



The Effect of Video Modeling Example, Worked-Example, and Practice Problem on Mathematics Learning

Zakiya Amalia Hartanto Putri¹, Cecep Anwar Hadi Firdos Santosa^{2*}, Novaliyosi³

^{1,2,3}Universitas Sultan Ageng Tirtayasa, Indonesia

E-mail: cecepanwar@untirta.ac.id

Abstract

Low learning results, learning motivation, and student confidence are frequently encountered when teaching mathematics in junior high school. To address these issues, it is vital to use learning methods that are appropriate for the student's qualities. The purpose of this study is to investigate and compare the impact of different learning strategies, such as video modelling examples, worked-examples, and practice problems, on students' self-efficacy, motivation, and learning outcomes in the cognitive parts of mathematics teaching. This study used a quantitative methodology and a quasi-experimental design. The study involved eighth-grade pupils from a junior high school in Serang City, who were divided into three classes and given different learning techniques. A learning outcomes exam, a self-efficacy questionnaire, and a motivation survey were used to collect data. To identify significant differences between groups, the obtained data were evaluated using a t-test, one-way ANOVA, and a post hoc Tukey HSD test. The study found that the three strategies had a substantial impact on self-efficacy, motivation, and learning results in the cognitive domain. The practice problem method is more effective at boosting self-efficacy, the video modelling example at raising learning motivation, and the worked example at enhancing learning results in cognitive areas. These findings emphasize the necessity of selecting instructional approaches that are consistent with the targeted learning objectives. Future research should look into the effectiveness of these methods across different topic areas, grade levels, or in combination with other pedagogical approaches to acquire a more complete knowledge of their effects.

Keywords: video modeling example; worked-example; practice problem; self-efficacy; motivation.

INTRODUCTION

Many junior high school kids continue to struggle with math. Observations at a junior high school in Serang City found that many eighth-grade students had low desire, confidence, and achievement in mathematics. Teachers stated that pupils frequently hesitated to participate fully in class, lacked persistence in problem solving, and displayed anxiety when confronted with mathematical challenges. This suggests the presence of cognitive and affective learning issues that must be addressed. This suggests the presence of cognitive and affective learning issues that must be addressed. Students' interest for learning arithmetic is impacted by this unfavorable attitude (Putri & Safrizal, 2023). Students' self-efficacy and drive to learn are greatly diminished by such unfavorable perceptions, which eventually result in reduced academic accomplishment in mathematics (Puspaningtyas et al., 2021). Hikmah & Saputra (2022) stated that the two primary variables that affect student learning outcomes are internal factors (such as motivation, interest, and self-efficacy) and external factors (such as learning methods and materials delivered).

In learning mathematics, one of the major challenges faced by students is the lack of confidence in their own ability to solve mathematical problems. This is closely related to the concept of self-efficacy, which is an individuals' confidence in their own ability to regulate and execute the actions needed to reach certain goals (Herzamzam, 2021). Students with high self-efficacy tend to have stronger motivation, a persistent attitude, and the belief that they are able to overcome learning difficulties (Afifah & Kusuma, 2021). A decrease in self-efficacy is also often followed by low learning motivation, which is an internal or external push that directs individuals to carry out learning activities and maintain them (Jainiyah et al., 2019). Without sufficient motivation, students tend to give up quickly when



experiencing learning difficulties, so that learning outcomes become less than optimal. In fact, learning outcomes are indicators of how far students have managed to master the competencies set out in the curriculum (Fazariyah & Dewi, 2020). Therefore, increasing self-efficacy and learning motivation are important aspects that must be considered in an attempt to improve the quality of mathematics learning outcomes of students.

