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ENHANCING THE PROBLEM-SOLVING ABILITY OF STUDENTS THROUGH THE IMPROVEMENT OF THEIR NUMERICAL FLUENCY

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Abstract

The study was centered on enhancing students' problem solving ability using the instructional strategy with numerical fluency activities namely math cards, manipulatives, and puzzles. The subjects of the study involved two selected Grade 7 sections with 28 students each, forming the control and experimental groups. This was conducted from February 20 to March 31, 2017 at Jose J. Mariano Memorial High School during the academic year 2016-2017

This study was conducted to determine how the students' problem solving ability be enhanced through the improvement of numerical fluency. Specifically, it described the problem solving ability of the students before and after the implementation of the two instructional strategies. Moreover, it also answered the questions if there are significant differences in the level of problem solving ability of the students based on the pre-test and post-test results of the two groups.

The study adopted the qualitative-quantitative methods of research and used the quasi-experimental method of study. The instruments used to collect data were the: (1) test of numerical fluency and problem solving ability (pre-test and post-test) consisted of 30 items multiple choice questions, (2) Talk-Aloud Test was utilized for the qualitative aspect of the study, (3) STAR observation technique was used to ensure proper implementation of experiment, and (4) rubrics were used to evaluate students' output.

The data of the study were treated using descriptive and inferential statistics. Mean and mean percentage were used to describe the numerical fluency and problem solving ability of the students before and after the treatment. The t-test was utilized to determine the significance of the mean

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difference between the post-test results of the control and experimental groups. Furthermore, it was also used to determine the significance between the mean differences of the pre-test and post-test results of the both groups.

The results of the study showed that instructional strategy with numerical fluency activities has significant impact on students' problem solving ability since the experimental group improved from *beginning* to *approaching proficiency* level. Although both methods showed significant differences on students' mathematical performance after exposure to the assigned strategy, findings revealed that instructional strategy with numerical fluency is better than the traditional method of teaching number problems.

In light of the findings of the study, the researcher recommends utilizing instructional strategy with numerical fluency activities as supplemental strategy in teaching problem solving topics. It may be adopted to address the deteriorating performance of students in Mathematics. Similar topics can be conducted using other approaches and topics.

Introduction

Problem solving transfer is one of the major goals of K to 12 Mathematics education. It is defined as the ability to analyze and apply students' knowledge in dealing with problems encountered in a daily basis. Hence, problem solving is essential to education because it is considered as the heart of mathematics learning. However, in the study of Mathematics, students often struggle in comprehending and solving mathematical word problems. Some students refute the subject, others feel anxious in solving questions especial ly word problems. Other reasons students take problem solving as a burden can be their dumbstruck feeling in understanding the problem and confusion in devising and carrying out a solution . They also get puzzled even in easy arithmetic questions, or they usually end up at the wrong answer mainly because of a simple mistake in their solution.

A typical Mathematics class scenario experienced by most teachers happens when a student is asked with a simple arithmetic question such as -3 + 5. Most teachers receive different responses like -2, 8, -8, -15, or many other possible answers. This dilemma results in students' poor performance in both national and international standardized examinations. Based on the National Achievement Test results for the academic years 2005 – 2006, 2006 – 2007, 2011 – 2012, and 2012 – 2013, the Mean Percentage Scores in Mathematics were 50.70%, 47.82%, 46.37%, and 46.83%, respectively. It has been noted that there was a decline of 3.87% in the MPS results from the year 2006 to 2013 (De Dios, 2013). This showed dwindling performance of students for the given school year, where most errors reflected on problem solving question s and simple mathematical equations.

The lack of basic math fact retrieval of students can impede not only participation in class discussions and successful problem solving but also their performance in mathematics achievement tests. The results and studies recognized that students' capacity to utilize basic mathematical skills comprises the foundation of their applied skills in problem solving, and that those critical thinking/problem solving skills were key factors in assessing their success (or, more often, their lack of success) in the workplace.

