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IDEAL (Identify, Define, Explore, Act, Look Back) Metacognitive-STAD Cooperative Learning to Improve Students' Self-Efficacy and Problem-Solving Ability

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Abstract: This study aims to determine the effectiveness of IDEAL-type metacognitive combined with STAD cooperative learning to improve students' self-efficacy and problem-solving abilities in thermochemistry. The research design used was a Quasi-Experimental Pretest-Postest Control Group Design and a 2 x 2 factorial design. The experimental class was taught with the IDEAL type metacognitive learning strategy combined with STAD cooperative learning, while the control class was taught with the STAD cooperative learning model. The data analysis technique used is descriptive analysis and different tests. The results showed that the IDEAL type metacognitive learning strategy combined with STAD cooperative learning was more effective in improving students' problem-solving abilities than the STAD cooperative learning model. However, it is not effective in increasing students' self-efficacy. Suppose students are taught with the IDEAL type metacognitive learning strategy combined with STAD cooperative learning and accompanied by high learning motivation. In that case, the students' self-efficacy and problem-solving abilities also increase even though the interaction between the two is weak.

Keywords: metacognitive strategies, learning motivation, combined learning strategy, 21^{st} century skills

INTRODUCTION

The 21st-century skill standard requires students to have high problem-solving abilities (Griffin & Care, 2015). This is a big challenge for Indonesia's people to continue competing with other countries in efforts to increase Human Resources. Özreçberoglu & Çaganaga (2018) stated that every student must own problem-solving abilities because the environment around students cannot be separated from chemical problems. Therefore, in learning chemistry, problem-solving activities must prepare students to enter the world of work full of challenges and innovations that demand a professional problem-solver (Kurniawati, 2022). Problem-solving ability can be seen from the individual process of identifying, searching, evaluating, selecting, and considering various alternatives accurately, precisely, harmoniously, and rationally (Polya, 1971).

Kurniawan & Sofyan (2020) stated that students' problem-solving abilities in chemistry lessons were still very low. This follows the PISA (Program for International Student Assessment) survey in 2018, which showed that Indonesia ranked 71 out of 79 countries in the science category. This ranking is not much different from the 2015 PISA survey. The 2015 PISA survey data shows Indonesia is ranked 64 out of 72 countries. The low ability of students to solve chemical problems is due to the characteristics of microscopic concepts (Demirdogen, 2017), mathematical, symbolic and involve manychemical reactions, calculations, and abstract concepts (Lindawati et al., 2019). Students' difficulties in solving chemical problems are often found in chemical materials related to calculations. Kusumaningrum, et al. (2015) stated that the chemical material considered the most difficult by students was thermochemistry, with a percentage of 38% of all chemical materials. The results of this study are in accordance with the research of Erna et al. (2018), which shows that students still have difficulty understanding thermochemical material, with a learning completeness percentage of only 49% in the 2015/2016 Academic Year and 55% in the 2016/2017 Academic Year. The low percentage of student learning completeness is caused by the many concepts in thermochemical material that students do not understand. This is in accordance with the research of Aswita et al. (2017), which shows that the level of students' understanding of thermochemical material is still in the low category, with a percentage of 25% of students who do not understand the concept; 10% of students who understand the concept; 64% students have misconceptions, and 2% errors. Based on the results of research by Kurnia et al. (2022) also obtained information that 75% of students still had difficulties carrying out problem-solving activities on thermochemistry because this topic was very complex, required in-depth understanding, and high problem-solving abilities.

Students' self-efficacy is one of the most critical dimensions of the problem-solving process (Husna & Kurniasih, 2019). Low student problem-solving abilities are usually accompanied by low self-efficacy. This is because self-efficacy within an individual can make him think critically, be motivated, and influence a person's behaviour (Wu et al., 2022). Self-efficacy can also help students evaluate self-confidence to overcome problems related to how far a person can act when faced with a problem (Bardach and Patashnik, 2019).

