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Using Grid as Teaching Strategy in Teaching Mathematics

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ABSTRACT

This paper analyzes how Grid as a graphic organizer can significantly improve the numeracy level in Mathematics of the Grade 3 pupils in addition and subtraction and identify common errors and misconceptions in adding and subtracting whole numbers. To answer this question, we compared the performance of Grade 3 pupil participants. Fifty-six percent (n= 39) from Jose Rizal Memorial School and forty-four percent (n=31) from San Juan Elementary School. Out of 70 pupils, 57 or 81.43% belonged to the non-numerate level, 13 or 18.57% were classified as instructional and non-numerate. The descriptive design was utilized. The data were analyzed using mean, frequency count, percentage, and z-test in determining the effect of the grid as a graphic organizer on the numeracy level of Grade 3 Pupils. The results of the study indicate that the numeracy level of Grade 3 pupils after using grid as graphic organizer revealed that the non-numerate

pupils were lessened to 23 out of 70 or 32.86%, instructional pupils increased to 27 or 38.57% and numerates became 20 or 28.57%. The computed mean was increased to 5.87, having a scale description of the instructional level. The findings suggest that Grid as a graphic organizer helped a lot in proper alignment of numbers to avoid common errors and misconceptions and found to be an effective teaching strategy in teaching Mathematics.

Keywords — Mathematics**,** Grid as a graphic organizer, descriptive design, Philippines

INTRODUCTION

In recent history, most states across the United States adopted mathematics standards, including mathematical practices intended to lead students toward effective mathematical thinking. Moreover, in turn, mathematical practices include identifying meaning within problems so that they can be developed reasonable solutions. Evaluation of possible solutions requires deep knowledge and understanding of numbers and operations such that multiple pathways toward a solution can be generated and then judged for reasonableness (Barlow & Harmon, 2012; Flores, Kaffar, & Hinton, 2019).

In order for students to engage in these practices, instruction must emphasize conceptual understanding, perseverance in problem-solving, as well as proficiency in procedural knowledge and fluency in operations (National Mathematics Advisory Panel, 2008). It is important for students to have conceptual knowledge because poor conceptual understanding often leads to confusion or error patterns as mathematics problem solving becomes more complex (Kroesbergen, van't Noordende, & Kolkman, 2014). Therefore, the development of conceptual understanding should begin in the early grades and continue, as more complex mathematical processes are introduced (Witzel, Ferguson, & Mink, 2012). Further, mathematics interventions for students who struggle should include modeling and emphasis on conceptual understanding as fluency develops (Flores, Kaffar, & Hinton, 2019).

In Philippine schools, the Department of Education (DepEd) Order No. 55 s2016 (Department of Education, 2016) also provides that students take mandatory national tests to provide feedback on Philippine education's current state and assess the effectiveness and efficiency of the delivery of education services. The Early Language, Literacy, and Numeracy Assessment are administered to Grade 3 pupils towards the end of the year.

Likewise, schools have traditionally taught most subject areas with a pedagogy based on repetition, drill, concrete to abstract process, with more recent attention to hands-on practice and wherever possible, the use of manipulative teaching aids to enhance the concept building (Bueno, 2016). In addition, many teachers and students use graphic organizers to enhance the writing process in all subject areas, including mathematics. "Graphic organizers help students organize and then clarify their thoughts, infer solutions to problems, and communicate their thinking strategies" (Zollman, 2009). It also guides learners' thinking as they fill in and build on a visual map or diagram. They are some of the most effective visual learning strategies for pupils and applying across the curriculum to enhance learning and understanding of subject matter content. A graphic organizer is an instructive tool that a student can use to organize and structure information and concepts and promote thinking about relationships between concepts. Furthermore, a graphic organizer's spatial arrangement allows the student, and the teacher, to identify missing information or absent connections in one's strategic thinking (Ellis, 2004).