To address these issues, selecting appropriate instructional methods becomes essential. One solution that can be done is to use the right learning method based on the characteristics of the students. Learning method acts as a driver of the learning process because it can encourage active student involvement and reinforce the comprehension of the material taught (Hidayat et al., 2020). In this context, some of the methods that have been developed and used to enhance the efficacy of mathematics learning includes video modeling, worked examples, and practice problems. According to (Van Harsel et al., 2022) a video modeling example is a video-based learning method that shows a recording of someone solving mathematical problems verbally and visually step by step. A worked example is a method that presents problem-solving along with complete and systematic procedures (Hoogerheide et al., 2018; Santosa et al., 2022). Meanwhile, practice problems emphasize problem exercises that are done independently by students to build problem-solving skills (Van Harsel et al., 2022). These three methods offer different approaches that can be matched to the needs of students.

However, most previous studies have examined these methods separately and focused mainly on cognitive aspects such as accuracy in solving problems (Hoogerheide et al., 2014; Van Harsel et al., 2022). There is still limited research that compares the three methods simultaneously and investigates their combined effects on both cognitive and affective domains, especially in the context of Indonesian junior high schools (Santosa et al., 2022). This indicates a gap in the literature that this study aims to fill. This research has novelty in several aspects. First, this study did not only test one learning method separately but compared all three-methods video modeling example, worked-example, and practice problem in one experimental design. Second, this study did not only assess learning outcomes as cognitive output but also evaluated students' affective aspects, namely self-efficacy and learning motivation, simultaneously. Third, this research was conducted at a junior high school level with a local context in Serang City, which has not been used as a similar research location, so the results have the potential to provide empirical contributions that are practically and contextually relevant. Based on this reasoning, this research is aimed at examining the effect of video modeling examples, worked-examples, and practice problem methods on mathematics learning, especially in terms of increasing self-efficacy, learning motivation, and student learning outcomes. In addition, this study also aimed to identify the effect of each learning method and identify the most effective method among the three in improving self-efficacy, motivation, and learning outcomes of students' cognitive aspects in mathematics learning.

METHOD

This research uses a quantitative-based approach with a quasi-experimental research type. The purpose is to know the effect of each learning method and identify the most effective method among video modeling examples, worked-examples, and practice questions on self-efficacy, motivation, and learning outcomes of students' cognitive aspects in mathematics learning. The research design used is a multiple group design involving three experimental classes that will be given three different learning methods (video modeling example, worked-example, and practice problem). This study did not involve a control class. The research was carried out on grade VIII junior secondary school students in Serang City in the even semester of the 2024/2025 academic year. A total of 90 students, consisting of 39 boys and 51 girls, were involved as samples in this study. The students were divided into three experimental classes, namely a class using the video modeling example method (30 students), a class using the worked-example method (30 students), and a class using the practice problem method (30 students).

This study was conducted in three parts. The first stage of this research involved identifying difficulties with students' capacity to absorb and master mathematics curriculum. Problem identification was accomplished by literature reviews and organized interviews with teachers about students' challenges understanding mathematics subject in class. After identifying the pertinent problems, the researcher gathered them into a study proposal, which was submitted and revised with the supervisor.

This engagement process included amending the proposal and incorporating feedback to ensure that the study was appropriately prepared. Furthermore, researchers developed study instruments such as pre-tests, post-tests, and questionnaires to assess students' self-efficacy, motivation, and learning outcomes in mathematics.

1. Learning Outcomes Test (Pre-test and Post-test)

The test consisted of 8 essay questions related to the mathematics material covered in the study. The test items were developed by the researchers based on the curriculum and validated by two mathematics education experts to ensure content validity (Fraenkel et al., 2012) A pilot test was conducted on a separate group of students to assess the reliability, which yielded a Cronbach's alpha of 0.82, indicating good internal consistency (Aziz & Azhar, 2021).

2. Self-Efficacy Questionnaire

This survey was modified from the 15-item scale created by Schunk & DiBenedetto (2020) to gauge students' confidence in their ability to solve mathematical problems. A 5-point Likert scale, with 1 representing "strongly disagree" and 5 representing "strongly agree," was used to gather responses. "I am certain I can solve math issues even if they are difficult" and "I believe I can understand math principles if I try hard enough" are two examples. Expert evaluation verified the validity of the questionnaire, and reliability testing revealed a Cronbach's alpha of 0.85.