The results of several studies show that learning motivation positively affects students' problem-solving abilities (Fatimah et al., 2018; Harahap, 2021). Learning motivation also contributes to students' self-efficacy and problem-solving abilities (Güss et al., 2017; Urhahne, 2021). The results of this study are supported by Ayunia & Marlena (2022), who states that if students' learning motivation is high, then students' problem-solving abilities are also high. The problem-solving skills of students with high learning motivation are better than students with low learning motivation (Pohan et al., 2020). This shows that learning motivation is a main factor in achieving students' problem-solving abilities. Learning motivation and self-efficacy also have a positive influence on each other. High student learning motivation can improve student self-efficacy for the better (Bandura, 1977). The higher the learning motivation, the higher the level of student self-efficacy (Ariff et al., 2022).

An alternative to increase self-efficacy and develop students' problem-solving abilities is to apply innovative and creative learning strategies. The IDEAL type metacognitive learning strategy (Identify the problem, Define the problem, Explore solution, Act on strategy, and Look Back & evaluate the effect) is a problem-solving learning strategy that was first developed by Bransford & Stein (1993). This learning strategy improves problem-solving abilities and influences students' metacognitive skills (Wehmeyer, 2007). The results showed that the IDEAL metacognitive learning strategy could improve students' problem-solving skills (Rahayu & Kartono, 2014; Hasbullah & Wibawa, 2017).

The STAD (Student Team Achievement Division) learning model is a cooperative learning model that Robert Slavin first developed. The STAD learning model is a simple cooperative learning model where students study in groups of 4-5 mixed students (Slavin, 2005). The STAD learning model emphasizes the learning of peer tutors (students) who help each other in groups when solving problems (Ishtiaq et al., 2017; Melian & Solihat, 2019). Through group activities, this learning can be used to improve cooperation, self-efficacy, and problem-solving abilities (Widhyastika et al., 2017).

The IDEAL type metacognitive learning strategy needs to be modified by combining it with the STAD cooperative learning model because it still has some weaknesses. IDEAL-type metacognitive learning strategies can only be used to improve students' problem-solving skills individually (Ulya, 2016). In addition, the steps of this learning strategy are not found in the initial stages that solidify small units of material, causing students difficulties when carrying out problem-solving activities (Murniati, 2018). Previous research also shows that this learning strategy takes a lot of time and is too long because there are many steps that students have to do independently (Indriyani, 2016).

A redesign is needed based on some of the weaknesses found in the IDEAL type of metacognitive learning strategy. The redesign of the IDEAL type metacognitive learning strategy is to combine it with the STAD cooperative learning model. IDEAL-type metacognitive learning strategies are inserted into group activities in the syntax of the STAD cooperative learning model. Through the application of the IDEAL type metacognitive learning strategy combined with STAD cooperative learning, it is hoped that students' self-efficacy and problem-solving abilities will increase.

METHOD

The research design used a Quasi-Experimental Pretest-Postest Control Group Design and a 2 x 2 factorial design. The Quasi-Experimental research design was used to determine whether students' self-efficacy and problem-solving abilities differed in the experimental and control classes. The experimental class applied the IDEAL type metacognitive learning strategy combined with STAD cooperative learning, while the control class in this study applied the STAD learning model. A 2 x 2 factorial design was used to show the possibility that there is a moderate variable (learning motivation) that influences the independent variable (learning model) on the dependent variable (self-efficacy and problem-solving ability).

The population of this study were all students of class XI MIPA at SMA Negeri 1 Malang. Class XI MIPA at SMA Negeri 1 Malang consists of eight classes. The sampling technique used in this research is cluster sampling. The class chosen as the research sample was class XI MIPA 5 and XI MIPA 6 at SMA Negeri 1 Malang.

