

Visual Representations in Elementary Mathematics: Effects of the Block Model Approach on Word Problem-Solving

Elsan Rose T. Tumpang

Misamis University, Ozamiz City, Philippines

Abstract— Word problem-solving remains challenging among elementary pupils, particularly in understanding mathematical situations and translating verbal statements into appropriate operations. This action research investigated the effectiveness of the Block Model Approach in improving the word problem-solving skills of Grade 2 pupils in a public elementary school in Misamis Occidental during School Year 2024–2025. A classroom-based pretest–posttest comparative design involving control and experimental groups was employed. The participants consisted of 20 purposively selected Grade 2 pupils equally distributed between the two groups. A researcher-made 20-item Word Problem Solving Test based on the Most Essential Learning Competencies (MELCs) was used to assess pupils’ performance before and after the intervention. Data were analyzed using frequency, percentage, mean, standard deviation, independent samples t-test, and paired sample t-test. Findings revealed low pretest performance among pupils in both groups. Following the implementation of the Block Model Approach through guided instruction, visual representations, and problem-solving activities, pupils in the experimental group demonstrated substantial improvement in posttest performance, while the control group showed minimal improvement under conventional instruction. Significant differences were found between the posttest performance of the control and experimental groups and between the pretest and posttest performance of the experimental group. The findings indicate that the Block Model Approach effectively improves pupils’ conceptual understanding, confidence, and mathematical problem-solving skills and may serve as a practical, learner-centered classroom intervention for strengthening learning outcomes in elementary Mathematics.

Keywords— Block Model Approach, Grade 2 Pupils, Mathematics, Problem-Solving Skills, Word Problems.

I. INTRODUCTION

Mathematics teaching at the elementary level can be challenging because pupils often struggle to connect abstract concepts with practical applications. Many pupils struggle to understand mathematical processes, particularly when solving word problems, due to differences in learning needs, limited conceptual understanding, and mathematics anxiety. These challenges require teachers to implement responsive, meaningful instructional strategies that foster deeper understanding and active engagement in learning. Providing pupils with structured opportunities to understand mathematical relationships and visualize abstract concepts can help reduce learning difficulties, improve confidence, and foster a more positive attitude toward Mathematics.

Mathematics education plays a crucial role in developing critical thinking and problem-solving skills and serves as a foundation for personal growth and national development (Ampofo, 2019). Mastering mathematical skills is essential to learners’ academic success and is considered a necessary competency for interpreting and solving real-life situations (Yeh et al., 2019; Jade et al., 2023). However, mathematics remains one of the most difficult subjects for many learners across educational levels, and poor performance in mathematics continues to be observed in both local and international assessments (Lapinid et al., 2022). In the Philippines, declining mathematics achievement has become a persistent educational concern, despite continuous educational reforms aimed at strengthening literacy and numeracy competencies (Igarashi et al., 2023).

The poor performance of Filipino learners in international assessments such as the Program for International Student Assessment and Trends in International Mathematics and Science Study reflects long-standing difficulties in mathematics learning, particularly in problem-solving and comprehension of mathematical concepts (Mullis et al., 2020). The Philippines ranked among the lowest-performing countries in mathematics in recent international assessments, underscoring the urgent need for effective, innovative classroom interventions to strengthen mathematical proficiency (Acido et al., 2024). Research suggests that early struggles in mathematics may result in long-term academic difficulties and reduced confidence in solving mathematical problems (Bryant et al., 2021). These concerns become more pronounced at the elementary level, where foundational mathematical skills are developed and reinforced.

The Department of Education encourages teachers to implement meaningful and learner-centered strategies to address learning difficulties in Mathematics. Such strategies include differentiated instruction, collaborative learning, guided discovery, problem-based learning, and contextualized teaching approaches that promote deeper understanding of concepts (Koskinen & Pitkäniemi, 2022). Among these approaches, the Block Model Approach has gained attention as a promising intervention strategy for helping pupils understand mathematical relationships and solve word problems more effectively (Chia & Ng, 2020). The Block Model Approach, rooted in the Concrete-Representational-Abstract (CRA) framework, enables learners to visually represent mathematical relationships using blocks or bars, making abstract mathematical ideas easier to understand (Jiang & Zhao, 2023).

