

# Development of Learning Achievement on Rectangles Using the KWDL technique and the Grid-Counting Method through Simulation-Based Multimedia Instruction among Fourth-Grade Students

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## **Abstract.**

This classroom action research aimed to develop Grade 4 students' learning achievement in mathematics on the topic of rectangles by employing the KWDL technique together with the Grid-Counting Method through simulation and multimedia, with the achievement criterion set at 60%. The sample consisted of 35 Grade 4 students from the Demonstration School of Suan Sunandha Rajabhat University (Elementary Level) in the first semester of the 2025 academic year, selected by cluster random sampling. The research instruments included lesson plans on rectangles integrating the KWDL technique, the Grid-Counting Method, simulation, and multimedia; multimedia materials consisting of concrete materials such as rectangle models and grid units, as well as technological media including the GeoGebra and Matific websites; and an achievement test on rectangles comprising 10 open-ended items. The data were analyzed using percentage, mean, standard deviation, and the Index of Item Objective Congruence (IOC).

The results revealed that the students' post-learning achievement in mathematics on rectangles exceeded the 60% criterion, which was consistent with the research objectives. These findings indicate that learning management integrating the KWDL technique, the Grid-Counting Method, simulation, and multimedia can effectively enhance mathematics learning achievement among elementary school students.

**Keywords:** KWDL technique, mathematics learning achievement, multimedia, rectangles, simulation

## **1. Introduction**

Mathematics plays a crucial role in achieving success in learning in the 21st century because it helps individuals think creatively, reason logically, be systematic, and analyze problems or situations carefully and thoroughly. It helps with forecasting, planning, decision-making, and problem-solving appropriately and can be effectively applied in real life. Additionally, mathematics is a tool for studying science, technology, and other fields, which are the foundation for developing human resources to improve the country's quality and advance its economy to be competitive internationally. Therefore, the study of mathematics must be continuously developed (Ministry of Education, 2017).

A study on strategies for improving students' learning outcomes regarding rectangular shapes revealed that some students were unable to calculate the area and perimeter of a rectangle. The problems included: 1) students couldn't recognize the shape as a rectangle, 2) they didn't understand the difference between calculating area and perimeter, and 3) when calculating the area of a rectangle, students didn't understand why they needed to multiply the width and length.

If these issues are not addressed, students may not meet the required standards and indicators mentioned above, which could affect their ability to learn mathematics at higher levels. Therefore, the researcher studied relevant research on improving learning outcomes for rectangular shapes using Grid-Counting Method and Simulation alongside multimedia learning tools. Multimedia tools are important in enhancing student learning outcomes as they serve as a medium for learning and stimulate students to learn according to the established objectives. Using a variety of learning tools can increase students' interest in learning.

According to a learning approach based on Van Hiele's theory combined with virtual tools to develop mathematical concepts of rectangles for Grade 4 students emphasizes designing the learning process in a step-by-step order, starting with recognizing the shape, observing relationships, exchanging knowledge, summarizing the concept, and practicing applying the concept. Sirintip Yanapan (2019) mentioned that the learning process includes six steps: 1) understanding the problem, 2) simplifying the problem, 3) thinking mathematically, 4) applying mathematical operations, 5) interpreting and checking the appropriateness, and 6) presenting the solution. The emphasis should be on using real-life problem situations relevant to students, where students can form hypotheses and mathematical models to solve problems, using questions to regularly encourage them to find solutions and helping students in writing and presenting in Thai. It was also found that in the third operation cycle, the majority of students (more than 85%) improved their problem-solving skills to level 3, meaning they understood the problem, chose strategies, and could verify and reflect on the problem-solving process, although further development is needed in exploring the problem. This study used the KWDL technique in combination with teaching and learning because the KWDL technique helps students follow a step-by-step method to find solutions. Sumalee Tiantongdee (2023) stated that solving problems in a clear, step-by-step process helps learners develop problem-solving skills more effectively.

Based on the above issues and related research, the researcher is interested in developing students' learning outcomes regarding rectangular shapes using Grid-Counting Method and Simulation combined with multimedia, including materials such as geometric shape models, Grid-Counting Method tables, and technological tools like the Matific website, where students can measure areas using grid lines. Additionally, a test was created to assess students' learning outcomes on rectangular shapes, including 10 problems showing methods for solving them. The variety of learning tools mentioned above can stimulate students' interest in learning and help solve problems related to students' learning outcomes on rectangular shapes. The target outcome is that over 60% of Grade 4 students pass the learning standard.