3. Learning Motivation Questionnaire

The motivation questionnaire consists of 15 items measured on a 5-point Likert scale. It assessed both intrinsic and extrinsic motivation towards mathematics learning. Examples include: "I enjoy learning mathematics because it challenges me," and "I study mathematics to attain good grades." This instrument was also validated and tested for reliability, yielding a Cronbach's alpha of 0.83.

After the preparation was completed, the research continued with the implementation in the field, which consisted of several main steps. First, all students will take a pre-test and questionnaire to determine their initial abilities. After that, students followed the learning session according to the predetermined method in several meetings.

- Class A (Video Modeling Example): Students in this class will learn through videos that show the steps of solving math problems related to the selected material.
- Class B (Worked-Example): Students study the solved problem and are given a detailed explanation of the steps.
- Class C (Practice Problem): Students in this class are immediately given problems to solve without being given examples first.

After the learning process is complete, students are given post-test questions related to the material that has been learned and fill out a questionnaire to see changes in self-efficacy, motivation, and learning outcomes of students' cognitive aspects after learning using each learning method. The post-test questions were designed in the form of essays consisting of 8 questions, and the questionnaire statements were arranged using a Likert scale of 1-5 consisting of 15 questions.

Table 3.1 Likert scale guidelines

Scale	1	2	3	4	5
	Strongly Disagree	Disagree	Less Agree	Agree	Strongly Agree

In the final stage, the data obtained were analyzed using a significance of $\alpha = 0.05$. Descriptive statistical analysis was conducted to determine the mean and score distribution of each variable. A normality test with Kolmogorov-Smirnov and a variance homogeneity test with Levene's test were conducted as prerequisites for inferential analysis. The t-test was used to test the hypothesis of differences in the average self-efficacy, motivation, and learning outcomes of students' cognitive aspects in each learning method, and the one-way ANOVA test was used to test the effect of the three learning methods on self-efficacy, motivation, and learning outcomes of students' cognitive aspects. If a difference is found, then it is followed by the Tukey HSD post hoc test to find out which class is significantly different. Overall, this procedure is designed to systematically measure the effectiveness of each learning method on self-efficacy, motivation, and cognitive learning outcomes. By using

validated instruments, it is hoped that this research can be beneficial for more effective mathematics learning innovations at the junior high school level.

RESULTS

Based on the prerequisite test which has a significance level of $\alpha = 0.05$, the self-efficacy questionnaire before and after learning is normally distributed and homogeneous. Before learning, the normality test of the self-efficacy questionnaire has a significance value of 0.223 (video modeling example), 0.137 (worked-example), and 0.170 (practice problem). Meanwhile, the self-efficacy questionnaire after learning is 0.151 (video modeling example), 0.304 (worked-example), and 0.135 (practice problem). The significance value of the homogeneity test for both groups was 0.554 (before learning) and 0.184 (after learning). Descriptive statistical analysis of students' self-efficacy questionnaire before and after learning is presented in table 4.1 and table 4.13 below.

Table 4.1 Descriptive analysis results of student self-efficacy questionnaire data before learning

Class	N	Min	Max	Mean	Std. Dev
Video Modeling Example	30	14,375	15,501	15,169	0,329
Worked-Example	30	14,359	15,507	15,188	0,355
Practice Problem	30	14,353	15,492	15,193	0,307

Table 4.2 Descriptive analysis results of student self-efficacy questionnaire data after learning

Class	N	Min	Max	Mean	Std. Dev
Video Modeling Example	30	15,589	16,264	16,09	0,212
Worked-Example	30	15,546	16,200	16,03	0,150
Practice Problem	30	15,601	16,386	16,20	0,215

Based on the prerequisite test with a significance level of $\alpha = 0.05$, the motivation questionnaire data before and after learning is normally distributed and homogeneous. Before learning, the normality test of the motivation questionnaire has a significance value of 0.570 (video modeling example), 0.088 (worked-example), and 0.432 (practice problem). While the motivation questionnaire data after learning is 0.172 (video modeling example), 0.108 (worked-example), and 0.733 (practice problem). The significance value of the homogeneity test for both groups is 0.055 (before learning) and 0.342 (after learning). Descriptive statistical analyses of student learning motivation questionnaires before and after learning are presented in Table 4.4 and Table 4.16 below.

