efficacy questionnaire, followed by the evaluation of the collected data. Employing the data normality test, the homogeneity test, and the MANOVA hypothesis test, the researchers will analyze the test scores for mathematical problem-solving skills and the self-efficacy questionnaire from the experimental and control classes. If the data under consideration has a normal distribution, then parametric statistical methods can be used; otherwise, non-parametric statistical methods can be used if the data does not have a normal distribution (Casella & Berger, 2002).

The first stage will consist of data analysis using the Kolmogorov-Smirnov normality test on the outcomes of mathematical problem-solving abilities and self-efficacy questionnaires administered to students. If the p-value exceeds 0.05, the Kolmogorov-Smirnov normality test concludes that the data are normally distributed. Table 3 is the calculated outcome of the normality test for mathematical problem-solving skills and self-efficacy.

Table 3. Summary of Normality Test Results for Mathematical Problem-Solving Ability

Group	p - Value	Significance	Decision
Experiment	0.200	0.05	Normal Distribution
Control	0.137	0.05	Normal Distribution

Table 3 displays the outcomes of the test calculation for learners' mathematical problem-solving skills at the 0.05 significance level. Normally distributed populations are assumed to be the experimental and control group data source because they match the criteria where the value of p - Value > α.

Table 4. Summary of Self-Efficacy Normality Test Results

Group	p - Value	Significance	Decision
Experiment	0.116	0.05	Normal Distribution
Control	0.200	0.05	Normal Distribution

Table 4 shows the results of normality test calculations of students' Self-efficacy at the significance level is α=0,05 can be concluded that the experimental class and control class data are collected from normally distributed populations because they match the criteria where the value of p - Value > α.

The data analysis includes a homogeneity test on the outcomes of mathematical problem-solving assessments and self-efficacy questionnaires administered to learners in the experimental and control classes. Self-efficacy follows the calculation of homogeneity on the outcomes of the mathematical problem-solving ability assessment, as presented in Table 5.

Table 5. Summary of Homogeneity Test

Statistics k	Mathematical Problem Solving	Self-Efficacy
p − Value	0.354	0.241
Significance	0.05	0.05
Conclusion	Homogeneous	Homogeneous

Table 5 shows that the mathematical problem-solving ability data comes from the same population variance because it fits the criteria where-Value = 0.354 > α = 0.05. Furthermore, it can be seen that the Self-efficacy data comes from the same or homogeneous population variance because it fits the criteria where p - Value = 0.241 > α = 0.05.

This study employs a parametric test to evaluate its hypothesis: the Multivariate Analysis of Variance (MANOVA) test. The initial test conducted is an influence test between subjects/variables (Test of Between-Subjects Effects). Table 6 displays the outcomes of the test.

Table 6. Test of Between-Subjects Effects

Source	Dependent Variables	Type III Sum of Squares	df	MeanSquare	F	Sig.
Corrected Model	Solution to problem	1354.673a	1	1354.673	13.515	0.001
	Self-efficacy	912.071b	1	912.071	19.455	0.000
Intercepts	Solution to problem	372199.127	1	372199.127	3713.300	0.000
	Self-efficacy	184690.286	1	184690.286	3939.448	0.000
Model	Solution to problem	1354.673	1	1354.673	13.515	0.001
	Self-efficacy	912.071	1	912.071	19.455	0.000

a. R Squared = 0.651 (Adjusted R Squared = 0.645)
b. R Squared = 0.337 (Adjusted R Squared = 0.325)

Table 6 shows that in the learning model row for mathematical problem-solving abilities, a value p - Value of 0.001 is obtained with the degree of significance used, namely 0.05. It shows that p - Value < 0.05, so H_{0A} is rejected and H_{1A} accepted. The conclusion is that there are differences in students' mathematical problem-solving abilities in classes that apply the MMP learning model with the ETH strategy. Interpreting the learning model line on Self-efficacy obtained a value p - Value of 0.000 with the degree of significance used, namely 0.05. It shows that p - Value < 0.05, so H_{0B} is rejected and and H_{1B} accepted. The conclusion is that there are differences in students' Self-efficacy in classes that apply the Missouri MMP learning model with the ETH strategy.