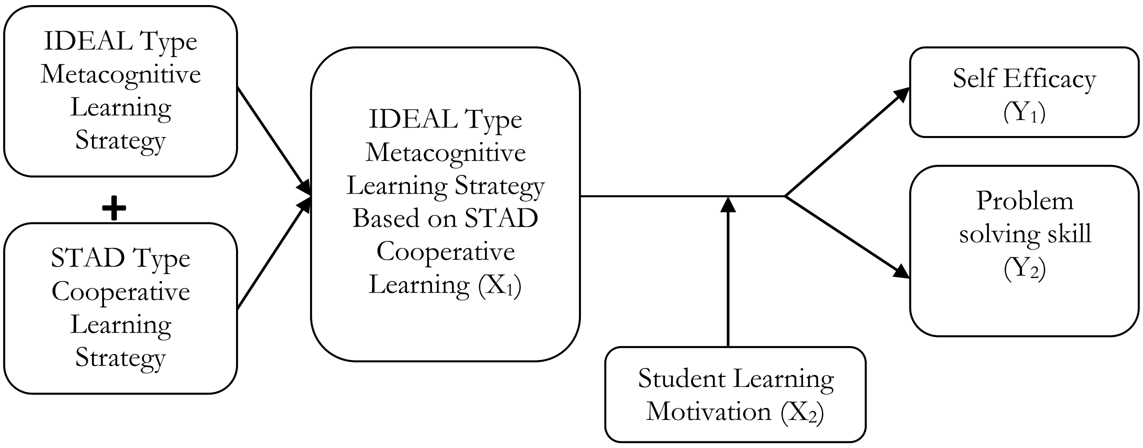

Figure 1.Research Scheme

The research instruments used were problem-solving ability tests, self-efficacy questionnaires, and student learning motivation questionnaires. Students' problem-solving ability is measure using 5 indicators in the IDEAL type metacognitive learning strategy developed by Bransford and Stein (1993). These indicators include: 1) defining the problem, 2) formulating the problem, 3) establishing a strategy, 4) implementing the strategy, and 5) checking again. These indicators are measured through the steps of solving essay questions. The self-efficacy and student motivation level was measured using the SMTSL (Student's Motivation Toward Science Learning) questionnaire developed by Tuan et al. (2005).

The data analysis technique used in this research is descriptive analysis and different tests. Effectiveness test of the learning model by using the N-Gain Score, Cohen's D-Effect Size test, and the Hierarchical Linear Regression test. The research scheme can be seen in Figure 1.

RESULTS AND DISCUSSION

Test the Validity and Reliability of the Problem Instrument

The empirical validity of the 7 items essay problem-solving ability test can be seen in Table 1.

Table 1. Empirical Validity of 7 Items Essay Problem-Solving Ability Test

Item Number	r_{count}	r_{table}	Information	Interpretation	Category
1	0.273				Low
2	0.461				Enough
3	0.744				High
4	0.843	0.195	> 0.195	Valid	Very high
5	0.708				High
6	0.528				Enough
7	0.310				Low

The reliability of problem-solving ability test questions can be seen in Table 2.

Table 2. Reliability Test Problem-Solving Ability

r_{count}	r_{table} (α= 0.05)	Information	Interpretation	Category
0.677	0.195	> 0.195	Reliable	Medium

Level of Learning Motivation, Self-Efficacy, and Problem-Solving Ability of Students

The level of student learning motivation is grouped into high and low. This grouping aims to determine the effect of low and high students' learning motivation on students' self-efficacy and problem-solving abilities. A diagram of the level of student learning motivation can be seen in Figure 2. Figure 2 shows that the number of students with low learning motivation is less than that of students with high learning motivation.

