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ENHANCING THE BASIC NUMERACY SKILLS OF GRADE 6 LEARNERS USING POLYGON NUMBER PUZZLES

RODOLFO M. MONTAÑO, JR

Program : Master of Arts in Education
Major in School Administration

Institution : Institute of Graduate and Professional Studies
Lyceum-Northwestern University
Dagupan City

ABSTRACT

This study focused on enhancing the basic numeracy skills of Grade 6 learners using polygon number puzzles in Binmaley II District, Schools Division Office I Pangasinan during the School year 2023-2024. The pretest-posttest design was used in this study. The researcher prepared and administered a teacher-made numeracy test to determine the performance level of the learners in the basic operations of whole numbers, decimals, and fractions before exposing them to the material. The same test has been administered to determine their performance level after their exposure to the material. The researcher then analyzed the significant difference between the performance levels of the learners before and after their exposure to the polygon number puzzles using the paired sample t-test. The computed t-value showed a significant difference in the numeracy levels of the respondents before and after their exposure to the polygon number puzzles. Thus, the material was effective in enhancing the numeracy skills of the learners. Based on the results, the researcher highly recommend that the teachers use the Polygon Number Puzzles to their learners with low numeracy level. Eventually, it will help them do higher competencies.

Keywords: polygon number puzzles, enhancing, basic numeracy skills

INTRODUCTION

Numeracy is a proficiency which involves the ability to use a range of mathematical skills and processes confidently to solve problems in everyday life. It goes beyond mere knowledge of number facts and processes and the ability to perform arithmetic operations.

Numeracy has become an integral part of everyone's life. Whether in purchasing a particular product, in receiving change, or in daily traveling activities - the time and distance in making to their destination, math is being used. In keeping the things working and functioning smoothly, mathematical processes is the hard work behind the scenes.

As cited in the article of Fatima (2012), "The Role of Mathematics in the Development of Society", as enumerated herein: First, Mathematics for Scientific and Technical Community: Although all careers require a foundation of mathematical knowledge, some are mathematics intensive. More students must pursue an educational path that will prepare them for lifelong work as mathematicians, statisticians, engineers, and scientists. In this fast-changing world, those who understand and do mathematics will have significantly enhanced opportunities and options for shaping their futures. Mathematical competence opens doors to productive futures. A lack of mathematical competence keeps those doors closed.

Second, Mathematics for Life: Knowing mathematics can be personally satisfying and empowering. The underpinnings of everyday life are increasingly mathematical and technological. For instance, making purchasing decisions, choosing insurance or health plans, and voting knowledgeably all call for quantitative sophistication.

Third, Mathematics as a part of Cultural Heritage: Mathematics is one of the greatest cultural and intellectual achievements of human-kind, and citizens should develop an appreciation and understanding of that achievement, including its aesthetic and even recreational aspects. Mathematics for the Workplace: Just as the level of mathematics needed for intelligent citizenship has increased dramatically, so too has the level of mathematical thinking and problem solving needed in the workplace, in professional areas ranging from health care to graphic design.

Fourth, Mathematics for the Workplace: Just as the level of mathematics needed for intelligent citizenship has increased dramatically, so too has the level of mathematical thinking and problem solving needed in the workplace, in professional areas ranging from health care to graphic design.

Lastly, the Role of Mathematics in Social Development: Man is a social animal and human life depends upon the cooperation of each other. Group work helps social skills. The ability to work together on tasks with others can build various social skills. In order to live a social life, mathematical knowledge is needed, because of the give and take process, business and industry depends upon the knowledge of mathematics. The change in the social structure with regards to the modern facilities like mode of transport, means of communication and progress in the field of science and technology is due to mathematics only. In this way mathematics has played an important role in not only understanding the progress of society but also to develop the society.

In society, numeracy is as equally important as literacy. Literacy and numeracy help people gain the fundamental skills necessary to achieve success in life (https://www.kangan.edu.au). The person's ability to use numbers and basic mathematics in work or personal life has great significance. According to R. Fatima (2012), the level of mathematical thinking and problem solving needed in the workplace, in professional areas ranging from health care to graphic design has dramatically increased. The underpinnings of everyday life are increasingly mathematical and technological. Therefore, knowing mathematics can be empowering and satisfying.