The Block Model Approach is particularly useful in solving mathematical word problems because it enables pupils to visualize quantities and understand relationships among numbers. Through visual representation, learners become more capable of analyzing situations, identifying unknown quantities, and determining appropriate operations to solve mathematical tasks. Research findings indicate that the

use of block models significantly improves learners' strategic problem-solving abilities and conceptual understanding in Mathematics (Garzon & Casinillo, 2021). Likewise, studies suggest that structured visual problem-solving strategies increase pupils' confidence, motivation, and participation in Mathematics learning (Lai & Murray, 2018). Despite these promising findings, few studies have examined the use of the Block Model Approach among Grade 2 learners, particularly in addressing difficulties with mathematical word problems at the elementary level (De Koning et al., 2022).

In one public elementary school in Clarin, Misamis Occidental, the teacher-researcher observed that several Grade 2 pupils experienced persistent difficulties in solving word problems in Mathematics. Classroom observations, formative assessments, and classroom performance records revealed that many pupils had difficulty understanding problem situations, identifying mathematical relationships, translating verbal statements into mathematical operations, and choosing appropriate strategies to solve problems. Pupils frequently guessed answers without following logical problem-solving procedures and showed low confidence in solving mathematical tasks independently. These observed challenges suggested the need for an immediate, practical classroom intervention to improve pupils' mathematical problem-solving skills.

Considering these concerns, this action research was conducted to improve Grade 2 pupils' word problem-solving skills through the Block Model Approach. Specifically, the study sought to determine whether the intervention could improve pupils' mathematical performance, strengthen conceptual understanding, and enhance confidence in solving word problems.

The findings of this study may help teachers implement more responsive classroom strategies, support school heads in strengthening mathematics interventions, improve pupils' mathematical performance, and serve as reference material for future classroom-based action research in Mathematics education.

Action Research Questions

This action research aimed to improve Grade 2 pupils' word problem-solving skills in Mathematics through the use of the Block Model Approach during School Year 2024–2025. Specifically, the study sought to determine whether the intervention could improve pupils' mathematical problem-solving performance and provide insights into responsive classroom practices in Mathematics instruction.

Specifically, it sought to answer the following questions:

1. What is the level of pupils' word problem-solving performance in the pretest between the control and experimental groups before the implementation of the Block Model Approach?
2. What intervention activities were implemented using the Block Model Approach to improve pupils' word problem-solving skills?
3. What is the level of pupils' word problem-solving performance in the posttest between the control and experimental groups after the implementation of the Block Model Approach?
4. Is there a significant difference in pupils' word problem-solving performance in the pretest between the control and experimental groups?
5. Is there a significant difference in pupils' word problem-solving performance in the posttest between the control and experimental groups after the implementation of the Block Model Approach?
6. Is there a significant difference between pupils' pretest and posttest word problem-solving performance in the control and experimental groups?
7. What reflections and insights emerge from the implementation of the Block Model Approach in improving pupils' word problem-solving skills?

II. RESEARCH METHODOLOGY

Design. This study employed an action research design, using a pretest–posttest comparative approach, to improve Grade 2 pupils' word problem-solving skills through the Block Model Approach. Action research is a systematic, reflective, and classroom-based inquiry conducted by teachers to improve instructional practices, address learning difficulties,

and enhance learners' academic performance through context-specific interventions implemented in authentic educational settings. The study followed the Plan–Act–Observe–Reflect Cycle, which enabled the teacher-researcher to identify pupils' learning difficulties, implement a responsive intervention, monitor pupils' progress, evaluate outcomes, and reflect on classroom practices to improve Mathematics instruction (Creswell & Creswell, 2017).

