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INVESTIGATING THE EFFECT OF UTILIZING THE TRADING BOARD IN TEACHING NUMERACY SKILLS AMONG JUNIOR HIGH SCHOOL STUDENTS

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ABSTRACT

The study was designed to investigate the efficacy of utilizing the trading board to the numeracy skills among junior high school students in Oras National Agro-Industrial School. It also aimed to compare and determine if there is significant difference between the pre-test and posttest numeracy mean scores and numeracy proficiency levels of the students. The subjects of the study were 22 identified non-numerate students in Oras National Agro-Industrial School. The 22 identified non-numerate students were taught the concepts of the four basic operations in mathematics with the use of the trading board over a period of three weeks. Quasi-experimental research design was utilized in this study. The instrument used for data collection was adopted from the Department of Education (DepEd) numeracy test in key stage 3 (grade 7 to 10). Students' achievements on the pretest and posttest were analyzed using percentages, mean, standard deviation and the dependent t-test. The findings of the study were that, those who were taught through extensive use of trading board performed significantly better. Thus, the use of the trading board proved very effective and promising approach to teaching and learning the concepts of the four basic operations in mathematics, and that the board also improved students' thinking process as they solved problems of the four fundamental operations in mathematics. On the basis of these findings, it is recommended that trading board should be used as a tool to introducing non-numerate students to the concepts of the four basic operations in mathematics.

Keywords: Effectiveness, Trading Board, Experimental, Manipulative.

I. INTRODUCTION

Mathematics has a vital part in the lives of students according to the George W. Bush Institute. It offers students job choices across many content areas of sciences, technologies, engineering and mathematics. It helps to promote critical thinking and address student difficulties. This makes them successful in the future in various ways (Layug et al, 2021).

However, despite different advantages of learning Mathematics, many, if not all, students find it extremely difficult to learn mathematics. This was supported by Garoof and Karukkan (2015), in their paper, Why High School Students Feel Mathematics Difficult? An Exploration of Affective Beliefs, which states that 88 percent of students in a 51-person random sample dislike mathematics due to difficulty in understanding the subject matter, and teacher or instructional related factors. This, on the other hand, contributes to poor level of mathematics literacy among students across the country.

Students from the Philippines are not exempted from this poor level of numerical competence. The dismal performance of the Philippines in the 2022 Program for International Student Assessment (PISA) indicates that students in the country are five to six years behind in learning competencies (Department of Education, 2023). Based on the 2022 PISA, for the second time, the Philippines landed in the bottom 10 out of 81 countries in reading comprehension, mathematics, and science (Servallos, 2023).

According to the Principles and Standards for School Mathematics, "the foundation for children's mathematical development is established in the early years" (Seefeldt & Wasik, 2006, p. 249). It is important for children to have a variety of materials to manipulate and the opportunity to sort, classify, weigh, stack and explore if they are to construct mathematical knowledge. "In order to have opportunities to learn math, children need firsthand experiences related to math, interaction with other children and adults concerning these experiences and time to reflect on the experiences" (Seefeldt & Wasik, 2006, p. 250). Educational research indicated that the most valuable learning occurs when students actively construct their own mathematical understanding, which is often accomplished through the use of manipulatives (Boggan, M. et al, n.d).

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In mathematics classroom today, it is very hard to see teachers using manipulatives when teaching, what they mostly use are board, chalk or marker and textbooks, this is not too good for mathematics teaching. Some educators believe that students learn concepts and solve problem better when using hands-on, concrete models when learning (Adesokan, R.T., 2023). Manipulatives are important to use in the classroom to help students learn and explore using a variety of hands-on learning methods (Lange, J., 2021). Math manipulatives are fun! Children who are known to be fun-loving individuals enjoy using these concrete tools to make sense of the problems they are given. These materials help our younger learners to learn new math concepts more easily. Through the use of math manipulatives, it enables to build a relationship when shown visually how to solve problems and given opportunities to explore some things (Guanzon-Pisaras, G. F., 2020).

