

The Development of Mathematics Achievement on Interest and Value of Money by the KWDL Technique for Grade 11 Students at the Demonstration School of Suan Sunandha Rajabhat University

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Abstract.

The objective of this research was to compare Grade 11 Students' Academic Achievement in Mathematical Problem-Solving on Interest and Value of Money before and after instruction using the KWDL technique. The study involved 20 students from classes M.5/1 and M.5/2, selected through purposive sampling. The instruments were three lesson plans using the KWDL technique, conducted over 12 sessions of 50 minutes each, and a 10-item, four-option multiple-choice problem-solving test. The research was conducted during the second semester of the 2024 academic year. Data were analyzed using means and relative gain scores.

The results indicated that students who participated in KWDL-based learning activities demonstrated a high level of relative gain in their mathematical problem-solving abilities, with a relative gain score of 57.2.

Keywords: mathematical problem-solving ability, KWDL technique

1. Introduction

Mathematics is a fundamental discipline in the 21st century, enabling learners to solve everyday problems while fostering systematic thinking, logical reasoning, creativity, and careful analysis (Ministry of Education, 2008). Contemporary mathematics education emphasizes not only computational proficiency but also the development of analytical thinking, critical reasoning, and complex problem-solving skills to meet the demands of a rapidly evolving global society.

Despite its importance, many students face challenges in learning mathematics due to its abstract nature, which requires conceptual understanding and systematic reasoning. Some students develop misconceptions or struggle to connect their knowledge to problem-solving (Kaewpilarom, 2011). According to the Institute for the Promotion of Teaching Science and Technology (IPST, 2008), students often encounter difficulties in solving mathematical word problems, particularly in interpreting problems, identifying key information, selecting appropriate strategies, and applying mathematical concepts to real-life situations.

Effective learning depends not only on the students themselves but also on the instructional approaches used by teachers, which are crucial for facilitating meaningful learning (Suriyachot, 2020). Teachers' roles must shift from knowledge transmission to designing activities that stimulate analysis, reasoning, and application in real-life contexts. Contemporary mathematics

instruction emphasizes active engagement and experiential learning to promote deeper understanding and effective thinking (Jampawai et al., 2021).

The KWDL (Know, Want, Do, Learn) technique is an instructional strategy that promotes systematic thinking and problem-solving by guiding students to review prior knowledge, set learning goals, plan and execute problem-solving steps, and reflect on outcomes (Shaw et al., 1997). This technique helps students analyze problems sequentially, identify essential information, choose suitable strategies, and draw reasoned conclusions. Therefore, the KWDL technique is considered an effective tool for developing learners' analytical thinking and problem-solving abilities.

Based on this rationale, the researcher applied the KWDL technique to teaching the topic of interest and value of money, which is relevant to daily life. The study aimed to enhance the problem-solving abilities of Grade 11 students at the Demonstration School of Suan Sunandha Rajabhat University. It is expected that instruction using the KWDL technique will deepen students' understanding, support the appropriate application of mathematical knowledge, and improve overall problem-solving skills in mathematics.

1.1 Research Objective

To compare Grade 11 Students' Academic Achievement in Mathematical Problem-Solving on Interest and Value of Money before and after instruction using the KWDL technique.

1.2 Definition of Terms

KWDL Technique refers to a teaching strategy that enables students to practice analyzing mathematical problems in a systematic and diverse manner, identify the best possible solution, and provide clear reasoning. It is a tool that fosters meaningful learning and active student participation. The technique consists of four steps:

Step 1: K (What we KNOW) - What do we already know, or what information does the problem provide?

Step 2: W (What we WANT to know) - What do we want to find out, or what is the problem asking?

Step 3: D (What we DO to find out) - What methods or processes will we use to solve the problem?

Step 4: L (What we LEARNED) - What did we learn? How did we arrive at the answer, and what reasoning did we use?

Mathematical Problem-Solving Ability refers to the ability to apply existing mathematical knowledge, processes, or experiences to understand a problem, plan, and solve it by selecting appropriate methods in order to obtain correct and reasonable solutions.

Relative Gain Score (RGS) refers to a measure of students' learning improvement after instruction. It compares students' pretest and posttest scores to evaluate the extent to which their knowledge or skills have developed.