Moreover, in 1995, Philippines ranked 30th out of 42 countries in Trends in International Mathematics and Science Study (TIMSS). It is a series of international assessments of mathematics and science that

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basically tests quality and quantity in content knowledge of students around the world. Also in 1999, it garnered a score of 345 which is the 36th place out of 38 participating countries. In 2003, the Philippines scored 376 ranking 43rd out of 46 countries. In addition, the country took part in the advanced TIMSS 2008 where it obtained a low score of 355 which did not reach even the intermediate benchmark score of 475. Results showed that the Philippines ranked last among 10 participating countries; only the students from the science high school and the elite private institutions in the Philippines took it in 2008 (De Dios, 2013). The TIMSS assessment in eighth grade typically consists of about 450 items and 225 items of which are mathematics questions which are in multiple choice and constructed- response formats. Each multiple choice item is worth one score point while constructed-response items are worth one or two score points, depending on the nature of the task and the skills required to complete it.
Results of this assessment indicated very poor performance of Filipino students in different content domains of Mathematics.

Beyond preparing students for college and corporeal setting , or entry to the senior high school programs, bringing students to a level of proficiency in Mathematics has implications for many basic life skills. For example, most of the students will face the need to purchase goods or services, perform household budgeting or even technical task in the workplace that requires basic skills . Such skills are highly needed to live and participate in the society and its progress (Lembke, Hampton, & Beyers, 2012). Rapid math fact retrieval has been shown to be a strong predictor of the development of everyday life skills.

To a person who lacks basic numerical fluency, arithmetic is a dazing domain *in which any deviation from the known path may rapidly lead to being totally lost.* Students who engage in a lot of practice without understanding what they are doing often forget, or most of the time remember incorrectly those procedures. Further, there is growing evidence that once students have memorized and practiced procedures without understanding, they have difficulty learning later to bring meaning to their work.

Also, competence in the basic problem solving skills is obviously a necessary prerequisite for all the high-ranking applied skills listed by employers and employees (i.e., professionalism/work ethic, oral and written communication, public-relations or consumer-relations teamwork/collaboration, and critical thinking/problem solving), a clear connection exists specifically between mathematical skills and critical thinking/problem solving proficiency (Krawec, 2006).

It is imperative to learn the bas ic mathematical skill during early age. It is to alleviate the frustration in learning mathematics in class and to build confidence for future work experiences. Another important component of mathematics training is solving word problems. Real-world problems that require mathematics for solution typically do not come to use as equations ready to be solved but rather (as a word or) pictorial representations that must be interpreted symbolically, manipulated, and solved.

Number recognition and problem solving comprehension are links that secure numerical fluency. It serves as an advantage for those who could utilize it properly. People who are not numerically fluent have problems on concentrating on operational facts, thus, they cannot focus on what the problem means. They have difficulty in making connections among ideas in the problem and their background knowledge. In other words, people who are not numerically fluent do not recognize the composition and decomposition of numbers based on patterns and cannot comprehend the usage of those numerical patterns to solve problems (Smith, 2006). Since solving worded problems require higher order thinking skills, it is a necessity that numerical fluency should not be a burden to the students. They themselves

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should have developed numerical fluency in order to facilitate solving problems properly. The students' ability to apply this numerical fluency skill comprises the foundation of their applied skills in problem solving. Also, their problem solving skill is a vital factor in evaluating their overall mathematical success.

In light of this concern, this study was conducted to develop grade seven students' problem solving ability by enhancing their numerical fluency through the use of math cards, manipulatives, and puzzles.

Statement of the Problem

The general problem of the study is: "How may the students' problem solving ability be enhanced through the improvement of numerical fluency?".

Specifically, the study sought answers to the following questions:

1. How may the level of performance in Mathematics of the control and experimental groups be described based on the pre-test results on numerical fluency and problem solving?

2. Are there significant differences between the pre-test mean results on the two measures of mathematical performance of the control and experimental groups?

3. What is the level of performance based on the post-test mean results of the subjects exposed to instructional strategy with numerical fluency activities (experimental group) traditional method (control group)?

4. How do the control and experimental groups differ in terms of their performance results?

5. Are there significant differences between the two groups of students' level of numerical fluency and problem solving ability before and after each exposure to the assigned instructional strategy?

