THE EFFECTIVENESS OF USING INSTRUCTIONAL VIDEOS ON LINEAR PROGRAMMING MATERIAL TOWARDS STUDENTS' MATHEMATICAL PROBLEM-SOLVING

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ABSTRACT

The effectiveness of using instructional videos in enhancing students' mathematical abilities, particularly in Linear Programming, is being researched due to the low problem-solving skills of students. This study is aimed at determining the effectiveness of using instructional videos on students' mathematical abilities. It is conducted at SMA Negeri 5 Binjai, specifically in class XI MIA 1, which consists of 36 students. The instrument utilized in this study comprises pretest and posttest questions. The procedures for using videos during the learning process are elaborated, including the appropriate validation treatment of the instruments to ensure smooth implementation of every component of the study. Data analysis employs the paired sample test. The obtained result shows a significance value of sig. = 0.000, where the value = 0.05 and the value of t-test = 22.57 > t-table = 1.688, hence it can be concluded that the pretest and posttest values differ significantly. From the test results and the fact that the post-test value is greater than the pre-test value, it can be concluded that teaching using instructional videos is effective for teaching and enhancing students' mathematical problem-solving abilities.

Keywords: Problem Solving, Student, Learning Video, Linear Program

ABSTRAK

Efektivitas penggunaan video pembelajaran dalam meningkatkan kemampuan matematika siswa, khususnya pada Pemrograman Linier, sedang diteliti karena rendahnya kemampuan pemecahan masalah siswa. Penelitian ini bertujuan untuk mengetahui efektivitas penggunaan video pembelajaran terhadap kemampuan matematika siswa. Dilakukan di SMA Negeri 5 Binjai tepatnya di kelas XI MIA 1 yang berjumlah 36 siswa. Instrumen yang digunakan dalam penelitian ini terdiri dari soal pretest dan posttest. Tata cara penggunaan video selama proses pembelajaran diuraikan, termasuk perlakuan validasi instrumen yang tepat untuk menjamin kelancaran pelaksanaan setiap komponen pembelajaran. Analisis data menggunakan uji sampel berpasangan. Hasil yang diperoleh menunjukkan nilai signifikansi sig. = 0,000, dimana nilai = 0,05 dan nilai t-hitung = 22,57 > t-tabel = 1,688 maka dapat disimpulkan bahwa nilai pretest dan posttest berbeda secara signifikan. Dari hasil tes dan nilai post-test lebih besar dari nilai pre-test, maka dapat disimpulkan bahwa pengajaran menggunakan video pembelajaran efektif untuk mengajar dan meningkatkan kemampuan pemecahan masalah matematis siswa.

Kata kunci: Pemecahan Masalah, Siswa, Video Pembelajaran, Program Linier
INTRODUCTION

In modern life, the development of science and technology (IPTEK) impacts all aspects of life, progressing rapidly. Education serves as guidance provided by educators to foster students' growth towards maturity, aiming for self-reliance without external assistance (Purnomo, 2019). This proficiency requires logical, critical, and systematic thinking, which can be developed through mathematics education. Mathematics plays a crucial role in everyday life and should thus be understood and mastered by all layers of society, especially students in schools.

Mathematics is a pivotal subject in education. According to James (Sariningsih & Purwasih, 2017), mathematics is a challenging logical science, yet it is indispensable not only in the realm of mathematics but also in various other fields as it aids problem-solving skills. Mathematical problem-solving is a fundamental skill that students need to master as it is considered the heart of mathematics (Branca, 1980). However, Sundayana (2015) states that many students still dislike mathematics, considering it extremely difficult and unpleasant, making it a daunting subject for all students. Conversely, Ruseffendi (Zakiyah, Imania, & Rahayu, 2018) asserts that problem-solving is crucial not only for the field of mathematics but also for other disciplines and daily life.

Polya (1973) proposed a procedure for solving mathematical problems: understand the problem and devise a plan, implement problem-solving strategies, review the solution, and check both the question and your answer. Despite these steps, many students still make mistakes. According to Newman (1977), students commit various types of errors such as reading errors, comprehension errors, transformation errors, process skill errors, and encoding errors.

Based on interviews conducted by the researcher with teachers at SMA Negeri 5 Binjai, it is evident that many students struggle to solve the given problems. The students' learning outcomes, especially in linear programming, are relatively low. This is attributed to students' difficulties and confusion in problem-solving. Daily quizzes on linear programming show that more than 75% of students have not met the Minimum Completion Criteria (KKM). Given these findings, there is a need for engaging learning variations to alleviate students' fear and boredom with mathematics. One effective variation is using instructional media. Educational media are objects that can be perceived, especially visually and auditorily, both inside and outside the classroom, utilized as aids in the teaching-learning process to enhance the effectiveness of students' learning outcomes (Zakiah, 2014). Educational media encompasses aspects both as tools and techniques closely
related to teaching methods.

