Block Model Approach in Problem Solving: Effects on Problem Solving Performance of the Grade V Pupils in Mathematics

Niño Jose P. de Guzman
La Salle Green Hills School
<niojosedeguzman@yahoo.com>

Rene R. Belecina
Philippine Normal University
<rrbelecina@yahoo.com>

The teaching of mathematics involves problem solving skills which prove to be difficult on the part of the pupils due to misrepresentation of the word problems. Oftentimes, pupils tend to represent the phrase “more than” as addition and the word difference as “- “. This paper aims to address the problem solving skills of grade five pupils employing the block model approach which is based on concrete - representation – abstract principle of teaching mathematics.

Since the turn of the century, traditional teaching based on the framework of behaviorism, such as the course in question, is being replaced by inquiry-based teaching, facilitating a constructivist framework of learning. Advocates of the constructivist-teaching paradigm (Draper, 2002), recommend a more student-centered math classroom that deemphasizes rote memorization of isolated skills and facts and emphasizes problem solving and communication. According to Larochelle and Bednarz (1998), a constructivist classroom is rich in conversation. By conversing, the teacher infers the learning level and preparation of the student and coaches the communication so that the learner is able to construct meaning, understanding, and knowledge. Teachers who embrace constructivism reject the transmission model of teaching (Richardson, 1997).

Relating to the constructivist theory of learning, the learner is active and continuously constructs and reconstructs conception of phenomena. The learning is not assessed with separate examination at the end of the course, but assessment methods are integrated into the learning process itself (Tynjala, 1998). The objective of the assessment is to encourage the learning process resulting in the discovery of qualitative changes in the student’s knowledge base. As a result, the course in question would benefit from an assessment method that stresses the application or performance that displays development of metacognition and critical thinking in an authentic and constructive way.

The study in general attempts to examine the effect of the use of block model approach in problem solving of the grade five pupils on problem solving performance in mathematics. Specifically it seeks to answers the following questions:

1. Is there a significant difference between the problem solving performance of the control group and the experimental group after the experiment?
2. Is the effect of the problem solving approach on the problem solving performance moderated by the level of mathematical ability?
3. Is the effect of the problem solving approach on problem solving performance moderated by the type of problem (one - step, two – step, three – step problem)?
4. How do pupils perceive the use of block model approach in problem solving?

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Hypotheses

The following null hypotheses were tested in this study

1. There is a no significant difference between the problem solving performance of the control group and the experimental group after the experiment.
2. The effect of problem solving approach on the problem solving performance of the pupils is not moderated by the level of mathematical ability.
3. The effect of the problem solving approach on the problem solving performance of the pupils is not moderated by the type of the problem (i.e. one step, two step, and three step problem).

Research Design

This study employed the Pretest-Posttest Control Group design. The control and the experimental groups were given a pretest, exposed to different treatments and then given a posttest. The control group was taught problem solving using the traditional approach while the experimental group was taught using the block model approach on problem solving. The participants of the study were taken from the ten heterogeneous sections enrolled in the school year 2007 – 2008. Intact groups and group - matching techniques were used to come up with the comparable groups. Fishbowl technique was used as a sampling technique in selecting the control and experimental group. The lessons covered by the study were one step problem solving, two step problem solving and three steps problem solving.