The study involved two groups of Grade 2 pupils, namely the experimental group, which received instruction through the Block Model Approach, and the control group, which continued to receive conventional classroom instruction. Although comparison groups were retained, the study remained action research because its primary purpose was to address observed classroom difficulties in mathematical problem-solving and to improve pupils' learning outcomes through a teacher-initiated intervention implemented within an authentic school setting. The pretest and posttest served as diagnostic and evaluative tools to assess pupils' progress and inform instructional decisions throughout the intervention.

During the planning phase, the teacher-researcher identified pupils' difficulties in solving mathematical word problems through classroom observations, formative assessments, and previous performance records. During the action phase, the Block Model Approach was introduced and implemented with pupils in the experimental group through structured, guided learning activities intended to improve conceptual understanding and mathematical reasoning. In the observation phase, pupils' classroom participation, engagement, responses, and performance were monitored and documented. Finally, during the reflection phase, the teacher-researcher evaluated the intervention's effectiveness and reflected on improvements in classroom practices, learner engagement, and instructional strategies for future Mathematics instruction.

Research Setting. This study was conducted in one public elementary school in the municipality of Clarin, Misamis Occidental, Northern Mindanao, during

School Year 2024–2025. The setting was considered appropriate because Grade 2 pupils at the foundational stage of learning often encounter challenges in understanding mathematical word problems, particularly in identifying relationships among quantities and selecting appropriate operations to solve problems. The school context provided a practical setting for implementing classroom-based interventions to improve pupils’ mathematical understanding, engagement, and problem-solving performance.

Participants of the Study. The participants in the study were 20 Grade 2 pupils, equally divided into a control group (n = 10) and an experimental group (n = 10) from one public elementary school in Clarin, Misamis Occidental. Participants were selected purposively based on classroom performance records, teacher observations, and formative assessment results indicating difficulties in solving mathematical word problems. The grouping of participants enabled the teacher-researcher to observe changes in pupils’ performance following the intervention’s implementation, while maintaining classroom authenticity and responsiveness to identified learning needs.

The inclusion criteria required participants to: (1) be officially enrolled as Grade 2 pupils during School Year 2024–2025; (2) demonstrate difficulty in solving mathematical word problems based on classroom assessments and teacher observations; (3) regularly attend Mathematics classes during the intervention

period; and (4) secure parental informed consent and pupil assent to participate in the study. The participants represented pupils requiring immediate instructional support in mathematical problem-solving, making them suitable recipients of classroom-based intervention strategy.

Research Instrument. The researcher utilized a researcher-made Word Problem Solving Test to assess pupils’ mathematical problem-solving performance before and after the intervention. The instrument consisted of 20 test items constructed based on the Most Essential Learning Competencies (MELCs) in Mathematics for the second quarter. The test items were distributed across levels of cognitive difficulty: 70% easy items focused on remembering and understanding, 20% average items that involved application and analysis, and 10% difficult items that required higher-order thinking skills such as evaluation and problem-solving.

To establish reliability, the instrument underwent pilot testing among pupils with characteristics similar to those of the study participants.

The reliability analysis yielded a Cronbach’s Alpha coefficient of 0.979, indicating a high level of internal consistency and suggesting that the instrument was reliable for measuring pupils’ mathematical problem-solving performance. To interpret pupils’ scores during the pretest and posttest, the study adopted the adjectival ratings and score equivalencies prescribed in DepEd Order No. 8, s. 2015, as shown below:

Scores	Grade Equivalent	Description
19–20	90–100	Outstanding
18	85–89	Very Satisfactory
16–17	80–84	Satisfactory
15	75–79	Fairly Satisfactory
1–14	Below 75	Did Not Meet Expectations

Data-Gathering Procedure. Prior to conducting the study, the teacher-researcher secured approval from school authorities and complied with institutional and ethical requirements for classroom-based research. Informed consent from parents or guardians and assent from pupils were obtained to ensure voluntary

participation and awareness of the study’s objectives and procedures.

The study began with the administration of a pretest using the researcher-made Word Problem Solving Test to determine pupils’ baseline problem-solving performance. The pretest results served as diagnostic

information to identify pupils' learning gaps and to inform the implementation of an appropriate intervention. Classroom observations and formative assessments were likewise conducted to gain a deeper understanding of pupils' difficulties in solving mathematical word problems.