One such media is instructional videos. Videos are commonly used for entertainment, documentation, and education purposes. They can present information, illustrate processes, explain complex concepts, teach skills, shorten or lengthen time, and influence attitudes (Azhar, 2014). Rachmawati (2019) found that statistics and probability learning using the PBL+ video model are effective in terms of students' critical thinking abilities and mathematical attitudes. Research in Korea indicates that videos can be a more effective medium than text in presenting real-life situations through problem-based learning (Choi, 2007). The results show that students who use video problems make more efforts to communicate their understanding of the problem and relevant knowledge than those who use text-based problems (Lu, 2015).

While several studies have been conducted, few have discussed the steps involved in using instructional videos and their outcomes. Therefore, this research aims to describe the use of instructional videos and to explore the effectiveness of using instructional videos in teaching linear programming to eleventh-grade students in high school.

**METHOD**

This study aims to describe and understand the use of instructional videos in teaching linear programming to students at SMA Negeri 5 Binjai. The subjects of this study are students of class XI MIA 1, totaling 36 students, at SMA Negeri 5 Binjai in the academic year 2021/2022. This research uses a quantitative method with statistical analysis using paired sample test with prerequisites of normality and reliability tests. The researcher compiled a test instrument consisting of 2 items. The test is in the form of essay questions referring to indicators of students' problem-solving abilities, such as understanding the problem, being able to create or formulate mathematical models, selecting and developing appropriate strategies in problem-solving, and being able to explain and verify the correctness of the answers obtained.

Then, the results of the post-test collected in this study are used to assess students' mathematical problem-solving abilities, as the data obtained will be the basis for drawing conclusions. To obtain results of students' mathematical problem-solving abilities, scoring is conducted on each student's answer to each item. To determine the extent of students' mathematical problem-solving abilities from the obtained scores, further analysis using SPSS is conducted.

**RESULT AND DISCUSSION**
This study aims to assess the effectiveness of using instructional videos. During the research process, group learning activities were conducted where students were directed to solve problems related to those discussed in the instructional videos. Before the learning process, students were given a pretest, and at the end of the session, they were given a post-test. The pretest and post-test results reflect the impact of using instructional videos on students' performance.

The learning process consisted of opening and closing sessions, with the core steps as follows: (1) The teacher introduced the topic to be taught. (2) The teacher divided the students into groups and provided them with activity sheets for evaluation and problem-solving during the research process. (3) The teacher distributed guidelines and instructional videos for collaborative problem-solving. (4) Students discussed the given problems while the teacher observed the discussion process. (5) The teacher called upon group representatives to present the solutions to the problems worked on after watching the instructional videos.

Both the videos and the questions used underwent a validation process. The first validator was a lecturer who validated the video content, pretest and post-test items, and student activity sheets. The second validator, a mathematics subject teacher, validated the same materials. The validation results of the instructional videos are summarized in Table 1:

<table>
<thead>
<tr>
<th>Validator</th>
<th>Avg. Score</th>
<th>Total Avg. Score</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Validator I</td>
<td>3.28</td>
<td>3.33</td>
<td>Very Valid</td>
</tr>
<tr>
<td>Validator II</td>
<td>3.34</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From the validation results presented in Table 1, it is evident that the instructional videos can be used as media for this research. Some corrections have been made by the researcher, including reviewing the definition of linear inequality systems with two variables, making it more interactive and constructive. The researcher has clarified the definition and made it more interactive and constructive.

The research collected data from evaluations through student activity sheets, as well as
pretest and post-test results from students taught using instructional videos. The student activity
sheets were also validated by the validators. The summary of validation results, as shown in Table
2, is as follows:

Table 2: Summary of Student Activity Sheet Validation

<table>
<thead>
<tr>
<th>Validator</th>
<th>Avg. Score</th>
<th>Total Avg. Score</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Validator I</td>
<td>3.53</td>
<td>3.53</td>
<td>Very Valid</td>
</tr>
<tr>
<td>Validator II</td>
<td>3.53</td>
<td></td>
<td>Valid</td>
</tr>
</tbody>
</table>

The summary of the validation of Student Activity Sheets presented in Table 2 by the two
validators indicates that they are categorized as highly valid. During the research, the responses from
the Student Activity Sheets were also good and adhered to the appropriate time allocation.