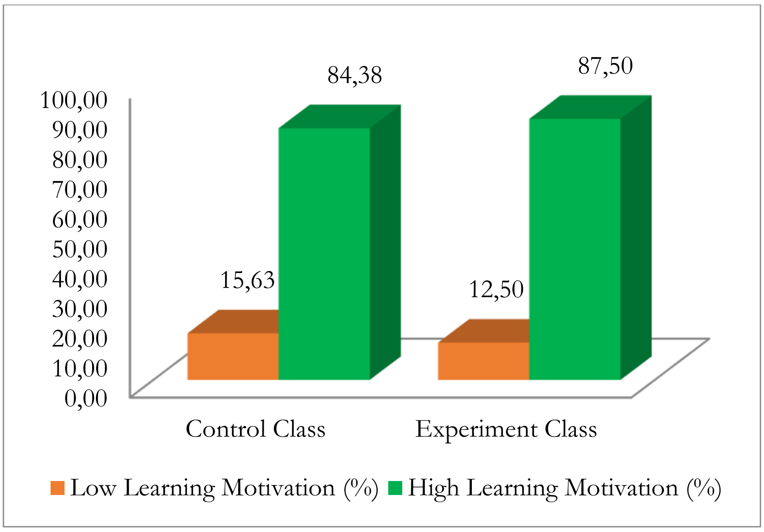

Figure 2. Student Learning Motivation in Control Class and Experimental Class

Student self-efficacy was measured before and after learning activities in the control and experimental classes. A diagram of students' self-efficacy levels can be seen in Figure 3. Figure 3 shows that students' self-efficacy level before and after learning activities in control and experimental classes is included in the high category.

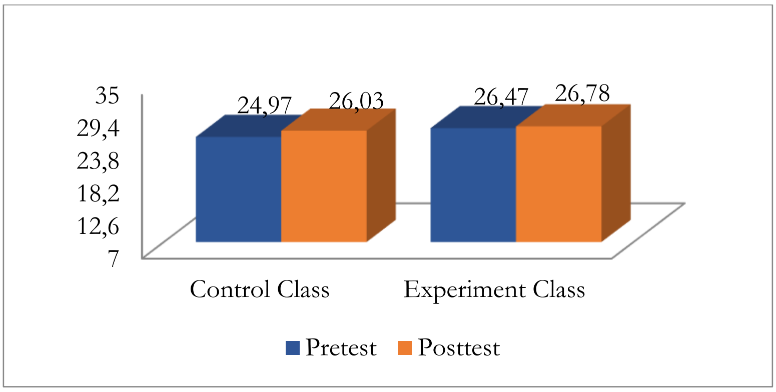

Figure 3. Students' Self-Efficacy Level in Control Class and Experiment Class

Students' problem-solving abilities before being treated with learning strategies were measured through the results of the pretest. Students' problem-solving abilities after being treated with learning strategies were measured through the post-test results. A diagram of students' problem-solving ability levels can be seen in Figure 4.

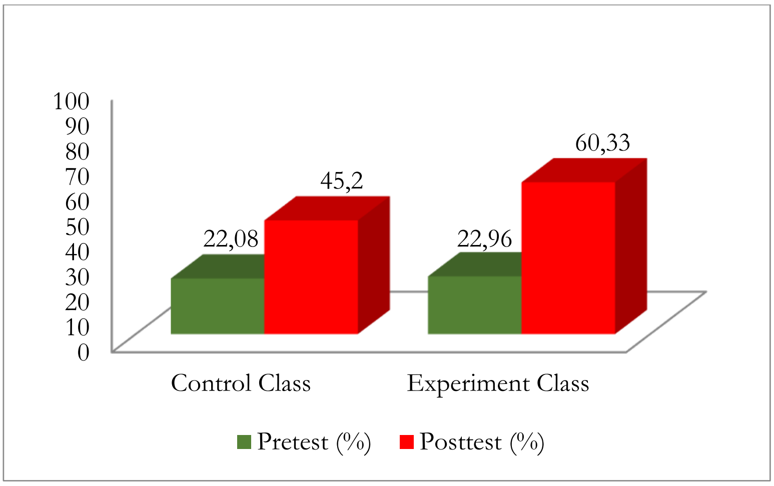

Figure 4. Student's Problem-Solving Ability Levels in the Control Class and Experiment Class

Figure 4 shows the level of students' problem-solving abilities before learning activities in the control class reached 22.08%, and in the experimental class, it reached 22.96%, with both categories being very low. The level of students' problem-solving abilities after learning activities in the control class reached 45.20% in the low category, and in the experimental class, it got 22.96% in the medium category.