Additional studies have shown that students who use "manipulatives in specific mathematical subjects are more likely to achieve success than students who don't have the opportunity to work with manipulatives" ("Research on the," n.d.). Some children need to use manipulatives to learn to count, while other students' understanding of place value increases with the use of manipulatives. Research also indicates that using manipulatives is especially useful for teaching low-achievers, and students with learning disabilities.

Thus, this study aimed at investigating the effect of utilizing the trading board as manipulative in teaching the numeracy skills among junior high school students in Oras National Agro-Industrial School. Specifically, it seeks to answer the following research questions:(1) How comparative are the students' numeracy scores in the pre-test and posttest? (2) How comparative are the numeracy proficiency levels of the students in the pre-test and posttest? (3) Is there a significant difference between the students' numeracy mean scores in the pre-test and posttest? (4) Is there a significant difference between the students' numeracy proficiency levels in the pre-test and posttest.

II. METHODS

Research Design

This study is quasi-experimental, employing one-group pretest and posttest. It is a design in which the outcome of interest is measured 2 times: once before and once after exposing a non-random group of participants to a certain intervention or treatment (Choueiry, G., 2024). This has been used to enable the effect of the instructional material (trading board) in the teaching and learning of the four basic operations in mathematics to be examined in natural settings.

Locale of the Study

This study was conducted at Oras National Agro-Industrial School, Oras, Eastern Samar. The school offers junior high school, and senior high school programs. The school comprises of 15 faculty members and 247 students for the school year 2023-2024.

Participants of the Study

As cited from the Practical Research 2, quarter 2 module, page 8, one of the approaches in identifying the sample size is heuristics which refers to the rule of thumb for sample size. Lunenberg and Irby (2008), as cited by Barrot (2017), suggested different sample sizes for particular quantitative research design to which experimental design has 30 or more participants. Prior to the selection of samples, the researcher conducted a pretest on all the junior high school students of Oras National Agro-Industrial School. The participants to this study were selected based on their scores gained on the pre-test. The test were 12 items composed of 4 sub-tests, three items for addition, three items for subtraction, three items for multiplication, and another three items for division. On the bases of Interpretation of the Numeracy Test Result (DepEd Region VIII-RM-s2021-280), learners who got a score of zero in any of the 4 sub-tests, were considered non-numerate. Students who were identified as non-numerate were selected as participants to this study. Out of 31 identified as non-numerate students, 22 agreed to participate in the study.

Research Instruments

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The research instrument that served as pretest and posttest in this study was adopted from the Department of Education (DepEd) Numeracy Test in Key Stage 3 (grade 7 to 10). Pretest has been administered before the conduct of the experiment. While posttest was administered after the experiment has been done. DepEd Numeracy Test in Key Stage 3 (grade 7 to 10) is a standardized test composed of questions in the four basic mathematical operations. It has three (3) items for each operation. The instrument used to measure the proficiency level of the student-participants in this study was the Interpretation of the Numeracy Test Result (DepEd Region VIII-RM-s2021-280). This instrument measured the level of numeracy skills of the students whether they are non-numerate (1), moderately numerate (2), or highly numerate (3). Trading Board utilized as a manipulative tool in teaching and learning numeracy skills during the intervention period is an innovation adopted from the DepEd to whom the researcher was one of the participants of the previously held training on the utilization of the trading board. It comes in different types. Three-column trading board is used for operations of three-digit number while two-column trading board is used for operations of two-digit number. Numerals symbolized the count or number of the chips in each column. The white chips are the count of number in the ones place value, the red chips are the count of number in the tens place value, and the blue chips are the count of number in the hundreds place value.

Data Gathering Procedure

The researcher assigned the identified non-numerate students-participants as intact class. They were taught using the trading board to enhance instruction and explanation of the concepts of the four basic mathematics operations. The intervention period ran for three weeks. On the first week, the participants were taught addition and subtraction of numbers using the trading board. While on the second week, the participants were taught multiplication of numbers using the trading board. And on the third week, the participants were taught division of numbers using the trading board. The posttest took place on the last day of the three-week intervention period. A letter of permission was sent to the school head prior to the conduct of the study. Informed consent was also sent to the parents of the participants few days before the intervention period. The numeracy test was administered as pretest and posttest. To ensure validity of the instruments, two teachers currently teaching mathematics at the JHS level were given copies of the numeracy test to assess the quality of each item in the context of clarity, ambiguity and generality. After the three-week instructional period, the participants were tested using the DepEd Numeracy Test in key stage 3 (Grades 7 – 10) to determine the effectiveness of the trading board used as instructional material in learning the concepts of the four basic operations in mathematics. After the administration of the posttest, the participants' work was checked to identify their scores. The data were stored for statistical treatment.