2. Methodology

2.1 Target group

The target group of this study consisted of 20 students from classes M.5/1 and M.5/2 at the Demonstration School of Suan Sunandha Rajabhat University in the second semester of the 2024 academic year, selected using purposive sampling.

2.2 Research Instruments

The instruments used in this study were as follows:

1. Lesson Plans

The researcher developed three lesson plans on the topic of interest and value of money using the KWDL technique for Grade 11 students. The lessons were conducted over 12 periods, with each period lasting 50 minutes, as detailed below:

| | | |
|----------------|----------------|-----------|
| Lesson Plan 1: | Interest | 4 periods |
| Lesson Plan 2: | Value of Money | 4 periods |
| Lesson Plan 3: | Annuities | 4 periods |

2. Mathematical Problem-Solving Test

The researcher developed a 10-item multiple-choice test to measure students' mathematical problem-solving ability on the topic of interest and value of money using the KWDL technique. Each item had four answer options.

2.3 Data Collection

This study was quasi-experimental research using a single-group pretest–posttest design (Tirakanun, 2007). The researcher conducted the experiment and collected data from the target students to measure their mathematical problem-solving ability on the topic of interest and value of money using the KWDL technique. Data were collected at Demonstration School of Suan Sunandha Rajabhat University. The procedures for data collection were as follows:

1. The researcher explained the preliminary agreements to the target students regarding the learning objectives, assessment criteria, and evaluation methods.
2. A pretest was administered using a 10-item multiple-choice test developed by the researcher to measure students' mathematical problem-solving ability.
3. The teaching was conducted according to the prepared lesson plans over 12 periods during the second semester of the 2024 academic year.
4. After completing all planned learning activities, a posttest was administered using the same test as the pretest.
5. The researcher then analyzed the collected data from the tests to evaluate the students' learning outcomes.

2.4 Data Analysis

1. Scoring the Achievement Test:

The pretest and posttest assessing students' academic achievement were scored, both before and after the KWDL-based learning activities.

2. Assessing the Improvement in Problem-Solving Ability:

The development of Grade 11 students’ mathematical problem-solving abilities after learning through the KWDL technique was measured using relative gain scores calculated from the pretest and posttest using the following formula (Kanchanawasi, 1995):

$$\text{Relative Gain Score (RGS)} = \frac{x_2 - x_1}{y - x_1} \times 100,$$

where x_1 = Pretest Score, x_2 = Posttest Score, and y = Maximum Score.

3. Analysis of Academic Achievement Development:

Relative gain scores were interpreted according to the following criteria:

- 75 – 100% = Very high development
- 50 – 74.9% = High development
- 25 – 49.9% = Moderate development
- 0 – 24.9% = Low development

3. Results

The results of the analysis of Grade 11 students’ mathematical problem-solving ability in the topic of interest and value of money following KWDL-based learning management are presented in terms of relative gain scores. The comparison of students’ pretest and posttest achievement scores was conducted to examine the development of their mathematical problem-solving skills. The findings are summarized in Table 1.