Table 4.3 Descriptive analysis results of student motivation questionnaire data after learning

Class	N	Min	Max	Mean	Std. Dev
Video Modeling Example	30	14,770	15,491	15,245	0,213
Worked-Example	30	14,435	15,509	15,228	0,300
Practice Problem	30	14,321	15,548	15,247	0,252

Table 4.4 Descriptive analysis results of student motivation questionnaire data after learning

Class	N	Min	Max	Mean	Std. Dev
Video Modeling Example	30	15,766	16,488	16,30	0,201
Worked-Example	30	15,569	16,388	16,20	0,214
Practice Problem	30	15,548	16,327	16,14	0,167

Furthermore, based on the prerequisite test with a significance level of $\alpha = 0.05$ conducted on the pre-test and post-test data, it shows that the data is normally distributed and homogeneous. The significance value of the normality test on the pre-test was 0.554 (video modeling example), 0.445 (worked-example), and 0.655 (practice problem). While in the post-test it was 0.554 (video modeling example), 0.440 (worked-example), and 0.106 (practice problem). The significance value of the homogeneity test for both groups was 0.944 (pre-test) and 0.063 (post-test). Descriptive statistical analysis of students' pre-test and post-test is presented in Table 4.7 and Table 4.10 below.

Table 4.5 Results of descriptive analysis of pre-test data

Class	N	Min	Max	Mean	Std. Dev
Video Modeling Example	30	12	64	33,33	17,367
Worked-Example	30	12	60	38,93	16,406
Practice Problem	30	12	64	35,20	18,327

Table 4.6 Results of descriptive analysis of post-test data

Class	N	Min	Max	Mean	Std. Dev
Video Modeling Example	30	40	100	73,20	18,299
Worked-Example	30	52	100	83,07	13,764
Practice Problem	30	40	96	81,07	14,477

Furthermore, hypothesis testing uses t-test. This test aims to determine whether there is an effect of video modeling example, worked-example, and practice problem learning methods on self-efficacy, motivation, and learning outcomes of students' cognitive aspects. The results of the t-test regarding the effect of each learning method on self-efficacy, motivation, and learning outcomes of students' cognitive aspects can be seen in the following table.

Table 4.7 Student self-efficacy t-test results

Learning Method	Df	P	Mean Difference	SE Difference	T
Video Modeling Example	58	< 0,001	-0,924	0,072	-3,336
Worked-Example	58	< 0,001	-0,843	0,070	-3,093
Practice Problem	58	< 0,001	-1,007	0,068	-3,802

Table 4.8 Student motivation t-test results

Learning Method	Df	P	Mean Difference	SE Difference	T
Video Modeling Example	58	< 0,001	-1,055	0,053	-5,097
Worked-Example	58	< 0,001	-0,972	0,067	-3,725
Practice Problem	58	< 0,001	-0,892	0,055	-4,176

Table 4.9 The results of t-test on learning outcomes of students' cognitive aspects

Learning Method	Df	P	Mean Difference	SE Difference	T
Video Modeling Example	58	< 0,001	39,867	4,597	2,239
Worked-Example	58	< 0,001	44,133	3,910	2,914
Practice Problem	58	< 0,001	45,867	4,264	2,777

Based on the t-test in the table above, the p-value < 0.001 was obtained for each video modeling example, worked-example, and practice problem class. Because all p-values (sig.) are smaller than the significance level $\alpha = 0.05$, H_0 is rejected. Thus, there is an average difference for self-efficacy, motivation, and learning outcomes of students' cognitive aspects (in each video modeling example, worked-example, and practice problem method). Thus, learning using video modeling example, worked-example, and practice problem methods can have a positive effect on self-efficacy, motivation, and learning outcomes of students' cognitive aspects.