Following the pretest, the experimental group received instruction using the Block Model Approach over two weeks, while the control group continued to receive conventional Mathematics instruction. The intervention involved teacher demonstrations, guided discussions, chalk-talk activities, guided practice, and independent exercises designed to help pupils visualize mathematical relationships using block representations and solve word problems systematically. Throughout implementation, the teacher-researcher continuously observed pupils' engagement, participation, confidence, and responses to classroom activities, documenting observations to support instructional reflection and improvement.

At the conclusion of the intervention, a posttest using the same Word Problem Solving Test was administered to both groups to determine changes in pupils' problem-solving performance and evaluate the effectiveness of the Block Model Approach. The gathered data were subsequently organized, analyzed, interpreted, and reflected upon to determine areas for instructional enhancement and future classroom-based intervention planning.

Ethical Considerations. The study adhered to ethical principles to ensure the safety, welfare, and rights of all participants. Prior to implementation, approval from school authorities was obtained, and parental informed consent and pupil assent were secured to ensure voluntary participation. Pupils were informed that participation was voluntary and that they could withdraw at any point without penalty or negative consequences.

Confidentiality and anonymity were strictly maintained throughout the study. Personal information and assessment results were treated with utmost confidentiality and used solely for research purposes. Codes and pseudonyms were used to protect pupils' identities, and the collected data were securely stored

to prevent unauthorized access. The teacher-researcher further ensured that all classroom activities promoted a safe, supportive, inclusive, and child-friendly learning environment during the intervention.

Data Analysis. The collected data were analyzed using appropriate descriptive and inferential statistical tools with the aid of statistical software. Frequency, percentage, mean, and standard deviation were used to determine pupils' performance on word problems in both the control and experimental groups during the pretest and posttest. To determine significant differences in pupils' performance between the control and experimental groups on the pretest and posttest, an independent-samples t-test was employed. Likewise, to determine significant differences in pupils' pretest and posttest performance within groups, a paired-samples t-test was used. These statistical procedures enabled the teacher-researcher to evaluate the effectiveness of the Block Model Approach as a classroom-based intervention for improving pupils' mathematical problem-solving performance.

III. RESULTS AND DISCUSSIONS

Pupils' Word Problem-Solving Performance Before the Implementation of the Block Model Approach

Table 1 presents the pupils' performance on word problem-solving before the implementation of the Block Model Approach. The findings reveal that both the control and experimental groups performed poorly on mathematical word problems during the pretest. Pupils in the control group fall entirely into the "Did Not Meet Expectations" category. In contrast, most pupils in the experimental group likewise do not meet expectations, with only one pupil achieving a fairly satisfactory level. The experimental group shows a higher mean performance ($M = 10.00$) than the control group ($M = 7.50$), suggesting slight differences in baseline readiness; however, both groups remain below the expected proficiency level, underscoring the need for classroom-based interventions to improve mathematical problem-solving performance.

The findings indicate that pupils in both groups encounter difficulties in understanding mathematical situations, identifying mathematical relationships, translating verbal information into mathematical

operations, and applying systematic problem-solving strategies. Classroom observations conducted by the teacher-researcher reveal that many pupils rely on guesswork, hesitate when solving mathematical tasks, and demonstrate limited confidence in identifying appropriate solutions. These findings imply that pupils possess insufficient conceptual understanding of mathematical word problems and require immediate instructional support to strengthen their problem-solving abilities.

Within the context of action research, the pretest findings serve as an important diagnostic basis for identifying pupils' learning needs and informing the development of an appropriate classroom intervention.

The low pretest performance justifies implementing the Block Model Approach as a responsive instructional strategy to help pupils visualize mathematical relationships and improve conceptual understanding. The findings emphasize the need for learner-centered interventions that address observed classroom difficulties and improve pupils' readiness for mathematical problem-solving.

The findings support previous literature emphasizing pupils' difficulties in mathematical problem-solving and the need for structured instructional support.

Klang et al. (2021) emphasized that weak conceptual understanding contributes to poor mathematical performance and low engagement in problem-solving activities.