Based on the above, the researcher is interested in conducting research to develop the learning outcomes of Grade 4 students on rectangular shapes using the Grid-Counting Method and Simulation along with multimedia, in the first semester of the 2025 academic year at the Demonstration School of Suan Sunandha Rajabhat University (Primary School Department), with the goal of improving mathematics learning outcomes to meet the 60% benchmark.

## 1.2 Research Objective

This study employed a classroom action research design to enhance Grade 4 students' mathematics achievement through instructional interventions integrating the KWDL technique, the Grid-Counting Method, and simulation-based multimedia.

### Population and Sample

The population of this study consisted of Grade 4 students. The sample included 40 Grade 4 students, selected from a single classroom.

### Research Setting

The study was conducted at Demonstration School of Suan Sunandha Rajabhat University (Primary Section) during the 2025 academic year.

**Sampling Method:** Cluster sampling was used to select the participants.

## 1.3 Research Methodology

### 1. Population

The population of this study consisted of Grade 4 students. The sample included 40 Grade 4 students, selected from a single classroom.

### 2. Research Instruments

#### Multimedia

The multimedia included material-based media such as geometric models and grid units (Grid-Counting Method), and technology-based media such as the Matific website, which provides games allowing students to practice measuring area using grid lines.

#### Lesson Plans

- 1) An analysis of problems was conducted by studying students' test scores on the topic of rectangles from exercises, worksheets, and end-of-chapter tests.
- 2) Relevant concepts, principles, documents, and research related to improving learning achievement in the topic of rectangles were studied, including principles of multimedia-based learning management, in order to adapt them appropriately to the content and learning activities.
- 3) The research topic was determined by considering the content and causes of the identified problems, as well as selecting appropriate research instruments.
- 4) Ten lesson plans on the topic of rectangles were developed to address the specific problems of the target group. Each lesson plan consisted of learning standards, learning objectives, key concepts, multimedia-based learning activities, assessment and evaluation methods, and post-teaching reflections.
- 5) The lesson plans were reviewed by three experts to evaluate the appropriateness of learning activities, instructional media, and assessment methods using a five-level rating scale.
- 6) The lesson plans were revised according to the experts' recommendations to improve their suitability and completeness.
- 7) The revised lesson plans were implemented with the sample group.

#### Achievement Test

The achievement test on rectangles consisted of 10 constructed-response items. The development process was as follows:

- 1) The content on rectangles was studied and analyzed based on Chapter 9: Rectangles in the Basic Mathematics curriculum for Grade 4 students, aligned with the Basic Education Core Curriculum B.E. 2551 (Revised Edition B.E. 2560).
- 2) A 10-item achievement test on rectangles was constructed.
- 3) The test items were reviewed by three experts to examine the congruence between objectives and questions using the Index of Item-Objective Congruence (IOC).
- 4) The results showed that seven items had an IOC value of 1.00, and three items had an average IOC value of 0.67. All ten items met the acceptable IOC range of 0.50–1.00 and were selected for use as the achievement test.
- 5) The validated achievement test was then used as a research instrument.

## 2. Literature review

The review of related studies indicates that learner-centered instructional approaches and the integration of diverse learning media play a significant role in enhancing students' learning outcomes. Sumalee Tiantongdee (2023) found that the 5E inquiry-based learning model combined with the KWDL technique and the Student vs. Zombie game effectively promotes scientific problem-solving skills in a systematic manner. This approach provides clear problem-solving steps, incorporates game-based assessment, and creates an enjoyable learning environment during instruction.

Similarly, Thanawat Srisiriwat (2022) emphasized that teachers should integrate instructional media to increase the variety of learning activities and support learners' understanding based on individual differences. This approach is particularly suitable for the current context of online learning during the COVID-19 pandemic. Multimedia is therefore considered an innovative tool that can be effectively used to facilitate learning activities, enhance learning achievement, and increase learners' motivation and interest.

In addition, Thanatchaporn Tanma (2018) stated that multimedia encourages students' interest and active participation in learning. It supports group activities, allows learners to study according to their individual abilities, and helps address individual differences. As a result, multimedia-based instruction improves teaching and learning efficiency while also saving time for both teachers and learners.