Basic numeracy skills consist of comprehending fundamental arithmetics like addition, subtraction, multiplication, and division. Thus, lack of numeracy skills could have a very detrimental and counterproductive effect to every learner. Higher fields of Mathematics such as Algebra, Geometry and Statistics cannot be understood without a prior understanding of number and consistent reference to numbers, calculations and the number system.

As learners progress, they learn to see numerical expressions as relational rather than computational, e.g. a computation such as $2 + 8 = 10$, and that this is the basis for deriving other facts, e.g. $8 + 2 = 10$, $8 = 10 – 2$, and so on. This lays the foundations for using algebraic symbolization successfully. Making connections between arithmetic and algebra helps to develop tools and skills for abstract reasoning from an early age. Thus, to avoid and overcome such deficiency, the students should learn and should have a firm foundation in the fundamental operations. A strong foundation in Mathematics will give the learner the ability to explain how he or she arrives at a solution to a complex problem or to describe the ideas behind a procedure or formula (https://www.thelearninglab.com.sg>blog).

Additionally, when the Organization for Economic Cooperation and Development (OECD) tested half-a-million 15-year-old students around the world in a test known as PISA in 2012, US teens came in 27th place in math, below their counterparts in Estonia, Latvia, Vietnam, and Spain. (https://qz.com/638845/americans-are-spectacularly-bad-at-answering-even-the-most-basic-math-questions/)

Adults need higher levels of mathematics skills to function as workers, parents, and community members. Surveys of the U.S. adult population underscore the need for stronger skills: 55 percent of adults in the U.S. are at a Basic or Below Basic level (NCES, 2006) in their quantitative literacy skills.

Meanwhile, the proportion of Australian 15-year-olds who are reaching international baseline levels in maths, reading and science has fallen significantly over a decade. Only 79 percent of year 10 students reached the international baseline level for maths in 2015, compared with 87 percent of students in 2006, according to a report released by the Australian Research Alliance for Children and Youth (ARACY) in 2018.

In the Philippines, the previous NAT and TIMMS results revealed disappointing performances of the Filipino learners. In the Third International Mathematics and Science Survey (TIMSS) in 2003, the Grade IV Filipino school children scored only 332 and ranked only 23rd among the countries that participated in that event. The average international score was 489. Similarly, second year high school students obtained an average score of 466. The 2008 test results showed the same dismal picture of our students' performance in advanced mathematics where they obtained an average score of 355 compared to the international average score of 500. (Source: TIMSS 2003 and 2008).

Based on the National Achievement Test conducted last 2015, the students' performance was alarmingly unsatisfactory. The Mean Percentage Score in Mathematics is 26.76 compared to the overall Mean Percentage Score of Schools Division Office I Pangasinan, which is 36.27 and ranked 141 among 179 schools in this division. In addition, the result of the National Achievement Test conducted last 2017 is another indicator of students' poor performance in Mathematics. The school registered an average Mean Percentage Score of 29.87. This means, the students did not meet the standard of 75% level of competency as prescribed by the Department of Education.

These are wake-up call for all teachers being in the front line of the Educational System to put up more labor of sweats in achieving the utmost goal. It has been found out that one of the reasons in such poor performance is the students' difficulty in performing the four fundamental operations which degrades their interests in learning Mathematics. These basic operations in Mathematics have significant role on the holistic development of every learner. Each student must have firm numeracy skills in order to understand higher fields in Mathematics.

The Mathematics Department of the Department of Education has been conducting different programs to elevate the mathematical skills and address the needs of the learners. One of the new programs being conducted is the Project All Numerates which aims to make every Filipino a numerate. DepEd Region III, with the joint efforts of different primary and secondary schools are implementing zero non-numerates in their respective schools by using different strategic intervention materials assuring that there will be zero non-numerates before the end of the school year.

The elementary schools in Binmaley II had been conducting school-based numeracy program for-almost four years already. It has become one of the school's interventions to increase the students' numeracy skills and interest in Mathematics.The mathematics teachers observed and found out that some learners do not cope with their math lessons due to difficulty in the four fundamental operations of numbers.Thus, this program provides an avenue for those students to improve.Furthermore, it gives the opportunity to develop critical and creative thinking among the students, which ultimately is the goal of Mathematics Education.