Likewise, Setiawan and Oka (2020) explained that insufficient conceptual mastery and ineffective problem-solving strategies contribute to low mathematics achievement.

Lucasia (2020) further noted that Filipino learners often struggle to interpret and represent mathematical word problems, contributing to poor academic performance in Mathematics.

The findings may further be explained through Constructivist Learning Theory, which emphasizes that learners actively construct knowledge through meaningful experiences and prior understanding. The low performance observed in both groups suggests that pupils lack the prior conceptual understanding necessary to solve mathematical word problems independently.

This underscores the need for scaffolded, visual, and learner-centered interventions that enable pupils to actively construct understanding and strengthen conceptual learning through guided experiences.

Table 1. Pupils' Word Problem-Solving Performance Before the Implementation of the Block Model Approach

Performance	Control Group (f)	Control Group (%)	Experimental Group (f)	Experimental Group (%)
Fairly Satisfactory	1	10.00	1	10.00
Did Not Meet Expectations	10	100.00	9	90.00
Mean Performance	7.50	—	10.00	—

Note: Scale: 19–20 = Outstanding; 18 = Very Satisfactory; 16–17 = Satisfactory; 15 = Fairly Satisfactory; 1–14 = Did Not Meet Expectations.

Pupils' Word Problem-Solving Performance After the Implementation of the Block Model Approach

Table 2 presents the pupils' performance on word problem-solving after implementing the Block Model Approach. Findings reveal a marked improvement in the experimental group's performance following the intervention. Pupils in the experimental group achieve Outstanding, Very Satisfactory, and Satisfactory performance levels, resulting in a substantially higher mean performance (M = 17.70). In contrast, pupils in

the control group continue to perform below expectations, with all pupils remaining under the "Did Not Meet Expectations" category despite a slight increase in mean performance (M = 8.70). These findings indicate that pupils exposed to the Block Model Approach demonstrate stronger mathematical problem-solving abilities and improved conceptual understanding than those exposed only to conventional instruction.

The findings suggest that pupils exposed to the Block Model Approach benefit from visual and scaffolded instruction that enables them to understand mathematical situations, identify relationships among quantities, and systematically solve mathematical word problems. Classroom observations reveal that pupils in the experimental group become more engaged, participative, and confident in solving tasks independently. In contrast, pupils in the control group continue to struggle with mathematical reasoning and conceptual understanding. These findings imply that the Block Model Approach supports meaningful learning experiences that improve pupils' conceptual mastery and mathematical performance.

Within the context of action research, the findings demonstrate the effectiveness of responsive and classroom-based interventions in addressing pupils' identified learning difficulties. The substantial improvement in the experimental group confirms that interventions grounded in classroom observations and diagnostic assessments can meaningfully improve pupils' mathematical understanding and problem-solving performance. The findings further emphasize the importance of implementing learner-centered and

visually supported instructional strategies to address observed conceptual gaps among learners.

The findings support Lucasia (2020), who reported that visual problem-solving strategies significantly improve mathematical performance and conceptual understanding among learners. Likewise, Garzon and Casinillo (2021) emphasized that structured visual representations improve pupils' mathematical reasoning and problem-solving skills, while Setiawan and Oka (2020) explained that scaffolded instructional strategies strengthen pupils' academic achievement and conceptual mastery in Mathematics.

The findings may further be explained through Constructivist Learning Theory, which posits that learners actively construct understanding through meaningful learning experiences and guided engagement. The Block Model Approach enables pupils to visualize mathematical concepts and actively construct meaning from abstract ideas, thereby strengthening conceptual understanding and improving mathematical performance. The findings further highlight the value of scaffolded and learner-centered interventions in promoting deeper learning and independent problem-solving skills.