Conceptual Framework

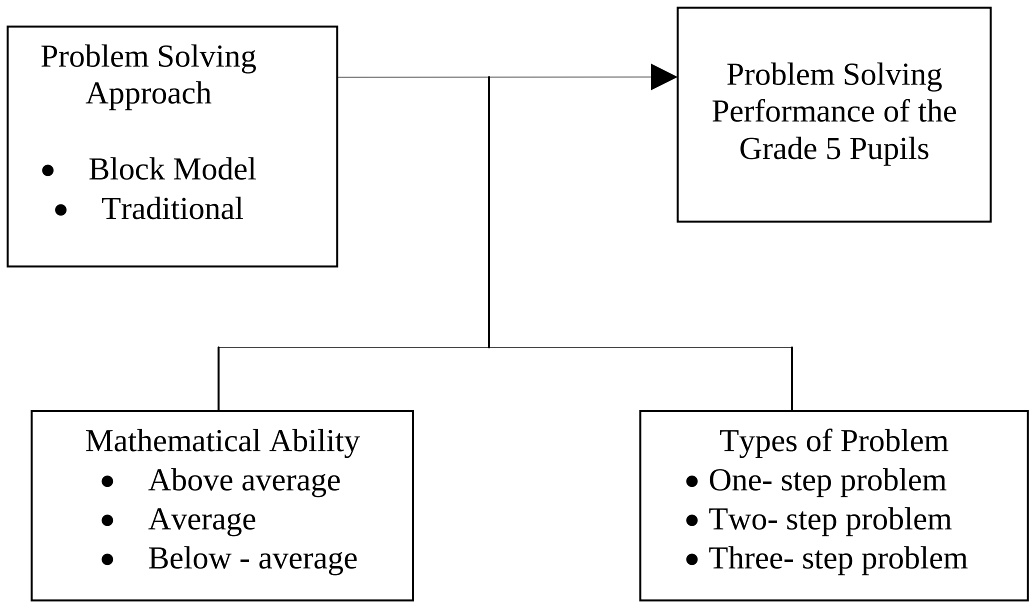

Figure 1. Conceptual Paradigm

Based on the above mentioned theory the conceptual paradigm was constructed. There are two problem solving approaches namely the Block Model Approach treated for the experimental group while the Traditional Method was employed to the control group. The Traditional Method merely employ algorithmic method of solving word problems while the

Block Model Approach employ the concrete- representation – abstract method of solving word problems. The Block Model Approach helps pupils visualize situations because it creates concrete picture of from abstract situation. It may satisfies the pupil's learning through seeing and doing. Finally, it transforms words into recognizable pictures for young minds. The researcher wanted to find out whether the problem solving performance of the Grade 5 pupils was moderated by the problem solving approach. The intervening variables are mathematical ability and types of problem. Under mathematical ability pupils are grouped into above average, average, and below average; for type of problems, it was classified into one - step, two – step, and three – step.

Data Gathering Procedure

The study has three phases. These are; 1) pre – experimental phase; 2) experimental phase; and 3) post – experimental.

Phase 1. Pre – Experimental Phase

An Achievement Test together with the table of specification was prepared. The other instruments used were also prepared. Lesson plans and Activity sheets for both the experimental and control groups. Letter of request were made (Appendices A to F); one was addressed to the Principal's office, the other one is addressed to the Registrar's office through the Office of the Academic Coordinators for the final grades of the respondents during the school year 2006 – 2007. After the thorough evaluation of the Achievement test, the final copy of this test was used as pretest and posttest of the study.

Phase 2. Experimental Phase

The teacher administered the Problem Solving Performance Test a day after the class orientation. The students in the control group went through the conventional way of teaching using the Traditional method. The students in the experimental group were exposed to Block Model Approach. During the experiment, the researcher following the same content coverage handled both groups.

Phase 3. Post-Experimental Period

A posttest was administered to both groups the day after the sessions. The results of the pretest and posttest were analyzed and examined to evaluate or assess the effects of the block model approach on the performance of the students.

Statistical Treatment of the Data

The following statistical tools were used to analyze the data gathered.

- t – test for Dependent Samples**.** This was used to determine if there is significant difference between the pretest and posttest scores of the experimental group and control group in terms of performance in the test.
- t – test for Independent Samples**.** This was used to find out if there is significant difference between the posttest mean scores of the experimental group and control group on problem solving performance test.
- Two – Way Analysis of Variance**.** This was used to determine if there is a significant interaction effect of problem solving approach and the mathematical ability on the problem solving performance of the pupils.

Research Instruments

Problem Solving Performance Test (PSPT)

Stage 1. Preparing the Initial Draft. A table of Specifications for the first draft was constructed to ensure that all content areas were represented in the test (Appendix B_1). The scope and sequence and the instructional objectives in the La Salle Green Hills, Grade School Math Department were the determining factors in the preparation of the table of specifications.

- Content Validation
  An initial draft of 50 multiple – choice items was made and submitted to the Academic Coordinator and three Mathematics teachers of the La Salle Green Hills for a thorough examination. A table of specifications was prepared to cover all the topics that will be discussed in the duration of the study.
- Face Validation
  Three Math experts teaching at La Salle Green Hills were involved in the validation of the Problem Solving Performance Test.
- First Try-out
  The 50 multiple choice test items were tried out to one of the sections of the graduating class of 2007 consisting of 30 pupils. These students were considered for the try – out of the test as they had just learned the items covered in the test few months back that they were in the position to answer the test items.