Finally, hypothesis testing uses the one-way ANOVA test. This test aims to determine the most effective learning method in improving self-efficacy, motivation, and learning outcomes of students' cognitive aspects. The results of the one-way ANOVA test regarding the most effective learning methods in improving self-efficacy, motivation, and learning outcomes of students' cognitive aspects can be seen in table 4.22 below.

Table 4.10 One-way ANOVA test results

No	Variable	Sum of Squares	Df	Mean Square	F	P
1	Self-efficacy	0,440	2	0,220	5,800	0,004
	Residual	3,298	87	0,038		
2	Motivation	0,396	2	0,198	5,209	0,007

	Residual	0,308	87	0,038		
3	Learning Outcomes	1632,356	2	816,178	3,348	0.040
	Residual	21208,533	87	243,766		

According to the table 4.22, the results of the ANOVA test show that the p-values for self-efficacy (0.004), motivation (0.007), and learning outcomes (0.040) were obtained. Because all p-values (sig.) are smaller than the significance level $\alpha = 0.05$, H_0 is rejected. This indicates that there are at least two significantly different groups of learning methods (video modeling example, worked-example, and practice problem) on students' self-efficacy, motivation, and learning outcomes. However, the ANOVA test only shows that there is a difference but does not indicate which group is significantly different. Therefore, a post hoc test is required to determine which group has a significantly difference.

To determine which group differs significantly, a further test using post hoc Tukey HSD was conducted. The post hoc test results for self-efficacy, motivation, and student learning outcomes are presented in the following tables.

Table 4.11 Post-hoc test results for self-efficacy

Comparison	Mean Difference	SE	df	T	P
Practice Problem – Video Modeling Example	0,106	0,050	87	2,114	0,093
Practice Problem – Worked-Example	0,169	0,050	87	3,370	0,003
Video Modeling Example – Worked-Example	0,063	0,050	87	1,256	0,424

According to the table 4.23, the results of the post hoc test for self-efficacy indicate a statistically significant difference in self-efficacy was obtained between the practice problem and worked-example methods ($p = 0.003$), while other comparisons did not show significant differences. This shows that the practice problem and worked-example methods have different effects on students' self-efficacy.

Table 4.12 Post-hoc test results for motivation

Comparison	Mean Difference	SE	df	T	P
Practice Problem – Video Modeling Example	-0,161	0,050	87	-3,198	0,005
Practice Problem – Worked-Example	-0,061	0,050	87	-1,218	0,446
Video Modeling Example – Worked-Example	-0,100	0,050	87	1,980	0,123

According to the table 4.24, the results of the post hoc test for motivation indicate a statistically significant difference in motivation was obtained between the practice problem and video modeling example methods ($p = 0.005$), while the other comparisons did not show significant differences. This shows that the practice problem and video modeling example methods have different effects on student motivation.

Table 4.13 Post-hoc test results for cognitive aspect learning outcomes

Comparison	Mean Difference	SE	Df	t	P
Practice Problem – Video Modeling Example	7,867	4,031	87	1,951	0,131
Practice Problem – Worked-Example	-2,000	4,031	87	-0,496	0,873
Video Modeling Example – Worked-Example	-9,867	4,031	87	-2,447	0,043

According to the table 4.25, the results of the post hoc test for cognitive aspect learning outcomes indicate a statistically significant difference in learning outcomes between the video modeling example and practice problem methods ($p = 0.043$), while other comparisons did not show significant differences. This shows that the video modeling example and practice problem methods have different effects on student learning outcomes.