Data Analyses

After gathering the data, the researcher recorded the scores gathered for problems 1 to 4 and presented it in tabular form through percentages, mean, standard deviation and the dependent samples t-test. Data were treated through the use of statistical software Statistical Package for the Social Sciences in order to determine the perceived significant effect between the independent and dependent variables.

III. RESULTS AND DISCUSSIONS

Research Question 1: How comparative are the students' numeracy scores in the pre-test and posttest?

Table 1: Pre-test and posttest score distribution of the 22 student-participants.

Score	Pre-test		Posttest	
	Frequency	Percentage	Frequency	Percentage
10 - 12	0	0	4	18.2
7 - 9	0	0	11	50
4 - 6	12	54.5	4	18.2
1 - 3	10	45.5	3	13.6

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Total	**22**	**100**	**22**	**100**

Table 1 shows the distribution of credits in the pre-test and posttest. Result shows 11 (50%) of the students were able to get seven to nine score in the posttest as compared to the result in the pre-test. A critical analysis of Table 1 indicates that while most of the students in the posttest seem to obtain high scores, the performance of most of the students in the pre-test is relatively lower. The score interval from 10 to 12 registered four students in the posttest with no student in the pre-test matching up to this performance. However, low score interval from one to three has more students in the pre-test than those in the posttest. Thus, the performance of students seems to be inversely related in favor to their performance after the intervention.

Table 2: A comparison of the mean scores of students in the pretest and posttest.

	N	Mean	Std. Deviation
Pretest_Numeracy_Scores	22	3.59	1.403
Posttest_Numeracy_Scores	22	7.09	2.524
Valid N (listwise)	22		

Table 2 shows the mean scores of students in the pretest and posttest. The mean score of 7.09 of students in the posttest suggests a better performance as compared to their mean score of 3.59 in the pretest. Result shows that students performed better after the intervention period indicating that continual exposure of the students to the use of trading board in learning the four basic operations could alleviate their performance.

Research Question 2: How comparable are the numeracy proficiency levels of the students in the pre-test and posttest?

Table 3: Comparative data on students' numeracy proficiency levels in the pretest and posttest.

Proficiency Level	**Pre-test**		**Posttest**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Highly Numerate	0	0	1	4.5
Moderately Numerate	0	0	17	77.3
Non-numerate	22	100	4	18.2
Total	**22**	**100**	**22**	**100**

Table 3 shows that as many as seventeen representing 77.3% of students are considered to be moderately numerate after the intervention period compared to zero in the pretest. One student, representing 4.5% of the students in the posttest compared to zero in the pretest is considered to be highly numerate. But the four students, representing 18.2% of the students in the posttest remained non-numerate. Fond of making absences during the three-week intervention period was the reason that the researcher foresaw for the nondevelopment of these four students after the posttest has administered. Nevertheless, as the number of students kept performing better, the number of students considered to be non-numerate kept reducing. It can be inferred from this result that students in the study, who were instructed consistently using the trading board performed relatively better than before.

Research Question 3: Is there a significant difference between the students' numeracy mean scores in the pre-test and posttest?

Table 4: An extract of t-test comparison between the students' numeracy mean scores in the pretest and posttest.

	Paired Differences	t	df	Sig.

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		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				(2-tailed)
					Lower	Upper			
Pair 1	Pretest_Numeracy_Scores - Posttest_Numeracy_Scores	-3.500	1.766	.377	-4.283	-2.717	-9.295	21	.000

Table 4 shows a significant difference between the numeracy mean scores of the students (M = -3.5); t (21) = -9.295, p = 0.000. Since p < 0.05, there is no evidence to retain the null hypothesis. Hence, we reject the null hypothesis and uphold the decision that there is a significant difference between the numeracy mean scores of students in the pretest and posttest.