The effectiveness of the IDEAL Type Metacognitive Learning Strategy combined with STAD Cooperative Learning to Increase Student Self-Efficacy in terms of Learning Motivation

Overall, the results of the data analysis show that the IDEAL type metacognitive learning strategy combined with STAD cooperative learning is ineffective in increasing students' self-efficacy even though they have high learning motivation. Students' self-efficacy levels in control and experimental classes showed no difference after learning activities. This can be seen from the results of the Two Way-Anova test, which showed no difference in self-efficacy of students in the control class and experimental classes (sig.=0.421). The results of the Two Way-Anova test on student self-efficacy data can be seen in Table 3.

Table 3. Results of the Two-Way-Anova Test on Student Self-Efficacy Data

Category	Significance	Conclusion
Learning model	0.421	No difference
Motivation to learn	0.009	There is a difference
Learning Model * Learning Motivation	0.079	No difference

The IDEAL type metacognitive learning strategy combined with STAD cooperative learning and STAD cooperative learning models cannot increase student self-efficacy. This can be seen from the results of the Wilcoxon test, which shows that the IDEAL type metacognitive learning strategy combined with STAD cooperative learning and the STAD learning model did not increase students' self-efficacy (Asymp.Sig. (2-tailed) = 0.764 and 0.194). The increase in students' self-efficacy in the experimental class was smaller than the increase in students' self-efficacy in the control class. Therefore, the IDEAL type metacognitive strategy combined with STAD cooperative learning was not used effectively to increase student self-efficacy. The results of the N-Gain Score and D-Effect Size tests reinforce this. The results of the N-Gain Score test showed an average increase in students' self-efficacy in the control class by 1.19% and in the experimental class by 0.12% in the ineffective category.The results of the D-Effect Size test in the control class showed a value of 0.19; in the experimental class, it was 0.05, which is much smaller than usual. This study does not follow the results of research by Saputri et al. (2017) and Rohmah et al. (2018), which shows that the STAD cooperative learning model can improve students' self-efficacy.

Students with high learning motivation have high self-efficacy. Meanwhile, students with low learning motivation have low self-efficacy. This is evident from the results of the One-Way Anova test, which shows a difference in self-efficacy between students with high learning motivation and students with low learning motivation both in the control and experimental classes (Sig.=0.009). The results of this study are in accordance with the results of Shin's research (2018), where learning motivation and self-efficacy positively influence each other. High learning motivation can increase student's self-efficacy. The higher the motivation to learn, the level of self-efficacy of students is also higher.

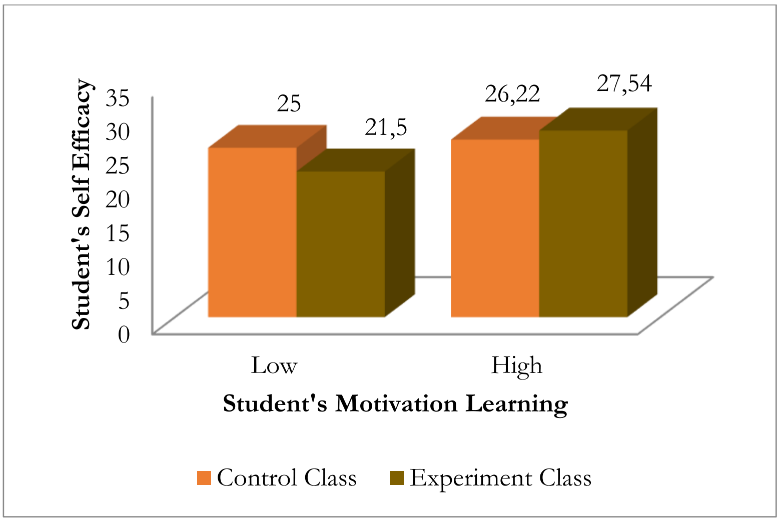

Figure 5. Grouping Student's Problem-Solving Ability Based on Learning Motivation

Conversely, the lower the learning motivation, the lower the students' self-efficacy (Ariff et al., 2022). A diagram of student self-efficacy grouping based on their learning motivation can be seen in Figure 5. This shows that learning motivation is a positive supporting factor in increasing student self-efficacy.