However, the instructional/intervention materials being used are very traditional. Students do not find it interesting, challenging and motivating. Thus, there is a need to elevate, upgrade, and innovate to increase the learners' interest. On this premise, the researcher saw the immediate need for developing the material "Polygon Number Puzzles" that basically focuses on the four fundamental operations of whole numbers, decimals, and fractions. The innovation on the utilization of polygon number puzzles will be one of the best tools in preventing non-numerates as well as enhancing students' basic numeracy skills. Polygon number puzzles provide the opportunities for students to develop their critical and creative thinking. This material suits the way of learning and thinking as well as the altitude of reasoning and erudition of our learners. This intervention material is carefully prepared and

designed by the researcher to ensure effective and efficient learning among different types of learners and varied situations.

Fernandez (2013) conducted a study on the performance level of Grade VI pupils in Mathematics in Lingayen I District. The study revealed that pupil-respondents are mostly eleven (11) years old whose academic rating in Mathematics in the First Quarter Examination ranged from 80-84 and with parents having monthly income of P10, 000 below. In terms of mathematics performance, 28.34% of the respondents obtained a score ranging from 16-20 categorized as 'low performance'. Only 0.53% was revealed to have a 'very high performance' with a score ranging from 46-50 while 11 or 5.88% were under 'very low performance'. The three least learned skills of the pupils based from the first quarter examination were: solving 2- to 3- step word problems involving decimals including money, dividing mixed decimals by mixed decimals and dividing mixed decimals by whole numbers.

The study of Fernandez (2013) is closely related with the present study for both are using on the performance of the students in mathematics and both dealt with the intervention material in mathematics instruction. However, the former study developed an intervention material based from the three least learned skills of pupils in the first quarter examination of Lingayen I District while the present study dealt with the performance level of the Grade 7 students in the four fundamental operations of numbers and the effectiveness of the developed intervention material in enhancing their basic numeracy skills.

The study of De Veas (2012) " A Mathematics Enrichment Program for Bacnotan National High School, revealed that in terms of academic profile, the final grade of the respondents were described as very good and their mean was good; involvement in Math-related activities was slightly involved (2.09), study habits rated as sometimes/moderately favorable (3.01), parents learning support was much supportive (3.50), most of them had visual learning style and math anxiety level was fairly anxious (3.03); in terms of non-academic, more of the respondents were females, most of them were middle born (40.36%), most of the parent were high school graduates (46%) and were within the P10,000-below monthly family gross income bracket (63.27%).

The former study and the present one are similar in the sense that both studied the performance of the students in mathematics. However, De Veas' study dealt with the determinants in the performance of the students of Bacnotan National High School and constructed a mathematics program while the present one will be dealing with the effectiveness of an intervention material in the performance of the Grade 7 students ofLasip National High School.

Meanwhile, a study conducted by Manuel (2015) entitled "The Proposed Puzzle Game Approach in Teaching Mathematics to Grade V Learners" determined the academic performance of the Grade V pupils in Mathematics based from the administration of Fraction Knowledge Test, and identified the effectiveness of the puzzle game approach through comparing the results of the pretests and posttests. The analysis of the results of the pretest on Fraction Knowledge Test depicted a low academic performance of the pupils in mathematics. There were score improvements from the Fraction Knowledge pretests to post-tests indicating that there was a significant effect of the puzzle game approach in improving their performance in math.

The former study is closely related to the present study. Both studies compare the pre-test-post-test results to determine the effectiveness of the material. However, the former study included the validation and acceptability of the proposed material, while the present study will only focus on testing the effectiveness of the material in enhancing the basic numeracy skills of the Grade 7 students. The material used – Polygon Number Puzzles – has already been approved by the SDO1 officials prior to the conduct of the study.

Statement of the Problem

This study sought to enhance the basic numeracy skills of Grade 6 learners using polygon number puzzles in Binmaley II District, Schools Division Office I Pangasinan during the School year 2023-2024.

Specifically, the study sought to answer the following problems:

1. What is the performance level of the Grade 6 learners in the teacher-made numeracy test before their exposure to polygon number puzzles?
2. What is the performance level of the Grade 6 learners after their exposure to polygon number puzzles?
3. Is there a significant difference in the performance levels of the respondents before and after their exposure to the polygon number puzzles?
4. Based on the findings, what intervention program can be proposed to enhance the basic numeracy skills of Grade 6 learners?