This result shows that the use of trading board has a statistically significant effect on students' performance in the four basic operations. Students taught using the trading board had a higher mean score (7.09), which meant a better performance than their mean score (3.59) prior to the intervention period.

Research Question 4: Is there a significant difference between the students' numeracy proficiency level in the pre-test and posttest?

Table 5: An extract of t-test comparison between the students' numeracy proficiency level in the pretest and posttest.

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pretest_Numeracy_Proficiency_Levels - Posttest_Numeracy_Proficiency_Levels	-.864	.468	.100	-1.071	-.656	-8.664	21	.000

Table 5 shows a significant difference between the numeracy proficiency levels of the students (M = -0.864); t (21) = -9.664, p = 0.000. Since p < 0.05, the decision that there is a significant difference between the numeracy proficiency levels of the students in the pretest and in the posttest with respect to the use of the manipulative "Trading Board" is upheld.

The finding of a significant difference between the pretest and posttest numeracy proficiency levels in favor of those exposed to the use of the trading board suggests that students' performance might have improved through the use of the board which might have helped them in concept formation and as a result enhanced understanding of the relevant concepts. Findings by some researchers (e.g. Fennema, as cited in Thornton, 1995) which suggest that most students gain very little regarding to understanding of mathematical concepts through the use of manipulatives are not supported by findings of this study. Findings from this study rather uphold the assertion that manipulatives offer important opportunity for students to link hands-on experience to understanding of mathematical concepts (Kurumeh, Chiawa & Ibrahim, 2010; Suydam & Higgins, 1977).

IV. CONCLUSION

The following conclusions were drawn, based on the findings of the study: (1) The 22 identified non-numerate student-participants exhibited low skills regarding the four basic operations in mathematics, however after being taught using the trading board manipulative, majority of the student-participants outperformed their

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result in the pretest; (2) The use of the trading board enabled students to demonstrate proficient skills in solving the four fundamental operations in mathematics; (3) As indicated from the numeracy mean scores between pretest and posttest, students taught with the manipulative-trading board performed significantly better than before. (4) Also, this study revealed that the student-participants' numeracy proficiency level has significant difference in favor to their numeracy proficiency level in the posttest.

V. RECOMMENDATIONS

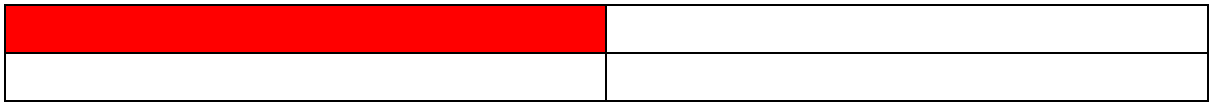
Based on the findings of this research endeavor, the researcher would like to make the following recommendations:

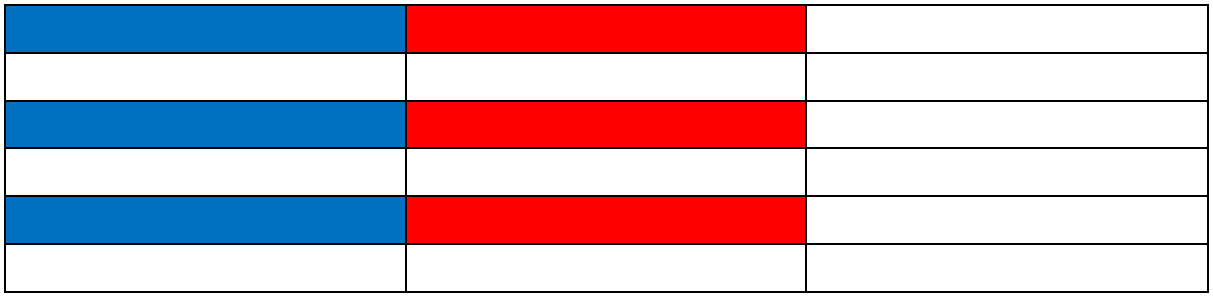
1. Mathematics curriculum for junior high school should give importance on the use of manipulatives.
2. Trading Board can be used as manipulative tool to introducing non-numerate students to the concepts of the four basic operations in mathematics.
3. Consistent exposure of the use of the trading board to the non-numerate learners during the intervention period is highly recommended.
4. Teachers should ensure that their teaching strategies will incorporate the use of manipulatives to help allow students improve their numeracy skills and have a meaningful learning in mathematics.
5. Seminars and workshops for mathematics teachers on the use and productions of manipulatives should be done regularly as needed.
6. Schools should provide funds to teachers for the productions of mathematically inclined manipulatives.