6. How is the improved numerical fluency manifested in the results of the problem solving ability test of the subjects?

Methods

The study adopted the qualitative-quantitative methods of research. Quantitative research refers to the systematic, empirical investigation of social phenomena via statistical, mathematical or computational technique. According to Creswell (2003), it stresses objective measurements and the statistical or numerical analysis of data gathered through questionnaires, and surveys, or by working the pre-existing statistical data using various computational procedures. This type of research can be administered and evaluated quickly. In addition, numerical data obtained through this approach facilitates comparisons between organizations or groups, as well as allowing determination of the extent of agreement and disagreement between respondents (Choy, 2014).

Since quantitative research focuses on numeric data, the quantitative components of this study described the significant gain in students' numerical fluency and problem solving ability before and after the implementation of the treatment. Moreover, their mathematics performance on number problem based on the pre-test and post-test results was also described using this type of research.

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Likewise, this research aimed to gather an in-depth understanding of the effect of numerical fluency activities to students' problem solving ability on the aforementioned topic. Thus, the qualitative method was also applied.

Qualitative research gathers information that is not in numerical form. Denzin & Lincoln (2011) described qualitative research as multimethod in focus, including an interpretive, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural settings, trying to make sense of, or interpret phenomena in terms of the meaning people bring to them.

It also involves the studied use and collection of a variety of empirical materials – case study, personal experience, introspective, life story, interview, observational, historical, interactional and visual texts – that define routine and problematic moment and meanings in individuals' lives. It involves interpretation of things in their natural setting. This type of research has the ability to probe for underlying values, beliefs, and assumptions. Furthermore, in the qualitative approach, the inquiry is broad and open-ended, allowing the participants to raise i ssues that matter most to them (Choy, 2013).

Since qualitative researches generate words rather than numbers as data for analysis, the qualitative part of this study was done through analyzing and interpreting students' responses on the Talk-Aloud Test. The results of this test aimed to support the results of the test of numerical fluency and problem solving by explaining how and why each group obtains their respective levels on each topic. In addition, this approach was utilized to determine the outcome of this study through analyzing classroom observations using the STAR observation technique.

Population and Sample of the Study

The subjects of the study were chosen from five sections of grade seven students of Jose J. Mariano Memorial High School for the school year 2016-2017. Cluster sampling was used in selecting the subjects of the study. Based on the third quarter grades of the students, two sections with similar grades were compared and selected. Fifty-six (56) subjects were taken out of 264 grade 7 students. Twenty-eight (28) students of section Camia were assigned as the control group. They were taught using the traditional method. Another twenty-eight (28) students from section Rose were assigned as the experimental group and were exposed to instructional strategy with numerical fluency activities.

The actual conduct of the study was observed from February 20 to March 31, 2017, covering a total of 24 hours consisting of a 6-week implementation period with 1-hour session 4 times a week following the regular session of classes, excluding the number of hours in answering the pre-test, post-test and Talk-Aloud Test. To attest that classes were held in relation to the study, the school's mathematics coordinator and other mathematics teachers were invited to observe the classes. They were provided copies of lesson plans (see Appendix J) and rubrics on the onset of the lesson proper.

Research Instruments

The following instruments were used to gather the needed data for the study: test of numerical fluency and problem solving ability, Talk-Aloud Test, and STAR observation technique.

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Test of Numerical Fluency and Problem Solving Ability. Pre-test and post-test (see Appendix E) were used in this study as the test of numerical fluency and problem solving ability . It is a teacher made test that was originally a 40- item multiple choice questions subjected to item analysis. For the validity of the test, it was first administered to grade 8 Narra of Jose J. Mariano Memorial High School. This section was chosen since the grade 7 students have no prior knowledge on number problems. The difficulty index and item discrimination were computed and items with negative values were discarded. Seven (7) poor items were revised while nine (9) items with negative values were rejected. After few revisions, the edited test resulted to a 30-item examination as reflected in the table of specification (see Appendix D). The test has a total of 50 points; 25 points were allotted for numerical fluency questions that ranged from numbers 1 to 25. While numbers 26 to 30 were allotted for the problem solving ability of the students which scored 5 points each item. Also, a rubric (see Appendix F) was constructed for the test of problem solving ability. It is a tool to identify score of students in each problem item or the degree to which learning standards have been executed or attained by the students.