Stage 2. Item Analysis. After the try-out, the test items were analysed by using the Upper and Lower Index Method.Option analysis was done. Deciding whether to retain of remove the items was based on two ranges. Items with difficulty indices within 0.20 to 0.80 and discrimination indices within 0.30 to 0.80 were retained. From the 50 multiple - choice items, 10 of these were discarded and, 30 items were retained and 10 were subjected to revision.

Stage 3. Second Try – out. After analyzing the results of the first draft, the final version of the 40 item multiple choice problem solving performance was administered to another group of graduating pupils. Another item analysis was done to find out the indices of discrimination and difficulty of the revised test items. Items with difficulty indices within 0.20 to 0.80 and discrimination indices within 0.30 to 0.80 were retained. The same procedure and computation instruments as in the first try – out were used. Appendix C2 shows the option for the second try – out and the analysis of each item as to difficulty and discrimination indices. From 40 multiple choice items, 10 were discarded, 24 were retained and 6 were subjected to revision.

Stage 4. Preparing the Final Draft. After conducting and revising the second try – out the final was ready to serve as pretest and posttest in the study. The final version composed of 30 multiple-choice items can be found in Appendix N.

- Lesson Plans
  Before the start of the experiment, lesson plans were prepared covering the lessons given during the experimental period, one using the traditional method and the other one using the Block Model Approach. These were submitted to a group of senior Mathematics teachers in La Salle Green Hills. After critiquing, suggestions and recommendations from the Mathematics experts were solicited and observed. The lesson plan can be found from Appendices AB to AQ.

Presentation, Analysis and Interpretation of Data

Comparison between the Problem Solving Performance of the Control Group and the Experimental Group after the Experiment.

Table 1 shows the comparison of the experimental and control groups in terms of problem solving performance after the experiment.

Table 1
Comparison of the Experimental and Control Groups in Terms of Mathematical Ability after the Experiment

Groups	Mean	Std Dev	Mean Difference	df	Computed t-value	Tab value	Interpretation
Experimental	22.71	4.04	3.92	82	3.94	1.99	Significant
Control	18.79	5.03					

It can be viewed from the table the computed t – value of 3.94 is greater than the critical value of 1.99 at 0.05 level of significance. It shows that there is significant difference in the problem solving performance between the control group and the experimental group. It can be also gleaned in the table that the experimental group performed better in terms of problem solving compared to their counter part in control group.

Comparison Between the Pretest Mean Scores of the Control and Experimental

Table 2 shows mean scores on problem solving performance of the experimental group and control group after the experiment when they are grouped according to their mathematical ability.

Table 2
Mean Scores on Problem Solving Performance of the Experimental Group and the Control Group According to their Mathematical Ability after the Experiment

	Mathematical Ability		
Groups	Below Average	Average	Above Average
Control	16.45	19.58	21.71
Experimental	19.62	22.86	27.38

As can be gleaned on the above data, it can be deduced that the mean scores of the pupils belong to the above average group are higher than their counter part in average and below average group. The data also shows that groups in the experimental group perform better than their counter part in the control group. To determine whether problem solving approach on problem solving performance is moderated by the level of mathematical ability, Two Way ANOVA was used. Table 3 shows the summary of the two - way ANOVA for the Interaction Effect of Problem Solving Approach and Mathematical Ability on Problem Solving Performance.

Table 3
Two Way ANOVA for the Interaction Effect of Problem Solving Approach and Mathematical Ability on Problem Solving Performance

Source of Variation	SS	df	MS	Computed F	Tab F	Interpretation
Problem Solving Approach	271.44	1	271.44	19.54	3.96	Significant
Math Ability	401.71	2	200.85	14.46	3.11	Significant
Interaction	27.76	2	13.88	1	3.11	Not significant
Error	1083.51	78	13.90			
Total	1784.42	83				

As can be seen in the table, the main effect yielded significant results. This means that the effect of the problem solving approach on the problem solving performance test is significant. Also, mathematical ability has a significant effect on the problem solving performance as expected. However, the interaction effect of the problem solving approach on mathematical ability on problem solving performance is not significant. On the other hand, the performance of the experimental group which was exposed to block model approach performed better than the control group which used the traditional method. This means that the effect of the problem solving approach on problem solving performance is not moderated by mathematical ability. Thus, with regards to mathematical ability, any problem solving approach can be utilized.