APPENDICES

Research Tools

Part I. Trading Boards ((Addition, Subtraction, Multiplication and Division)





Numerals (Cutouts)

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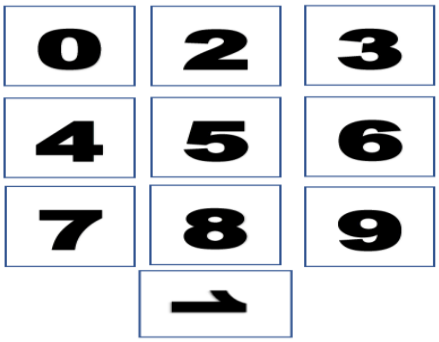
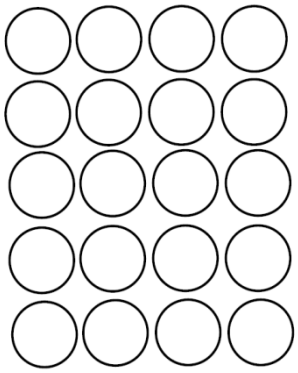
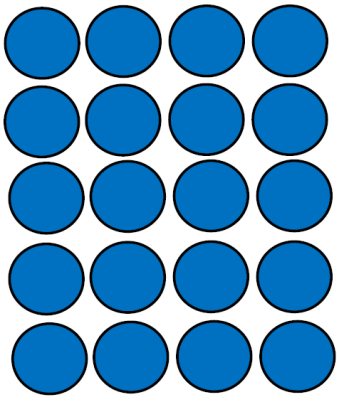


White Chips (Cutouts)



Blue Chips (Cutouts)



Red Chips (Cutouts)

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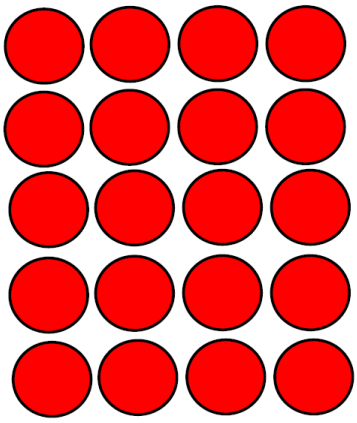

Part II. DepEd Numeracy Test in Key Stage 3 (Grade 7 to 10)

Name: _____ Grade: _____ Section: _____

Date of Administration: _____

Directions: Perform the indicated operations. You are given 12 minutes to answer all the items.

Add the following:

1. 3520 + 4372	2. 239 +123	3. 2763 3687 + 2976

Subtract the following:

4. 469 -123	5. 4000 -1832	6. 65023 - 3704

Multiply the following:

7. 76 x 18	8. 894 x 100	9. 2756 x 52

Divide the following:

10. $99 \div 11 =$

11. $4152 \div 8 =$

12. $120 \div 23 =$

Interpretation of Numeracy Test Result (DepEd Region VIII-RM-s2021-280)

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Description	Interpretation		REMARKS	Classified as
PERFECT SCORE	IF THE LEARNER GOT CORRECT ANSWERS IN THE 4 SUB-TESTS (Addition, Subtraction, Multiplication and Division)	HIGHLY NUMERATES	no need for intervention	Numerate
NOT PERFECT SCORE	IF THE LEARNER GOT ONE (1) OR MORE MISTAKES IN IN ANY OF THE 4 SUB-TESTS	MODERATELY NUMERATES	provide enrichment in area of the sub-tests which incurred mistake(s)	Numerate
ZERO SCORE	IF THE LEARNER GOT A SCORE OF ZERO IN ANY OF THE 4 SUB-TESTS	NON-NUMERATE	provide intervention	Non-Numerate

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