Table 1: The mean relative gain scores of students

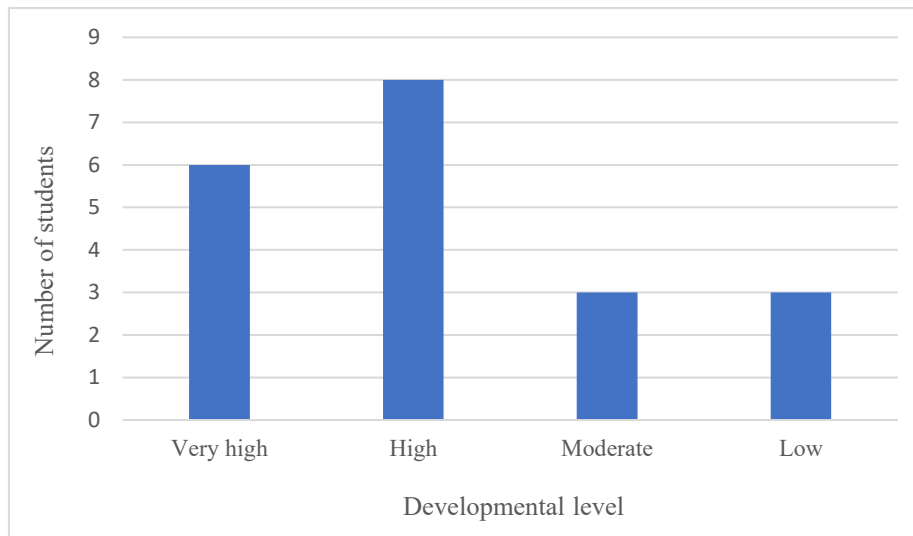
| No. | score | | | RGS | Development | No. | score | | | RGS | Development |
|-----|-------|----------------|----------------|------|-------------|-----|-------|----------------|----------------|------|-------------|
| | y | x ₁ | x ₂ | | | | y | x ₁ | x ₂ | | |
| 1 | 10 | 5 | 8 | 60.0 | High | 11 | 10 | 8 | 10 | 100 | Very high |
| 2 | 10 | 8 | 10 | 100 | Very high | 12 | 10 | 4 | 7 | 50.0 | High |
| 3 | 10 | 1 | 5 | 44.4 | Moderate | 13 | 10 | 4 | 6 | 33.3 | Moderate |
| 4 | 10 | 4 | 7 | 50.0 | High | 14 | 10 | 8 | 10 | 100 | Very high |
| 5 | 10 | 4 | 7 | 50.0 | High | 15 | 10 | 7 | 7 | 0.0 | Low |
| 6 | 10 | 4 | 8 | 66.7 | High | 16 | 10 | 8 | 10 | 100 | Very high |
| 7 | 10 | 4 | 7 | 50.0 | High | 17 | 10 | 5 | 9 | 80.0 | Very high |
| 8 | 10 | 7 | 7 | 0.0 | Low | 18 | 10 | 5 | 8 | 60.0 | High |
| 9 | 10 | 5 | 8 | 60.0 | High | 19 | 10 | 5 | 7 | 40.0 | Moderate |
| 10 | 10 | 7 | 7 | 0.0 | Low | 20 | 10 | 8 | 10 | 100 | Very high |
| | | | | | | | Mean | 5.55 | 7.9 | 57.2 | High |

where x_1 = Pretest Score, x_2 = Posttest Score, and y = Maximum Score.

As shown in the table 1, the relative gain level of Grade 11 students’ mathematical problem-solving ability in the topic of interest and value of money through the KWDL technique at Demonstration School of Suan Sunandha Rajabhat University was at a high level.

Based on the data in the table 1, a graph was constructed to illustrate the number of students at each level of relative gain in mathematical problem-solving ability, as shown in the figure 1.

Figure 1: the number of students at each level of relative development



As illustrated in the figure 1, individual analysis revealed that 6 students demonstrated a very high level of relative gain (RGS = 75-100%), 8 students showed a high level of relative gain (RGS = 50-74.9%), 3 students exhibited a moderate level of relative gain (RGS = 25-49.9%), and 3 students displayed a low level of relative gain (RGS = 0-24.9%).

These results indicate that the KWDL technique enhanced Grade 11 students' mathematical problem-solving ability in the topic of interest and value of money.

4. Conclusion

The results of the study revealed that the mathematics achievement in problem-solving skills of Grade 11 students, specifically on the topics of interest and value of money, demonstrated a high overall level of improvement. At the individual level, students exhibited a range of relative gains from low to very high, reflecting diverse levels of progress, yet overall indicating substantial development in their mathematical problem-solving abilities, which aligns with the objectives of this research. The findings demonstrate that the KWDL instructional technique facilitates systematic and analytical thinking by engaging students in a structured problem-solving process.

This approach encourages learners to collaboratively explore problems, actively participate in discussions, and follow sequential steps to arrive at solutions. Students are guided to comprehend mathematical problems clearly, decompose them into manageable components, and identify relevant information and conditions based on prior knowledge and previously learned concepts. They then develop strategies to address each component of the problem, implement these strategies through active problem-solving, and finally summarize and present their solutions accurately according to established mathematical procedures.

By integrating the KWDL technique into mathematics instruction, students are not only able to enhance their understanding of abstract concepts such as interest and value of money but also improve their ability to apply mathematical knowledge to real-life situations. This method promotes deeper engagement, critical thinking, and systematic reasoning, enabling students to approach complex problems methodically. Consequently, the study underscores the effectiveness of KWDL as a teaching strategy that supports active learning, strengthens

problem-solving skills, and fosters students' ability to think critically and analytically in mathematics.

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