Talk-Aloud Test. To describe the mathematics performance of the subjects exposed to instructional strategy with numerical fluency activities and traditional method qualitatively, the Talk-Aloud Test (see Appendix G) was also used. It comprises of three open-ended questions with varying levels of difficulty to measure students' problem solving ability and support the result of the test of numerical fluency and problem solving ability (Santos, 2006). Questions were based on the topic number problems. This was administered to five members of each group of students. As the subject- respondents answered each test item, the teacher-researcher interviewed the subjects. This was videotaped to record students' responses. These videotapes were then transcribed to written forms and coded for key events. Rubrics for the Talk-Aloud T est (see Appendix H) was constructed by the researcher with the guidance and inputs from the adviser and critic. It served as guide in determining the students' problem solving ability in the topic qualitatively .

STAR Observation Technique. The Department of Education (DepEd) STAR observation tool was used by the teacher observers. It serves as a supervisory tool which was used to collect information from the actual teaching learning activity of the two selected sections. The STAR observation (see Appendix I) also shows the strategies and methods which are effective and suitable for the subjects' needs and capacity. It also gives feedback of observers to the classroom situation, tasks given by the facilitator, actions with the class, and results of the teaching-learning process. This also validates the results of the test of numerical fluency and problem solving ability and the Talk-Aloud Test made by the researcher.

Results and Discussion

Part I. Level of Performance of the Two Groups in terms of Numerical Fluency and Problem Solving Ability

Table 1 shows the pre-test results on numerical fluency and problem solving of the control and experimental groups and its description based on the K to 12 Levels of Proficiency.

Table 1

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Pre-test Mean Scores of Control and Experimental Groups in Numerical Fluency and Problem Solving Ability

Group	Numerical Fluency			Problem Solving Ability		
	Mean Score	Mean Percentage Score	Verbal Description	Mean Score	Mean Percentage Score	Verbal Description
Control	10.39	41.56%	Beginning	1.43	5.72%	Beginning
Experimental	11.6	46.40%	Beginning	0.6	2.40%	Beginning

At df = 54, t-critical = 2.005, = 0.05

The mean score in the numerical fluency was taken from the first 25 items in the 30-item teacher-made test, while the problem solving a bility was covered by the remaining 5 items. The mean scores obtained by the control and experimental groups for numerical fluency were 10.39 and 11.6, respectively, both in the *beginning* level. Likewise, for problem solving, mean scores of 1.43 and 0.6 were observed for the control and experimental groups, both in the *beginning* level. The pre-test mean scores revealed that students have inadequate knowledge both on numerical fluency and problem solving; furthermore the levels of understanding on the said topics were below the expected level of understanding of the current curriculum.

Part II. T-test Results on the Differences between the Pre-Test Mean Results of the Control and Experimental Groups

Table 2 exhibits the pre-test mean results of the control and experimental groups. The mean percentage was transmuted to a verbal description aligned to the K to 12 Levels of Proficiency. It also presents the mean difference of the pre-test mean scores of the two groups, together with the t-value and the interpretation based on the level of significance.

Table 2

Mean Distribution of the Pre-test Scores of the Control and Experimental Groups

Groups	Pre-test Mean Score	Mean Percentage	Verbal Description	Mean Difference	t-value	Interpretation
Control	11.79	23.58%	Beginning	0.46	0.494	Not Significant
Experimental	12.25	24.50%	Beginning			

As can be gleaned in the table, the control group scored a mean of 11.79 out of the 50-point examination, whereas the experimental group garnered a mean of 12.25. This implies that the control group has a mean percentage of 23.58%, while the experimental group has a mean percentage of 24.50%, which were both categorized as *beginning*. Comparatively, the experimental group's mean score

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was higher than the control group's. Considering the small mean difference of 0.46 reflected in Table 2, the researcher inferred that the mathematical ability of the two groups was of equal level.