## 3. Methodology

- 1.1 The research was conducted with a sample group of students who were Grade 4 students in the 2025 academic year at Suan Sunandha Rajabhat University Demonstration School (Primary Section). Data were collected according to the following procedures:
- 1.2 The sample group for this study consisted of 35 Grade 4 students in the 2025 academic year from Suan Sunandha Rajabhat University Demonstration School (Primary Section), selected from a total population of 99 students. The sample was obtained using cluster random sampling, with classrooms serving as the sampling units.
- 1.3 The researcher informed the target group about the instructional process using teaching media on the topic of rectangles, in order to ensure that students could correctly follow the learning activities.

- 1.4 Instruction was implemented to address students' learning achievement in the topic of rectangles by using the KWDL technique and
- 1.5 the Grid-Counting Method for simulation activities, integrated with multimedia. The total instructional time was 9 class periods.

After completing the instruction using the KWDL technique and the Grid-Counting Method through simulation and multimedia, students were administered an achievement test on the topic of rectangles. The researcher then checked the accuracy and completeness of the test responses, scored the tests, and recorded the post-test scores for data analysis.

The scores obtained from the 10-item achievement test on rectangles were analyzed using statistical methods.

## **4. Results**

The results of data analysis based on the research objective to develop mathematics learning achievement on the topic of rectangles using the KWDL technique and the Grid-Counting Method through simulation-based multimedia instruction for Grade 4 students, with a performance criterion of 60 percent, are presented as follows.

*Table 1 Mathematical Problem-Solving Skill Scores on Rectangles Using the KWDL Technique and the Grid-Counting Method through Simulation-Based Multimedia Instruction among Grade 4 Students*

<b>Number of Students</b>	<b>Criterion Score (20)</b>	<b>Number of Students Meeting the Criterion</b>	<b>Percentage (%)</b>	<b>Number of Students Not Meeting the Criterion</b>	<b>Percentage (%)</b>
35	12	25	71.43	10	28.57

Analysis of Mathematics Learning Achievement Based on the data presented in Table 1, the results indicated that Grade 4 students demonstrated mathematical problem-solving skills on the topic of rectangles after learning through the KWDL technique and the Grid-Counting Method integrated with simulation-based multimedia instruction. A total of 25 students achieved scores equal to or higher than the 60 percent criterion of the total score (12 points or above), representing 71.43 percent of the sample. In contrast, 10 students, accounting for 28.57 percent of the sample, did not meet the predetermined criterion.

These findings suggest that the majority of the target group achieved the expected level of mathematics learning achievement on rectangles following the implementation of the instructional approach.

## **5. Conclusion**

### **Research Results**

The findings revealed that out of 35 sample students who completed the achievement test on rectangles after learning through the KWDL technique combined with the Grid-Counting Method for simulation and multimedia, 25 students (71.43%) achieved scores above the 60% criterion, while 10 students (28.57%) did not meet the criterion. These results were consistent with the objectives of the study and indicate that the instructional approach was effective in improving students' mathematics achievement.

## Discussion

The improvement in students' learning achievement can be attributed to the use of the KWDL technique, which supported students in organizing their thinking in a systematic process. This process included reviewing prior knowledge, generating questions, actively solving problems, and summarizing newly acquired knowledge. As a result, students gained a clearer understanding of the steps involved in solving problems related to rectangles. This finding is consistent with the study of Sumalee Tiantongdee (2023), who suggested that step-by-step problem-solving processes effectively enhance problem-solving skills.

Furthermore, the use of the Grid-Counting Method and simulation activities through multimedia helped students visualize rectangles more clearly and understand the relationships among width, length, area, and perimeter. This approach reduced students' confusion between calculating area and perimeter. The integration of both physical materials, such as geometric models and grid units, and technological media, such as the Matific website, enhanced students' interest and active participation in learning. These findings align with the views of Thanawat Srisiriwat (2022) and Thanatchaporn Tanma (2018), who emphasized that multimedia increases learning effectiveness and helps reduce individual differences among learners.

Therefore, the integration of the KWDL technique with the Grid-Counting Method and simulation through multimedia is an appropriate instructional approach for enhancing mathematics achievement on the topic of rectangles at the primary education level.

## Recommendations for Further Research and Practice

Based on the research findings, the instructional approach using the KWDL technique combined with the Grid-Counting Method, simulation, and multimedia effectively improved Grade 4 students' achievement in mathematics on the topic of rectangles. It is therefore recommended that teachers apply this approach in classroom instruction, particularly for content that requires visualization and step-by-step thinking processes. In addition, teachers should develop and select a variety of appropriate multimedia resources that align with learners' contexts to stimulate interest and engagement in learning. Future research should extend this instructional model to other mathematics topics and involve more diverse and larger sample groups to enhance the reliability and generalizability of the findings.

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