The pretest scores represent the students' performance before being taught using instructional
videos, while the post-test scores represent their performance after being taught using instructional
videos. In the validation process by both validators, two items of the questions provided were
considered relevant by both, although they had suggestions regarding sentence structure, which were
duly revised by the researcher.

The validation results of the two question items indicate that these questions are valid and can
be used. They were deemed relevant by both validators, making them suitable for pretest and post-test
assessments for the classes taught using instructional videos.

Teaching mathematics using instructional videos on linear programming material with
contextual problems, modeling, student contribution, interactive learning processes, and
interconnection between topics contributes positively to students' attitudes. This positive attitude
reflects their problem-solving abilities. Begle (Darhim, 2012) states that "A positive attitude towards
mathematics correlates positively with mathematical learning outcomes."

Learning begins with contextual problems, where students feel excited and actively
engaged in exploring everyday problem scenarios or those they can imagine. After watching the
instructional videos, students can experience positive impacts, as suggested by Hidayat (2009).
The pretest and posttest conducted in this study consist of the pretest administered before the instructional video and the posttest afterward, as explained in the steps. The results of the pretest and posttest conducted in class XI MIA 1 are summarized in Table 3 below:

Table 3. Recapitulation of Student Scores Taught with Instructional Videos

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>N</th>
<th>Score Minimum</th>
<th>Score Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRETES</td>
<td>36</td>
<td>46.88</td>
<td>75.00</td>
<td>57.5547</td>
<td>6.69698</td>
</tr>
<tr>
<td>POSTTEST</td>
<td>36</td>
<td>75.00</td>
<td>96.88</td>
<td>85.0728</td>
<td>5.84022</td>
</tr>
</tbody>
</table>

From the summary of student scores in Table 3, it can be concluded that the use of instructional videos can have a positive impact when a good and appropriate validation process is conducted.

The hypothesis in this study is: The use of instructional videos is effective in improving students' mathematical problem-solving abilities in linear programming material.

The normality test of the data distribution was conducted using the Kolmogorov-Smirnov test (KSZ), and the results are as follows:

a. The experimental group obtained a Kolmogorov-Smirnov Z (KSZ) value of 0.656 and a significance of 0.782. This means that the calculated significance level is greater than the significance level \( \alpha = 0.05 \). Thus, the N-Gain data of the experimental group comes from a normally distributed population.

b. The control group obtained a Kolmogorov-Smirnov Z (KSZ) value of 0.873 and a significance of 0.432. This means that the calculated significance level is greater than the significance level \( \alpha = 0.05 \). Thus, the N-Gain data of the control group comes from a normally distributed population.

Homogeneity testing was conducted using SPSS 18, and a significance level of 0.884 was obtained. This means that the calculated significance level is greater than the significance level \( \alpha = 0.05 \). Therefore, the distribution of problem-solving N-Gain scores in mathematics for both groups is homogeneous.

Also, based on the gain values obtained from the post-tests conducted at the beginning and end of the learning process after the treatment with instructional videos on linear programming material, the percentage of average post-test scores from the study is presented in Table 4 below.
Table 5. Results of Gain Score Post-test for Students

<table>
<thead>
<tr>
<th>Level</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>10</td>
<td>26.60</td>
</tr>
<tr>
<td>Medium</td>
<td>17</td>
<td>40.60</td>
</tr>
<tr>
<td>Low</td>
<td>9</td>
<td>32.80</td>
</tr>
<tr>
<td>Jumlah</td>
<td>36</td>
<td>100.00</td>
</tr>
</tbody>
</table>

This is the recapitulation of N-Gain levels from students measured in High, Medium, and Low categories. Out of 36 measured students, 10 students have a High N-Gain level, 17 students have a Medium N-Gain level, and 9 students have a Low N-Gain level. The total percentage of all N-Gain levels is 100.00%.

From the gain score post-test results for students in Table 5, it is found that students who obtained high scores reached 26.6%, while those with moderate scores were at 40.6%. The total percentage of students who obtained high and moderate scores is 67.2%. Therefore, looking at the distribution of student scores, more than half of them achieved high or moderate scores.

To determine the effectiveness of using the validated instructional videos, an experiment was conducted using a before-after design or pretest-posttest with paired sample t-test analysis technique. The results of the data analysis using SPSS are presented in Table 6 below.

Table 5. Results of the paired sample t-test
CONCLUSION

1. The core steps of learning using videos include introducing the material, dividing students into groups, providing student activity sheets, distributing guides and instructional videos, student discussions, and presenting problem-solving results.
2. Validating instructional instruments is crucial to ensuring their effectiveness and obtaining good results.
3. The effective use of instructional videos enhances students’ mathematical problem-solving abilities in linear programming material, as evidenced by the results of the paired sample t-test.

REFERENCES