The conclusion was strengthened by comparing the values of the t-value of 0.494 and the t-critical of 2.005 at the degrees of freedom (df) of 54 and a level of significance () of 0.05. Since the t-value is less than the t-critical (tvalue tcritical), hence there was enough reason to accept the no significant difference between the pre-test mean results of the two groups. It was an indication that the two groups were of the same numerical fluency and problem solving ability level before the implementation of the treatment.

Part III. Level of Performance of the Control and Experimental Groups

Table 3 presents the mathematics performance of the subjects exposed to two instructional strategies based on the post-test results.

Table 3

Mean Distribution of the Post-test Scores of the Control and Experimental Groups

Groups	Post-test Mean Score	Mean Percent-age	Verbal Descrip-tion	Mean Differ-ence	t-value	Interpretation
Control	30.93	61.86%	Beginning	9. 28	4.316	Significant
Experimental	40.21	80.42%	Approaching Proficiency			

At df = 54, t-critical = 2.005, = 0.05

The entries in table 3 indicate the post-test mean results and the level of mathematics performance of the two groups after the experiment. As shown in the table, the experimental group recorded a mean of 40.21, which was categorized as *approaching proficiency*. This implies that the subjects of the experimental group showed a remarkable performance considering their post-test mean score which was thrice as their pre-test score. Likewise, the performance of the members of the control group showed positive outcome considering a post-test mean of 30.93, which was twice higher than the pre-test. However, result still falls on *beginning* level. These numerical figures revealed that most of the subjects of the experimental group performed better than the subjects of the control group.

Part IV. T-test Results on Differences between the Post-test Mean Results of the Control and Experimental Groups

Table 4 displays the t-test analysis of the post-test mean results of the control and experimental groups.

Table 4

T-test Results of the Post-test Mean Scores of the Control and Experimental Groups

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Groups	Mean Score	Verbal Description
Control (Exposed to Traditional Method)	30.93	Beginning
Experimental (Exposed to Instructional Strategy with Numerical Fluency Activities)	40.21	Approaching Proficiency

At df = 54, t-critical = 2.005, = 0.05

If the post-test mean results of the control and the experimental groups were to be compared, remarkably there was an observable difference of 9.28. This suggests that majority of the students in the experimental group performed well as compared to the students of the control group. The aforementioned claim was even justified since the t-value of 4.316 is higher than the t-critical of 2.005. Therefore, there are significant differences between the performance results of the two groups based on their post-test. This goes to show that the instructional strategy with numerical fluency activities was remarkably better than the traditional lecture-discussion approach in teaching number problems.

Part V. T-test Results on the Differences between the Control and Experimental Groups' Level of Problem

Solving Ability Based on the Pre-test and Post-test Results

The following tables present the comparison of the pre-test and post-test mean scores of the control and experimental groups, together with the t-value, and the interpretation based on the level of significance.

Pre-test and Post-test Mean Results of the Control Group

The table also illustrates the mean results of the pre-test and post-test of the control group, whereas, mean percentage and mean difference are tabulated.

Table 5

T-test Results of the Pre-test and Post-test Scores of the Control Group

Test of Numerical Fluency and Problem Solving Ability	Mean Score	Mean Percentage	Mean Difference	t-value	Interpretation
Pre-test	11.79 (Beginning)	23.58%	19.14	11.556	Significant
Post-test	30.93 (Beginning)	61.86%			

For the control group, the concepts of number problems were taught using the traditional mode of teaching. The pre-test scored a mean of 11.79, while the post-test recorded a mean of 30.93. It presented mean percentages of 23.58% and 61.86%, respectively. Thus, both examinations were noted as *beginning.* It revealed that the learning acquisition of the control group was inadequate in the K to 12 levels of proficiency but still obtained a high mean difference of 19.14.

Further computation was made using t-test and revealed that the t-value of 11.556 was greater than the t-critical of 2.005, tvalue tcritical at df = 54 and . Thus, there are significant differences between the pre-

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test and post-test mean results of the control group. These findings were indications that the learning process through traditional method could still hold a significant change in students' mathematics performance. However, the increase is not substantial enough in the K to 12 curriculum since the level of the students in the control group retained to the *beginning* level.

Pre-test and Post-test Mean Results of the Experimental Group

The experimental group was exposed to the instructional strategy with numerical fluency activities in teaching number problems.