DISCUSSION

Based on the results of data analysis, it was found that the significant increase in student learning outcomes in each group showed that the three learning methods of video modeling examples, worked

examples, and problem exercises had their respective effectiveness in strengthening mathematical concept understanding. The video modeling example method proved effective in explicitly displaying problem-solving to improve self-efficacy, motivation, and learning outcomes, as supported by the findings of (Fiorella & Mayer, 2015) which showed that active observation of the model in the video can improve knowledge transfer. Furthermore, Lestari et al. (2022) discovered that students' mathematical reasoning skills are greatly improved when they learn mathematics using instructional video media, indicating that the multimedia component further improves conceptual knowledge. According to Sweller et al. (2011); Van Harsel et al. (2020), worked-examples speed up the development of conceptual schemas in the early stages of learning because they give students step-by-step instructions that help them comprehend the structure and procedures of solving problems systematically and make them feel capable of learning on their own. However, practice problems are useful because they promote strategy reinforcement, knowledge retention, and the development of mathematical thinking automation through regular and organized independent practice, which increases students' motivation and self-efficacy (Kirschner & Hendrick, 2020; Koedinger et al., 2013). This is especially true for students who have a sufficient amount of prior knowledge. Additionally, results from a meta-analysis by Kamsurya et al. (2022) demonstrate a medium and positive effect size ($g = 0.518, p < 0.001$), confirming that self-efficacy considerably adds to students' mathematical ability. This bolsters the idea that teaching strategies that boost self-efficacy, like the practice problem approach are essential for enhancing mathematical performance. Therefore, depending on students' preparation and learning needs, each approach makes a substantial contribution to learning results in cognitive dimensions.

The success of pupils in gaining a thorough understanding of mathematics depends on the strategy they choose. This study demonstrates that the three approaches, video modeling example, worked-example, and practice problem have varying effects on students' cognitive learning outcomes, learning motivation, and self-efficacy. Self-efficacy ($p = 0.004$), motivation ($p = 0.007$), and cognitive learning outcomes ($p = 0.040$) were the three variables on which the one-way ANOVA analysis revealed significant differences between the three approaches. Further post hoc tests revealed that the practice problem method is most effective in enhancing students' self-efficacy because it provides opportunities for students to practice independently and build confidence through direct experience in solving problems (Bandura, 1997). On the other hand, the video modeling example method proved to be the most effective in increasing students' motivation to learn, as the engaging visual and audio approach is able to increase students' attention and emotional engagement (Kaiser & Mayer, 2019). Meanwhile, the worked-example method produces higher cognitive learning outcomes than the video modeling example because it is able to significantly improve students' concept understanding and cognitive efficiency without causing excessive cognitive load (Santosa & Filiz, 2025; Sweller et al., 2011). This result is reinforced by the research of (Santosa et al., 2018) which proved that the worked-example method helps the formation of knowledge schemes efficiently through examples of problem solving and can correct students' misconceptions in mathematics material.

Thus, it can be concluded that each method has its own strengths depending on the learning focus to be achieved. If the learning goal is to increase students' confidence in facing math problems, then the practice problem method is more appropriate. If learning motivation is the main focus, then a video modeling example is more appropriate. However, if the priority is to achieve optimal cognitive learning outcomes, then the worked-example method is the best choice. Therefore, educators need to consider specific learning objectives in determining the methods to be used so that the process of learning runs more efficiently and purposefully.

CONCLUSION

Based on the research and data analysis, it was found that the three learning methods significantly influenced the improvement of students' self-efficacy, motivation, and cognitive learning outcomes. The video modeling example method is effective because it is able to present the problem-solving process verbally and visually, while the worked-example method helps students understand the structure of problem solving through examples of problems complete with steps. The practice problem method is proven to train independence and improve learning outcomes, especially for students who

already have a good initial understanding. The results of ANOVA and post hoc tests also show that there are differences in the effectiveness of the three methods; namely, practice problems are superior in increasing self-efficacy, video modeling examples are more effective in increasing learning motivation, and worked-example are most effective in improving learning outcomes in cognitive aspects. Thus, each method has different advantages, so the selection of learning methods must be adjusted to the learning objectives to be achieved. Based on the findings of this study, it is recommended that teachers apply the video modeling example, worked-example, and practice problem methods selectively according to the learning objectives and student characteristics. Initial assistance and media socialization need to be done so that students understand the learning flow, and time management and learning activities must be organized effectively. Future researchers can develop this method by utilizing interactive media or digital platforms, as well as adding measurement instruments for affective and psychomotor aspects so that the research covers all dimensions of learning outcomes more comprehensively.

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