Interaction Effect of Types of Problem and Problem Solving Method on Problem Solving Performance

Table 4 shows the mean scores on problem solving performance of the experimental group and control group after the experiment when they are grouped according to their type of problems.

Table 4
Mean Scores on Problem Solving Performance of the Experimental Group and the Control Group According to Types of Problems after the Experiment

	Type of Problems		
Groups	One - Step	Two - Step	Three - Step
Control	29.92	25.56	25.11
Experimental	34.42	30	30.11

As can be gleaned on the above data, it can be deduced that the mean scores of the pupils who solved one- step are higher than their counter part in average and below average group. The data also shows that groups in the experimental group perform better than their counter part in the control group.To determine whether problem solving approach on problem solving performance is moderated by the types of problems, Two Way ANOVA was used. Table 5 shows the summary of the two - way ANOVA for the Interaction Effect of Problem Solving Approach and Mathematical Ability on Problem Solving Performance.

Table 5
Two Way ANOVA for the Interaction Effect of Problem Solving Approach and Types of Problems on Problem Solving Performance

Source of Variation	SS	df	MS	Computed F	Tab F	Interpretation
Problem Solving Approach	322.02	1	322.02	10.72	4.02	Significant
Type of Problems	288.26	2	144.13	4.8	3.17	Significant
Interaction	0.87	2	0.44	0.01	3.17	Not significant
Error	1621.83	54	30.03			
Total	2232.98	59				

As can be seen in the table, the main effect yielded significant results. This means that the effect of the problem solving approach on the problem solving performance test is significant. Also, type of problems has a significant effect on the problem solving performance. As expected, pupils perform the highest when they are given one – step word problem. Therefore, the number of steps in problem solving affects their performance.

However, the interaction effect of the problem solving approach on type of problems on problem solving performance is not significant. On the other hand, the performance of the experimental group which was exposed to block model approach performed better than the control group which was used the traditional method. This means that the effect of the problem solving approach on problem solving performance is not moderated by types of problem. Thus, regardless of the type of problems any problem solving approach can be utilized.

Summary of Findings

The following summarizes the findings of the study.

1. There is a significant difference between the problem solving performance of the control group and the experimental group after the experiment. Moreover, the experimental group performed better than the control group.
2. The effect of problem solving approach on the problem solving performance of the pupils is not moderated by the level of mathematical ability.
3. The pupils' mathematical ability does not depend on the approach given. However, the performance of the experimental group which uses the block model approach performed better that the control group which was exposed to the traditional method.
4. The effect of problem solving approach on the problem solving performance of the pupils is not moderated by the type of the problem (i.e. one step, two step, and three step problem). However, the performance of the experimental group which uses the block model approach performed better that the control group which was exposed to the traditional method.
5. Regardless of the mathematical ability any teaching approach on the problem solving can be used since there is no interaction effect of problem solving approach and mathematical ability on problem solving performance.
6. Regardless of the types of problems any teaching approach on the problem solving can be used since there is no interaction effect of problem solving approach and the types of problems on problem solving performance.

7. Majority of the respondents found the block model approach in teaching mathematics interesting and useful in solving worded problems. This approach is so helpful that it really make them have an easier time to learn and understand the lessons. Other student-respondent claimed that the block model approach “is very simple, easy to use and it shows how the process happened in word problems.”

Based on the findings from this study, the following conclusions are drawn:

1. The use of block model approach helps the student’s problem solving skills and enhances the retention of concepts learned. Thus, Block Model Approach helps the pupils to performed better in the problem solving performance.
2. Block Model Approach as perceived by the pupils were useful in solving word problems in mathematics and easy to use.

Recommendations

Based on the findings and conclusion on this study, the researcher proposes the following recommendations:

1. Use the Block Model Approach as an alternative approach in teaching the word problem solving in Mathematics.
2. Introduce the Block Model Approach as early as Grade I to master the said approach.
3. Support and fund research to identify programs that successfully tie literacy to content instruction, particularly in Mathematics.
4. Support and fund professional development for teachers regarding the needs of problem solving performance of the pupils.
5. Conduct further research on the relationship between mathematics learning and problem solving.

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