Numerical fluency activities such as math cards, manipulatives and puzzles were provided to improve students' numerical fluency at the same time develop their problem solving ability.

Table 6

T-test Results of the Pre-test and Post-test Scores of the Experimental Group

Test of Numerical Fluency and Problem Solving Ability	Mean Score	Mean Percentage	Mean Difference	t-value	Interpretation
Pre-test	12.25 (Beginning)	24.50%	27.96	18.319	Significant
Post-test	40.21 (Approaching Proficiency)	80.42%			

At df = 54, t-critical = 2.005, = 0.05

Table 6 revealed the pre-test mean score of 12.25 and post-test mean score of 40.21 of the experimental group. Mean scores could be transmuted to mean percentages of 24.50% and 80.42%, respectively. In addition, the table presented a mean difference of 27.96, implying that numerical fluency activities contributed a lot in improving the mathematics performance of the students in the experimental group.

The researcher's conclusion was there are significant differences between the pre-test and post-test mean scores of the experimental group. The basis was that the t-value of 18.319 is greater than the t-critical of 2.005 (tvalue > tcritical) at df = 54 and a = 0.05 . As a result, it revealed that the members of the experimental group improved from "*Beginning*" to "*Approaching Proficiency"* level.

With this, the researcher could say that a firm understanding of numbers or numerical fluency is essential to mathematical learning and problem solving, that instruction with numerical fluency activities such as math cards, manipulatives, and puzzles lead to significant reductions of mathematical failures.

Findings of this study are confirmed by the study of Conley (2014) that students who are exposed to an additional mathematical program related to breaking apart word problems show evidence of a greater understanding and mastery of solving mathematical word problems. Thus, students have a greater opportunity to be successful.

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Similarly, Janes (2015) showed that students' pre-test and post-test scores on a standard chapter test on numerical fluency and Algebra were compared following an intervention which involves teacher-student and student-student interaction. Results indicated that there was an increase in students' understanding of numerical fluency and Algebra including problem solving based on the pre-test and post-test score comparisons and student and teacher narrative. This shows significant differences between the pre-test and post-test results of both studies.

Part VI. Talk-Aloud Test Results of the Control and Experimental Groups

To assess student-respondents' level of numerical fluency and problem-solving ability, a modified version of the Talk-Aloud Test was used. The Talk –Aloud Test was utilized to describe each group's numerical fluency and problem solving ability qualitatively. Each of the 10 subjects was given 10 minutes to answer and complete the problem and then was asked some questions for him/her to explain.

The Talk-Aloud Test used in this study comprised of three questions with varying levels of difficulty (easy, average, and difficulty), based on number problems. This test aimed to gather an in-depth assessment of students' level of numerical fluency and problem solving ability. Five randomly selected members of each group were the subjects of the said test.

Table 7 shows the subjects' scores per problem number, its description, and mean in the Talk-Aloud Test.

With the experimental group having a mean score of 4.03 out of the highest possible mean of 5, could be transmuted into a mean percentage of 80.6%. Hence, the result falls into *approaching proficiency* level. This indicated a fair level of numerical fluency and problem solving ability in solving the assessment defined by the rubrics. However, the control group ha s a mean score of 3.70 which could be transfigured into a mean percentage of 74%. This result was classified into *beginning* level in the levels of proficiency of the K to 12 curriculum. This re sult for the control group showed a low rating level in the numerical fluency and problem solving ability of the respondents defined by the rubric.

Table 7

Summary of Group Scores of the 10 Subjects in the Talk-Aloud Test

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	Student Number	Problem Number 1		2		3		Mean	Verbal Description
Control	S – 5	4.50	A	4.25	P	3.50	B	4.08	Approaching Proficiency
	S – 7	3.75	D	4.00	AP	4.00	AP	3.92	Developing
	S – 15	4.50	A	3.50	B	3.25	B	3.75	Developing
	S – 11	3.25	B	4.25	P	4.00	AP	3.83	Developing
	S – 26	3.00	B	3.25	B	2.50	B	2.92	Beginning
	Average Rating	3.80	D	3.85	D	3.45	B	3.70	Beginning
Experimental	S –16	3.75	D	4.50	A	4.25	P	4.17	Approaching Proficiency
	S – 19	3.50	B	4.00	AP	3.75	D	3.75	Developing
	S – 8	3.50	B	4.50	A	4.75	A	4.25	Proficient
	S – 7	4.25	P	4.25	P	4.50	A	4.33	Proficient
	S – 27	3.75	D	4.00	AP	3.25	B	3.67	Beginning
	Average Rating	3.75	D	4.25	AP	4.10	P	4.03	Approaching Proficiency