Next, a Multivariate test will be carried out to know the impact of the learning model on mathematical problem-solving abilities and Self-efficacy simultaneously. The Multivariate test was done using the SPSS 26 program. The outcomes of the Multivariate test are presented in Table 7.

Table 7. Multivariate Test

	effects	Value	F	Hypothesis df	df errors	Sig.
Intercepts	Pillai's Trace	0.992	3134.554b	2.000	53.000	0.000
	Wilks' Lambda	0.008	3134.554b	2.000	53.000	0.000
	Hotelling's Trace	118.285	3134.554b	2.000	53.000	0.000
	Roy's Largest Root	118.285	3134.554b	2.000	53.000	0.000
Model	Pillai's Trace	0.338	13.557b	2.000	53.000	0.000
	Wilks' Lambda	0.662	13.557b	2.000	53.000	0.000
	Hotelling's Trace	0.512	13.557b	2.000	53.000	0.000
	Roy's Largest Root	0.512	13.557b	2.000	53.000	0.000

a. Design: Intercepts + Models

b. Exact statistics

Table 7 shows that the Wilks' Lambda Test analysis outcomes on the learning model line for mathematical problem-solving ability and Self-efficacy obtained a value of p – Value 0.000 with the degree of significance used, 0.05. It shows p – Value < 0.05, so H_{0C} is rejected and H_{1C} accepted. The conclusion is that there are several contrasts in the mathematical students' problem-solving ability and Self-efficacy in the class that implements the MMP learning model with the ETH strategy.

The findings gained by the researchers are also suitable to prior research using the MMP learning model with the active learning strategy ETH by Nike Astiswijaya. The results showed that implementing the MMP learning model effectively enhances learners' mathematical communication skills (Astiswijaya, 2020). Further research by Rahma Faelasofi Sunanto, Risna Apriliani, and Walidatul Nafi'ah revealed that learning using the MMP model could enhance students' problem-solving abilities (Sunanto et al., 2020). Then Anggraini et al. (2020) found that learning using the MMP model could enhance students' conceptual understanding abilities.

The researchers' results are that integrating the MMP learning model with the Everybody a Teacher strategy in the experimental class has a more significant impact on students' mathematical problem-solving skills and self-efficacy than the control class using traditional learning models. This research is supported by Namaziandost & Çakmak (2020), that there were significant differences in self-efficacy levels between male and female learners, with females demonstrating higher levels of self-efficacy. It is possible since the MMP learning model with the ETH strategy has distinct features from traditional educational models, one of which is derived from the learning model's phases. Learning model phases differ between the MMP learning model with the ETH strategy and the traditional educational approach. At the beginning of experiment, to confirm the "uniformity" of mathematical abilities in the control and experimental classes, researchers often employ a process called randomization or random assignment. The random assignment involves randomly assigning participants to either the control or experimental class, which helps ensure that any pre-existing differences in mathematical abilities are distributed evenly across the class.

The first stage in the MMP learning model with the ETH active learning strategy is the preliminary or review step. At this stage, the educator discusses the questions or assignments that are considered the most difficult by students, then reviews previous lessons related to the material to be studied and motivates students regarding the importance of the material to be studied. The development step is the secondary step of the MMP learning model with the ETH active learning strategy. At this stage, the educator conveys new material to expand previous mathematical concepts and then includes demonstrations with concrete examples. The controlled exercise step is the third step of the MMP learning model with the ETH active learning strategy. At this stage, the educator divides students into several groups and then provides specific details of the responsibilities of each student and group based on the achievement of the material being studied. Next, the teacher distributes index cards to all learners in the class and allows them to write down one question related to the material or topic to be discussed.