Table 2. Pupils' Word Problem-Solving Performance After the Implementation of the Block Model Approach

Performance	Control Group (f)	Control Group (%)	Experimental Group (f)	Experimental Group (%)
Outstanding	—	—	2	20.00
Very Satisfactory	—	—	4	40.00
Satisfactory	—	—	4	40.00
Fairly Satisfactory	—	—	—	—
Did Not Meet Expectations	10	100.00	—	—
Mean Performance	8.70	—	17.70	—

Note: Scale: 19–20 = Outstanding; 18 = Very Satisfactory; 16–17 = Satisfactory; 15 = Fairly Satisfactory; 1–14 = Did Not Meet Expectations.

Significant Difference in the Problem-Solving Performance of Pupils in the Pretest Between Experimental and Control Groups

Table 3 presents a significant difference in pupils' problem-solving performance during the pretest between the control and experimental groups, prior to the implementation of the Block Model Approach.

Findings reveal a statistically significant difference: the experimental group obtained a higher mean score ($M = 10.00$, $SD = 2.54$) than the control group ($M = 7.55$, $SD = 2.32$). The computed t-value ($t = 2.54$, $p = 0.04$) indicates a significant difference in baseline performance, leading to the rejection of the null hypothesis. These findings suggest slight differences

in pupils' readiness and conceptual understanding before the intervention, although both groups remain below expected performance standards.

The findings indicate that pupils in both groups experience difficulties with mathematical problem-solving prior to the intervention, although the experimental group demonstrates greater readiness and prior conceptual understanding. Classroom observations reveal differences in pupils' confidence, familiarity with mathematical tasks, and engagement in problem-solving, suggesting variability in prior learning experiences and mathematical preparedness. Despite these differences, both groups continue to demonstrate low proficiency levels, emphasizing the need for responsive classroom intervention.

Within the context of action research, the pretest findings serve as an essential diagnostic basis for intervention planning and classroom decision-making. The observed differences in baseline performance allow the teacher-researcher to identify learning needs, adjust instructional strategies, and implement targeted interventions designed to strengthen pupils' mathematical understanding and problem-solving performance. The findings reinforce the importance of

evidence-informed classroom practices that respond to observed learner difficulties and readiness levels.

The findings support Klang et al. (2021), who emphasized that conceptual understanding and structured mathematical experiences influence learners' readiness and confidence in problem-solving activities. Likewise, Setiawan and Oka (2020) highlighted that prior learning experiences and scaffolded instructional support contribute to pupils' mathematical competence and engagement in learning activities. Lucasia (2020) further noted that inadequate conceptual understanding contributes to poor mathematical problem-solving performance among learners.

The findings may also be interpreted through Constructivist Learning Theory, which emphasizes that learners build knowledge from prior understanding and meaningful experiences. Differences in pupils' pretest performance may reflect variations in prior conceptual experiences and mathematical exposure, reinforcing the need for scaffolded, learner-centered, and visually supported interventions that strengthen conceptual understanding and reduce learning gaps among pupils.

Table 3. Significant Difference in the Problem-Solving Performance of Pupils in the Pretest Between Experimental and Control Groups

Variables	M	SD	t-value	p-value	Remarks
Experimental Group	10.00	2.54	2.54*	0.04	Significant
Control Group	7.55	2.32	—	—	—

Note: $p < 0.05$ (Highly Significant); $p < 0.05$ (Significant); $p > 0.05$ (Not Significant).

Significant Difference in the Problem-Solving Performance of Pupils in the Posttest Between Experimental and Control Groups

Table 4 presents the significant difference in pupils' problem-solving performance during the posttest between the control and experimental groups after the implementation of the Block Model Approach. Findings reveal a highly significant difference between the two groups, with the experimental group obtaining a substantially higher mean performance ($M = 17.70$, $SD = 1.25$) than the control group ($M = 8.70$, $SD = 2.11$). The computed t-value ($t = 11.41$, $p < .001$) indicates a highly significant difference, leading to

rejection of the null hypothesis. These findings suggest that pupils exposed to the Block Model Approach demonstrate stronger conceptual understanding, greater mathematical confidence, and improved problem-solving performance than those who continue to receive conventional instruction.