Here is the summarized result of the respondents’ answers in each problem.

Problem Number 1.

“When 6 times a number is increased by 4, the result is 40. Find the number.”

A comprehensive analysis of the scripts of the students' responses showed that all student-respondents were able to represent variables as their missing term but not all student-respondents were able to construct a mathematical sentence and solve for the correct final answer or explain thoroughly the reason they arrived at such answer. Among the student-respondents, three subjects (S-5, S-15, S-7) from the control group and experimental group, respectively, responded comprehensively and three subjects (S-7, S-16, S-27) had solved the equation fairly but failed to elaborate their solutions. Also, one student-respondent from the control group (S-26) failed to solve the problem after he had presented the missing variable.

Problem Number 2

“The sum of two consecutive numbers is 23. Find the numbers.”

The result of the analysis of the transcripts of interviews and written responses to Problem 2 of the respondents showed that the subje cts in the control group possess a *developing* level while subjects in the experimental group were noted as *approaching proficiency* level in their mathematical communication and problem solving ability. All the subjects in the experimental group were able to narrate the process of solving the problem and the application of substitution method in their checking. However, two su bjects in the control group failed to communicate answers to questions accurately and clearly. For this reason, they are categorized as *beginners* for this item.

Problem Number 3

“The ratio of two numbers is 1 is to 5. Their sum is 18, what are the numbers?”

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A number problem which involves the concept of ratio is presented in problem number 3. It was rated by the validators as difficult compared to the first two problems considering that the respondents are grade 7 students only. It requires an understanding of the concept of ratio in order to arrive at the anticipated answer.

The subjects' average ratings of 4.10 (*Proficient*) and 3.45 (*Beginning*) were noted for the experimental and control groups, respectively. This indicated that for this item, subjects in the experimental group have shown a fair mathematical communication and problem solving ability while the subjects in the control group demonstrated little knowledge and insufficient skill in solving the said problem.

To support the results of the given numerical fluency and problem solving ability test and Talk-Aloud Test, a short conversation between the researcher and observer were presented. The STAR observations showed an exemplary outcome on subjects' outputs specifically results in the experimental group. The STAR observation also revealed that the strategies and methods on the said research were effective and suitable for the subjects' needs and capacity. Consequently gives validity to the examinations. Comments and suggestions of the mathematics coordinator and other invited math teacher were taken into consideration. Below was a script by the researcher and the observer;

Observer: "Ma'am good morning! Let us talk about your discussion earlier?"

Researcher: "Don't mind if we do, and thank you for your time."

Observer: I have noticed the attendance was complete and the review activity was effective and appealing to the students, did the students had the same groupings with your previous activities?

Researcher: Yes Ma'am, though they have been grouped the same as before, the grouping was made based on each student's academic achievement in Mathematics.

Observer: Good! I commend you for the proper use of manipulatives (integer sticks) and ICT presentation for the lesson. The students enjoyed the class and the approach was engaging to the students. Was the concept taught before the lesson started? Or did the students already know the topic or lesson at hand?

Researcher: No, it was the first time the students had encountered the topic and the students were engaged to discover the topic for themselves, though it was hard to expect the results from the topic and if they will enjoy the topic itself.

Observer: The discussion was interesting and students learned and enjoyed at the same time. They could solve the problem especially number problems as though it was automatic to them. Their understanding of the problem and numerical fluency was outstanding. It was a good class discussion and congratulations Ma'am!

To further understand the impact of numerical fluency to the problem solving ability of students, and evaluate traditional method and instructional strategy with numerical fluency activities, below is another recorded post-conference of the observer and researcher from the control group.