The interaction between students' learning motivation and IDEAL-type metacognitive learning strategies combined with STAD cooperative learning shows a very weak relationship. This can be seen from the One Way Anova test results, which show no interaction between the IDEAL type metacognitive learning strategy combined with STAD cooperative learning and learning motivation on student self-efficacy (Sig.=0.079). The results of the Hierarchical Regression test reinforce this result. Hierarchical Regression test results can be seen in Table 4.

Table 4. Hierarchical Regression Test Results

Category	R2	R2Change	Significance	Conclusion
Learning Model with Self-Efficacy (X*Y)	0.009	0.009	0.451	No connection
Learning Model*Motivation to Learn with Self-Efficacy (Z*Y)	0.101	0.092	0.015	There is a relationship
Learning Motivation with Learning Model (Z*X)	-	-	0.362	No connection

The Hierarchical Regression test shows an R^2 of 0.146 or 14.6%. When the learning motivation score is added to this test, the R^2 value increases significantly (Sig. = 0.015) by 0.092 or 9.2% towards increasing student self-efficacy. So that it can be interpreted that the IDEAL type metacognitive learning strategy combined with STAD cooperative learning with learning motivation affects the increase in student self-efficacy only by 14.6%, and other factors influence the rest. Therefore, learning motivation is a pure moderator variable.

Strategy Effectiveness IDEAL Type Metacognitive Learning combined with STAD Cooperative Learning to Improve Students' Problem-Solving Ability in terms of Learning Motivation

Overall, the results of the data analysis show that the IDEAL type metacognitive learning strategy combined with STAD cooperative learning effectively improves students' problem-solving abilities, especially those with high motivation. Students' problem-solving skills in both the control and experimental classes showed differences after teaching activities. This can be seen from the results of the Two Way-Anova test, which showed differences in students' problem-solving abilities in the control and experimental classes (Sig.=0.012). The results of the Two Way-Anova test on data on students' problem-solving abilities can be seen in Table 5.

Table 5. Results of the Two Way-Anova Test on Student Problem-Solving Ability Data

Category	Significance	Conclusion
Learning model	0.012	There is a difference
Motivation to learn	0.000	There is a difference
Learning Model * Learning Motivation	0.045	There is a difference

IDEAL-type metacognitive learning strategies combined with STAD cooperative learning and STAD cooperative learning models can improve students' chemistry problem-solving abilities. This can be seen from the Wilcoxon test results, which show that the IDEAL type metacognitive learning strategy combined with STAD cooperative learning and the STAD learning model improves students' problem-solving abilities (Asymp Sig. (2-tailed)=0.000).

The increase in students' problem-solving abilities in the experimental class was more significant than the increase in student's problem-solving skills in the control class. Therefore, the IDEAL type metacognitive strategy combined with STAD cooperative learning is more effectively used to improve students' problem-solving skills. This can be seen from the results of the N-Gain Score and D-Effect Size tests. The results of the N-Gain Score test showed that the average increase in student's problem-solving abilities in the control class was 28.63% in the ineffective category, and in the experimental class was 47.91% in the less effective category.The results of the D-Effect Size test in the control class showed a value of 1.49; in the experimental class, it was 2.38, which is far greater than usual. The results of this study follow previous research where the IDEAL type metacognitive learning strategy can improve students' problem-solving abilities (Rahayu & Kartono, 2014; Hasbullah & Wibawa, 2017).