The findings indicate that pupils exposed to the Block Model Approach become more systematic, engaged, and confident in solving mathematical word problems through repeated exposure to guided demonstrations, visual representations, and scaffolded practice. In contrast, pupils in the control group continue to demonstrate difficulties in understanding

mathematical situations and selecting appropriate problem-solving strategies. These findings imply that the Block Model Approach serves as an effective learner-centered intervention for strengthening conceptual understanding and improving mathematical performance.

Within the context of action research, the findings affirm the importance of responsive classroom interventions grounded in observed learner difficulties and instructional reflection. The substantial improvement observed among pupils exposed to the intervention demonstrates that classroom-based strategies tailored to learners' needs can significantly improve mathematical understanding and strengthen problem-solving performance. The results emphasize the importance of evidence-informed instructional practices that address conceptual difficulties and improve learner engagement.

The findings support Hughes et al. (2014), who emphasized that model-based instructional approaches significantly improve mathematical understanding and

learner performance compared to conventional teaching approaches.

Likewise, Garzon and Casinillo (2021) reported that visual problem-solving strategies improve conceptual understanding and strengthen mathematical reasoning, while Klang et al. (2021) highlighted that scaffolded interventions improve learners' readiness, engagement, and problem-solving confidence.

The findings may further be explained through Social Learning Theory and Constructivist Learning Theory. Social Learning Theory explains that pupils improve through observation, guided modeling, imitation, and reinforcement, while Constructivist Learning Theory emphasizes active knowledge construction through meaningful experiences.

Through repeated guided demonstrations and visual learning opportunities, pupils exposed to the Block Model Approach actively construct understanding and internalize systematic problem-solving behaviors, thereby improving their mathematical performance.

Table 4. Significant Difference in the Problem-Solving Performance of Pupils in the Posttest Between Experimental and Control Groups

Variables	M	SD	t-value	p-value	Remarks
Experimental Group	17.70	1.25	11.41**	< .001	Highly Significant
Control Group	8.70	2.11	—	—	—

Note: $p < 0.01$ (Highly Significant); $p < 0.05$ (Significant); $p > 0.05$ (Not Significant).

Significant Difference Between Pupils' Pretest and Posttest Performance

Table 5 presents the significant difference in pupils' pretest and posttest performance between the control and experimental groups following the implementation of the Block Model Approach. Findings reveal a significant difference in the performance of pupils in the experimental group ($p = 0.03$), indicating that exposure to the Block Model Approach results in meaningful improvement in mathematical problem-solving performance. In contrast, the control group shows no significant difference between pretest and posttest performance ($p = 0.16$), suggesting that conventional instruction alone does not substantially improve pupils' ability to solve mathematical word problems. These findings indicate that the Block Model Approach contributes

significantly to pupils' mathematical improvement and strengthens conceptual understanding in solving word problems.

The findings indicate that pupils exposed to the Block Model Approach benefit from structured, scaffolded, and visual instructional experiences that strengthen conceptual understanding and mathematical reasoning. Classroom observations reveal that pupils in the experimental group become more engaged, systematic, and confident in solving mathematical word problems after repeated exposure to guided demonstrations, visual representations, and independent practice. In contrast, pupils in the control group continue to show limited improvement, suggesting that conventional instructional approaches

alone may not adequately address pupils' difficulties with mathematical problem-solving.

Within the context of action research, the findings demonstrate the value of responsive classroom interventions in addressing observed learning gaps and improving pupils' mathematical performance. The significant improvement observed among pupils exposed to the Block Model Approach highlights the importance of using interventions grounded in classroom needs assessment and instructional reflection. The results further affirm that meaningful changes in learning outcomes occur when teachers implement structured and learner-centered strategies that directly address pupils' conceptual difficulties.

The findings support Hughes et al. (2014), who emphasized that model-based instructional approaches significantly improve pupils' mathematical understanding and problem-solving performance. Likewise, Klang et al. (2021) explained that scaffolded and structured interventions improve learners'

Table 5. Significant Difference Between Pupils' Pretest and Posttest Performance

Variables	t-value	p-value	Remarks
Experimental Group	5.38*	0.03	Significant
Control Group	1.15	0.16	Not Significant

Note: $p < 0.01$ (Highly Significant); $p < 0.05$ (Significant); $p > 0.05$ (Not Significant).