Observer: Good Morning Ma'am! Let's begin the post-conference?

Researcher: Good Morning Ma'am, let's start.

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Observer: Students were well-motivated for the lesson and the sequence of events were systematic. Classroom management is well-observed. Do the students have prior knowledge on the topics discussed?

Researcher: Regarding problem solving, yes, because the problems given were quite the same problem solving question given to them when they were in their lower grades. But in terms of the steps, I think it is new to them so I discussed the topics as simple and progressive as possible.

Observer: The seat work and recitation were given properly and orderly. The evaluation is aligned with the objectives which were great. But how about the students who got lower scores than the rest?

Researcher: Students who got scores lower than the expected score shall choose a peer to help him cope up with the topics or concepts that he thinks is difficult to under stand.

Observer: Though the lesson is teacher-centered you had managed to facilitate the learning quite well. Also, the students manage to learn the basic skill they need to solve the problem. I also praise your diligence in the subject matter even though you used minimal materials in class, for that thank you for the class discussion and congratulations.

In conclusion, both the control and experimental groups met the expected outputs but the experimental group had yielded a more promising result. Data garnered by the experimental group were clustered while the score of the control group was diverse. This showed the effectiveness of the use of innovative materials like numerical fluency activities in teaching students and preparing them for topics particularly in problem solving .

Supports for this outcome were Louange and Bana's (2005) findings that there is a strong relationship among number sense and problem solving proficiency of students. The evidence points towards a relationship in which problem solving performance depends upon students' numerical fluency. Students learn best when they are actively engaged in their own learning. They need the opportunity to construct their own thoughts and build ways that will benefit and improve their cognition. The research has shown that improved numerical fluency results to an enhanced problem solving ability.

Conclusion

In light of statistical analysis and findings of the study, the following conclusions were drawn;

1. There are no significant differences between the pre-test mean results of both groups before exposure to instructional strategy with numerical fluency activities and traditional method of teaching number problems since the numerical fluency and problem solving ability of the students were of the same level before the experiment.

2. There are significant differences between the performance of the students before and after exposure to instructional strategy with numerical fluency activities and traditional method of teaching number problems. This implies that both strategies can increase students' mathematical performance on number problems. Hence instructional strategy with numerical fluency activities had yielded a more promising result than the traditional method.

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3. There are significant differences between the gained scores of those exposed to instructional strategy with numerical fluency activities and traditional method of teaching number problems. This indicates that innovative teaching strategies were effective in improving students' mathematics performance.

4. It is justifiable that improving students' numerical fluency is effective in enhancing their problem solving ability since there was a significant gain in the problem solving ability of students exposed to instructional strategy with numerical fluency activities after the implementation of the treatment.

Recommendations

In light of the findings and conclusions derived from the study and personal observation of the researcher, the following recommendations are offered for consideration:

1. The results of the study may serve as an input for the enhancement of the program in Mathematics curriculum.

2. Instructors may come up with a teaching module incorporating the instructional strategy with numerical fluency activities.

3. School administrators are encouraged to design training courses or series of workshop about numerical fluency activities and require teachers to integrate the strategy in their teaching methodology.

4. An in-depth study that investigates instructional strategy with numerical fluency activities on students' problem solving ability should be continually conducted. Moreover, future researchers are encouraged to use other numerical fluency activities that may further develop students' numerical fluency and problem solving ability and replication of the study in a longer period of time to validate the results of the study.

5. Mathematics teachers must devise teaching resources that will promote students' knowledge, skills, and competencies in terms of their numerical fluency and problem solving ability. Teachers of Mathematics must establish a critical thinking rich classroom which problem solving is centered. They are encouraged to make their students involved in Mathematics by giving them opportunities to solve Mathematics in a more profound sense. K to 12 Mathematics teachers are stirred to include it in delivering their lessons.

6. Concerned stakeholders in Mathematics education may provide training and seminars for teachers in which numerical fluency and problem solving instruction are facilitated.

7. The continuous search for instructional strategies that could lift not only levels of students' numerical fluency and problem solving ability, but also the K to 12 education curriculum program in general, must be persistent.

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