Students with high learning motivation have high problem-solving abilities. Meanwhile, students with low learning motivation have low problem-solving abilities. This is evident from the results of the One Way Anova test which showed differences in problem-solving abilities between students with high learning motivation and students with low learning motivation both in the control class and in the experimental class (Sig.=0.000). The results of this study are under the results of research conducted by Hutajulu et al. (2014), where students' learning motivation has a positive effect on students' problem-solving abilities. The research of Zubaidillah et al. (2022) supports the results of this study, which states that if students' learning motivation is high, then students' problem-solving abilities are also high. The problem-solving abilities of students with high motivation are better than those with low motivation (Pohan et al., 2020). This shows that learning motivation is one of the supporting factors that positively affect the achievement of students' problem-solving abilities. A diagram of grouping students' problem-solving abilities based on their learning motivation is in Figure 6.

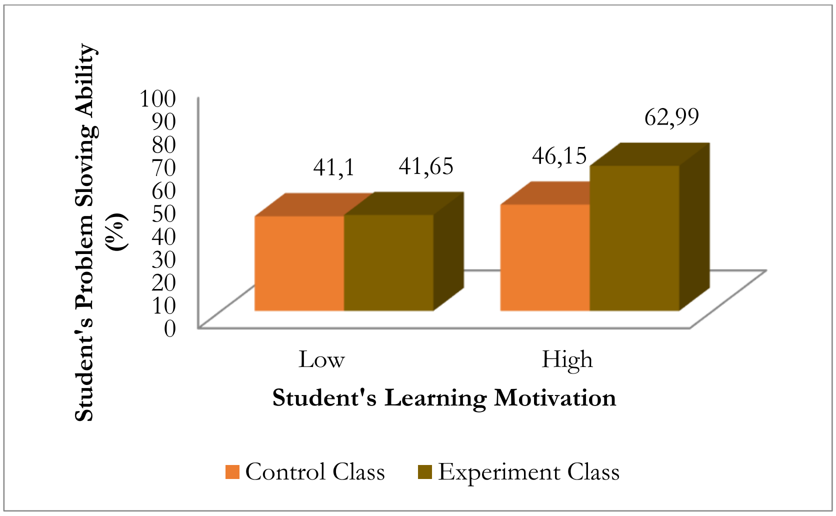

Figure 6. Grouping Student's Problem-Solving Ability Based on Learning Motivation

The interaction between learning motivation and IDEAL-type metacognitive learning strategies combined with STAD cooperative learning shows a weak relationship. This can be seen from the One Way Anova test results, which show an interaction between the IDEAL type metacognitive learning strategies combined with STAD cooperative learning and learning motivation on students' problem-solving abilities (Sig.=0.045). The results of the Hirearchical Regression test reinforce these results. Hierarchical Regression test results can be seen in Table 6.

Table 6. Hierarchical Regression Test Results

Category	R^2	R^2Change	Significance	Conclusion
Learning Model with Problem-Solving Ability	0.344	0.344	0.000	There is a Relationship
Learning Model*Motivated Learning with Problem Solving Ability	0.466	0.122	0.000	There is a relationship
residual	-	-	0.362	No connection

The Hierarchical Regression test shows an R^2 of 0.488 or 48.8%, implying that the IDEAL type metacognitive learning strategy combined with STAD cooperative learning with learning motivation increases students' problem-solving abilities by 48.8% and other factors influence the rest. When the learning motivation score is added to this test, the R^2 value increases significantly (Sig.=0.000) by 0.122 or 1.22% towards increasing students' problem-solving abilities. Therefore, learning motivation is a pure moderator variable. The significance value at (Z*Y) indicates a relationship, whereas (Z*X) indicates no relationship

CONCLUSIONS

The results showed that the IDEAL type metacognitive learning strategy combined with STAD cooperative learning was more effective in improving students' problem-solving abilities than the STAD cooperative learning model. However, it is not effective in increasing students' self-efficacy. Suppose students are taught with the IDEAL type metacognitive learning strategy combined with STAD cooperative learning and accompanied by high learning motivation. In that case, the students' self-efficacy and problem-solving abilities also increased even though the interaction between the two was weak.

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