Reflection and Insights of the Teacher-Researcher

The implementation of the Block Model Approach provides meaningful insights into how structured, visual, and learner-centered interventions improve pupils' mathematical problem-solving performance. Prior to the intervention, pupils in both groups demonstrated hesitation, confusion, limited conceptual understanding, and reliance on guesswork when solving mathematical word problems, as reflected in their low pretest scores. During the implementation, pupils in the experimental group gradually become more engaged, participative, and confident in identifying mathematical relationships and solving word problems systematically through visual representations. Classroom observations reveal increased willingness to participate, greater confidence in independent problem-solving, and a deeper understanding of mathematical concepts among pupils exposed to the intervention. The

readiness, confidence, and participation in mathematical activities, while Setiawan and Oka (2020) highlighted the role of guided instruction in strengthening learners' mathematical competence and conceptual understanding.

The findings may further be interpreted through Social Learning Theory and Constructivist Learning Theory. According to Social Learning Theory, pupils learn through observation, guided modeling, imitation, and reinforcement. During the intervention, pupils observe structured demonstrations and gradually internalize effective problem-solving strategies, thereby improving performance. Similarly, Constructivist Learning Theory explains that learners actively construct knowledge through meaningful experiences and guided practice. The Block Model Approach enables pupils to actively engage with mathematical ideas through visual representations, resulting in deeper conceptual understanding and improved problem-solving performance.

significant improvement observed in the experimental group, compared to the limited progress in the control group, highlights the importance of responsive classroom interventions grounded in learners' needs. The teacher-researcher realizes that continuous use of scaffolded instruction, visual problem-solving strategies, differentiated activities, and formative assessment may further strengthen pupils' mathematical understanding, sustain learning gains, and improve overall classroom learning outcomes.

IV. CONCLUSIONS

The study's findings reveal that Grade 2 pupils in both the control and experimental groups initially demonstrate low word problem-solving performance, indicating difficulties in understanding mathematical situations, identifying relationships among quantities, and selecting appropriate operations to solve word problems. The implementation of the Block Model

Approach provides meaningful, structured learning experiences that enable pupils to visualize mathematical relationships, strengthen conceptual understanding, and develop more systematic problem-solving approaches. Following the intervention, pupils in the experimental group demonstrate substantial improvement in mathematical performance, increased classroom engagement, and greater confidence in solving word problems. In contrast, pupils in the control group exhibit minimal improvement under conventional instruction. The significant differences observed in posttest performance between groups and in the pretest–posttest performance of the experimental group further indicate that the Block Model Approach effectively improves pupils’ mathematical problem-solving skills and serves as a responsive, learner-centered intervention that strengthens conceptual understanding and classroom participation. Moreover, the findings highlight the importance of visual, scaffolded, and evidence-informed instructional strategies in addressing pupils’ mathematical learning difficulties and improving problem-solving performance.

V. RECOMMENDATIONS

Based on the study’s findings and conclusions, Mathematics teachers are encouraged to continuously implement the Block Model Approach in teaching mathematical word problems to strengthen pupils’ conceptual understanding, engagement, confidence, and problem-solving performance. School heads and Mathematics coordinators are encouraged to support the integration of classroom-based interventions through instructional supervision, technical assistance, mentoring, and professional development opportunities that strengthen teachers’ competencies in Mathematics instruction. Schools may likewise conduct Learning Action Cell (LAC) sessions focused on innovative, scaffolded, and learner-centered teaching strategies to address pupils’ mathematical learning difficulties and improve instructional effectiveness. Mathematics teachers are further encouraged to utilize formative assessments, differentiated instruction, guided practice, and reinforcement activities to continuously monitor pupils’ progress and address varying learner needs in problem-solving. Future researchers may conduct

similar classroom-based action research involving larger participant groups, longer intervention periods, and broader mathematical competencies to further validate the effectiveness of the Block Model Approach and strengthen evidence-based Mathematics instruction.

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