METHODOLOGY

Research Design

The design adopted by this study is pretest-posttest design. The pretest-posttest design determines the effect of a treatment or intervention on a given sample (Allen, 2017). This design is appropriate for this study since it endeavored to determine the significant difference in the performance levels of the students before and after their exposure to the intervention material which is the polygon number puzzles.

Sources of Data

This study was conducted in public elementary schools of Binmaley II District, Schools Division Office I Pangasinan during the School Year 2023-2024.

Instrumentation and Data Collection

The researcher administered a pre-test to all Grade 6 learners before exposure to the polygon number puzzles. The pre-test, which focuses on the fundamental operations of whole numbers, decimals, and fractions, including problem solving, was prepared by the researcher, validated by experts chosen on the basis of their qualification as teachers of Mathematics. A post-test parallel to the pre-test was administered after their exposure to the material. The data collected were tabulated, analyzed and interpreted.

Tools for Data Analysis

In order to provide accurate interpretations of the data collected from the respondents, the researcher used the following statistical tools for the computations:

To answer sub-problem 1 on the performance level of the respondents in the pretest, the A**rithmetic Mean** and **Mean Percentage Score** were used and described by the following formulas.

Formula: $\bar{x} = \frac{\sum X}{N}$

Where: $\bar{x}$ = the arithmetic mean

$\sum X$ = the summation of the scores of the group

N = the number of students involved

Formula: $\text{MPS} = \frac{\text{mean}}{\text{total numer of items}} \times 100\%$

To answer sub-problem 2 on the performance level of the respondents in the post-test, the researcher also used the

A**rithmetic Mean** and **Mean Percentage Score**.

To answer sub-problem 3, the **t-test** was used. It is described by the following formula.

Formula:

$$t = \frac{(\sum D)/N}{\sqrt{\frac{\sum D^2 - \left(\frac{(\sum D)^2}{N}\right)}{(N-1)(N)}}}$$

Where: **ΣD**= Sum of the differences

ΣD^2= Sum of the squared differences

$(\Sigma D)^2$ = Sum of the differences, squared.

RESULTS AND DISCUSSION

1. Performance Level of the Grade 6 Learners in the Teacher-Made Numeracy Test Before Exposure to Polygon Number Puzzles

The performance level of the grade 6 learners in the teacher-made numeracy test is represented in terms of their mean score per section and average mean in the grade level which is displayed in Table 1.

Table 1
Mean and Mean Percentage Score of the Grade 6 Learners per Section in the Teacher-Made Numeracy Test Before Exposure to Polygon Number Puzzles

Grade 6 Section	Mean	MPS
1	20.26	40.52
2	20.29	40.58
3	19.47	39.94
4	20.39	40.78
5	19.96	39.92
6	19.59	39.18
Overall Mean	**19.99**	**39.98**

It can be gleaned on table 1 that the Grade 6 learners from section 1 registered an average score of 20.26 or 40.52%, while section 2 got 20.29 or 40.58%; section 3 had an average score of 19.47 or 39.94%; section 4 registered 19.96 or 39.92%; section 5 had a mean score of 19.89 or 39.78%; and section 6 got a mean score of 19.59 or 39.18%.
In the table, the mean scores from the different sections are noticeably close, whereas there are only about 2 to 3 learners per section got a score of above 50%. The closeness of the mean score per section may be due to the sectioning process done where the learners are fairly distributed among the 6 sections (heterogeneous).
Table 2 further shows that the grade 6 learners achieved an overall mean of 19.99 or 39.98% in the teacher-made numeracy test, which is below the standard competency level of 75%. This implies that these students still lack mastery of the basic numeracy skills needed for them to advance on higher mathematical concepts. They have found difficulty in doing the basic operations, specifically in fractions and decimals. This has been observed by the teachers in their classes not only in the lower grades. Many students really struggle in performing operations most especially with fractions.

2. Performance Level of the Grade 6 Learners in the Teacher-Made Numeracy Test After Exposure to Polygon Number Puzzles

Table 2
Mean and Mean Percentage Score of the Grade 6 Learners per Section in the Teacher-Made Numeracy Test After Exposure to Polygon Number Puzzles

Grade 7 Section	Mean	MPS
1	32.74	65.48
2	31.82	63.64
3	30.00	60.00
4	30.65	61.30
5	31.35	62.70
6	31.59	63.18
Overall Mean	**31.36**	**62.72**

It can be seen on Table 2 that after exposure to the polygon number puzzles, the learners from section 1 achieved a mean score of 32.74 or 65.48%; those from section 2 got an average of 31.82 or 63.64%; learners from section 3 had a mean score of 30.00 or 60%; section 4 registered 30.65 or 61.30%; section 5 achieved 31.35 or 62.70%; and those from section 6 got an average score of 31.59 or 63.18%.