The fourth step of the MMP learning model with the QSH (Question Student Have) strategy is the independent work step or seatwork. At this stage, the educator gives several questions as exercises for expanding the concept of material that has been studied in the development step. Then the educator directs students to work independently for practice or expansion of concepts. The closing step is the fifth step of the MMP learning model with the ETH active learning strategy. At this stage, the educator invites students to present the findings of problem solutions found with educators or other students. Educators and participants students together make conclusions (summaries) of the learning material that has been obtained.

The description explains the other factors that caused problem-solving abilities and self-efficacy to be better by teaching the MMP learning model with the active learning strategy ETH compared to conventional learning models. It is suspected because students that were taught using the learning model MMP with the active learning strategy ETH were directed to match or look for pairs of cards (question cards and answer cards) that required students to be active and work together, so it could increase students' sense of responsibility for what was learned by fun and helped each other in solving questions. This activity made students look enthusiastic about working on questions. Students competed with each other to work on existing questions quickly. Since the group discussion phases in the MMP learning model with the ETH active learning strategy were highly structured and interesting, students were more focused during group discussions. When students were successfully following each step, they could comprehend and solve each math challenge. Students will be more interested in the subject matter presented, foster excitement during the learning process, increase collaboration between students through the learning process, students are actively involved during the learning process and can improve student learning outcomes (Aldig & Arseven, 2017; Suherman & Vidakovich, 2022).

After the learning activities were completed and the material delivered, the researcher gave post-test questions and questionnaires to students. The post-test and questionnaire were administered to determine the impact of using the MMP learning model with the active learning strategy ETH on students' problem-solving abilities and Self-efficacy. Students responded well to the MMP learning model with an active ETH learning strategy. It shows that students were interested in implementing the MMP learning model with an Active ETH learning strategy in SPLTV material. In the MMP learning model with the active learning strategy ETH, it could be seen from the atmosphere during the process of teaching and learning (KBM) that the student felt comfortable, motivated, enthusiastic, and seemed active for learning in the class and able to accept material that researchers have presented.

Several things were not maximized during the implementation of this research, namely, the student who was passive when the MMP learning model was implemented with the active learning strategy ETH. The students conveyed that some students lack confidence in the discussion results in group discussions. Furthermore, some students had good abilities but in the learning process were not active and did not understand the material, so they got poor test scores. Then there are students who have low abilities but are in an active learning process and understand the material so they get better test scores. Then some students worked together in answering questions, students who like to ask questions that did not understand or lack clarity about questions and those who liked mathematics so much. However, the student responded and understood the material well in the MMP learning model and with this active learning strategy ETH.

Student enthusiasm for the MMP learning model with the ETH strategy is presented in the outcomes. The rules in the teaching and learning process (KBM) revealed that the learners experienced relaxing, inspired, enthusiastic, and active learning and can interact effectively with others. The material had been submitted by researchers in good receiving. However, they were still students who were passive when the MMP learning model was applied with the ETH strategy; however, when students were presented with the results of group discussions, any students lacked the confidence to convey the results of the discussion. Overwhole, students could respond and understand the material well in the MMP learning model with the ETH strategy.

Based on this result, students who had applied the MMP learning model with the ETH active learning strategy produced better problem-solving abilities and Self-efficacy and could optimize the potential within. Each student had compared to learning using conventional learning models. The research outcomes show that learners who get the MMP learning model with the active learning strategy ETH have better problem-solving abilities and self-efficacy than learning using traditional learning models.

Conclusions and Recommendations

This study's analysis and discussion led to the conclusion that the MMP learning model impacted the learners' mathematical problem-solving skills regarding using the active learning strategy of ETH. MMP learning model with the active learning strategy of ETH impacted learners' self-efficacy. The MMP learning model impacted the active learning strategy of ETH on the learners' mathematical problem-solving skills and self-efficacy. Other more effective learning models than this particular one have been examined by researchers to evaluate students' mathematical problem-solving skills and self-efficacy. It seeks to determine the efficacy of alternative learning models in enhancing students' mathematical problem-solving skills and self-efficacy.

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