Table 2 depicts that the grade 6 learners achieved an overall mean of 31.36 or 62.72% after they were exposed to the materials, polygon number puzzles. When compared to the scores in the pretest, there is a remarkable increase in their scores per section and as a whole. In section 1, the mean score increased by 12.48; 11.53 in section 2; 10.53 in section 3; 10.26 in section 4; 11.39 in section 5; 12 in section 6; and there was an overall increase of 11.37.This implies that learners displayed an improvement in their performance. Generally, however, they still did not meet the required mastery level of 75%. Only 8 learners from section 1, 7 from section 2, 4 from section 3, 4 from section 4, 6 from section 5, and 4 from section 6 reached the mastery level. Achieving the required mastery level means they can independently perform the basic operations in whole numbers, fractions, and decimals.

3. Significant Difference in the Performance Levels of the Respondents Before and After Their Exposure to the Polygon Number Puzzles

Table 4
Significant Difference in the Performance Levels of the Respondents in the Pre-test and Post-test

Pre-test	Posttest	Mean Difference	Computed t-value	Critical t-value
19.99	31.36	11.37	60.41	1.96
Significant (2-tailed), $\alpha = 0.05$			0.000	

Based on table 3, grade 6 learners' performance level in the post-test is notably higher than that in the pre-test. They marked average scores of 19.99 and 31.36 in the pre-test and post-test, respectively with a mean difference of 11.37. This means their basic numeracy skills have been improved. Although most of them still did not meet

the mastery level, the important thing is, there is still a good improvement in their performance and this is a good start. Just a little more practice and patience

As also shown on the table, the computed t-value of 60.41 is remarkably greater than the critical value of 1.96. This means there is a significant difference in the numeracy levels of the respondents before and after the exposure to polygon number puzzles.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

This study focused on assessing the effectiveness of the intervention material polygon number puzzles in strengthening the basic numeracy skills of the grade 6 learners in public elementary schools of Binmaley II District. The researcher prepared and administered a teacher-made numeracy test to determine the performance level of the learners in the basic operations of whole numbers, decimals, and fractions before exposing them to the material. The same test has been used and administered to determine their performance level after their exposure to the material. The researcher then analyzed the significant difference between the performance levels of the students before and after their exposure to the polygon number puzzles.

Conclusions

Based from the results of the study the following conclusions are drawn:

1. Majority of the grade 6 learners from each section poorly performed in the pre-test but improved and performed better in the post-test after having been exposed to the Polygon Number Puzzles. The intervention material contributed positively in enhancing the basic numeracy skills of the students.
2. There is a significant difference in the performance levels of the grade 7 learners before and after their exposure to the Polygon Number Puzzles.
3. The Polygon Number Puzzles is effective both in enhancing the basic numeracy skills of the grade 6 learners and in boosting their interest towards math.
4. Generally, improvement in the basic numeracy skills could lead to improvement in the performance of these learners in Mathematics.

Recommendations

In light of the conclusions drawn, the following recommendations are offered:

1. Before teaching or developing a higher competency/skill in a learner, the teacher should see to it that they have strong, solid foundation in the basic competencies/skills. In Mathematics, it will be a struggle for the learners to learn, and for the teachers to teach higher concepts if the learners do not have strong numeracy skills, specifically in the four fundamental operations.
2. There is a need to enhance the basic numeracy skills of our students to boost their interest and confidence in learning mathematics. More importantly, proper attitude and values towards the subject should be developed among these learners.
3. An intervention should be developed/created in the light of addressing the needs of the learners
4. The researcher highly recommends the use of the intervention material, Polygon Number Puzzles, to the teachers for their students with low numeracy level as it was found to be effective in enhancing the basic numeracy skills of the grade 7 students.
5. The researcher also recommends the reproduction and utilization of the Polygon Number Puzzles by the other schools and even in the elementary level.
6. Mathematics teachers should conduct similar researches in other grade levels.

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