Despite these effects, mathematics teaching is a complex task. The effect on pupil learning of changing a single teaching practice may be difficult to discern because of the simultaneous effects of both the other teaching activities surrounding it and the context in which the teaching takes place. Research findings suggest that as teachers strive to improve mathematics teaching practices, certain teaching strategies and methods are worth serious (Grouws & Cebulla, 2000). Therefore, teachers need to find ways to improve teaching strategies so that the number of learners of pupils is large.

What makes a pupil numerate? Numeracy encompasses deep thinking, meaning-making, and sense building. It is more than the ability to do basic arithmetic. Pupils, when numerated, do not simply do the math; they are taught how to think through Math (Pearse & Walton, 2011). Basic numeracy skills consist of comprehending fundamental arithmetic like addition, subtraction, multiplication, and division.

In Calamba East 3 District, two elementary schools, namely, Jose Rizal Memorial School and San Juan Elementary School, were given numeracy tests on addition and subtraction of whole numbers to selected Grade 3 pupils. A teacher-made tool composed of 10-item pre-test on numeracy on simple addition and subtraction up to four digits numbers were given in July 2018. The internal consistency of the tool was determined through a split-half method was 0.844; therefore, the tool was highly valid and highly reliable. Likewise, with the scale

of 0-4 for non -numerate, 5-7 for instructional and 8-10 for numerate, the following are the significant findings. Out of 70 pupils, 57 or 81.43% belonged to non-numerate level, 13 or 18.57% were classified as instructional, and 0% were numerate. Considering the use of mother tongue in teaching Mathematics from Kindergarten to Grade 3 level, the above statistical data showed that the learning grasp of the learners on the basic math concepts most importantly in the four fundamental operations particularly simple addition and subtraction was deteriorating and quite alarming since the primary level was the foundation of higher learning.

This has inspired the researcher to identify pupils' common errors and misconceptions in column addition and subtraction. Because learning foundation is important, the researcher with the consent of the two school heads, advisers and mathematics teachers strived to improve the numeracy level of Grade 3 pupils using the grid as a graphic organizer as one of the teaching strategies to address the common errors and misconceptions in column addition and subtraction of numbers.

FRAMEWORK

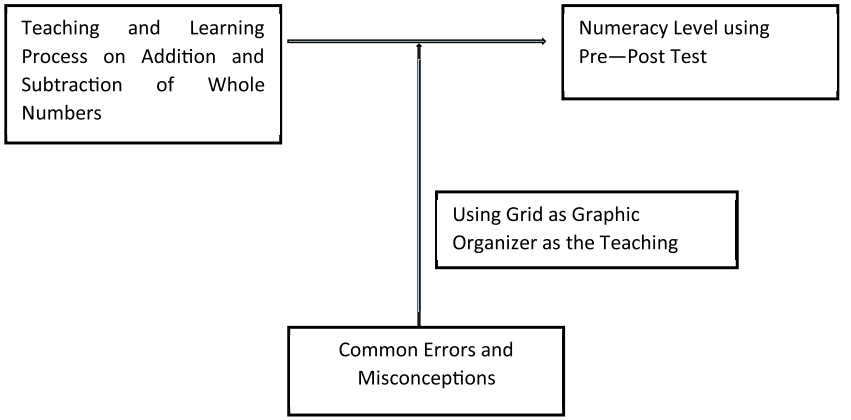

Figure 1. Conceptual Framework

The top left rectangle shows the teaching-learning process on the addition and subtraction of whole numbers using column form. Before and after teaching the concept, the numeracy level of the pupils will be determined using the pre-

post-test given. Using Grid as Graphic Organizer served as the teaching strategy to help pupils reduce errors and correct the misconceptions on adding and subtracting numbers.

OBJECTIVES OF THE STUDY

This study aimed to determine the effect of the grid as a graphic organizer in teaching Mathematics. Specifically, it sought to answer the numeracy level of the Grade 3 pupils in addition and subtraction before and after using grid as a graphic organizer and identifying common errors and misconceptions in adding and subtracting whole numbers. Lastly, the existence of a significant difference in the numeracy level from the pre-test and post-test of the pupils from non-numerate to instructional and numerate learners.

METHODOLOGY

Research Design

This study used descriptive design. The researcher measured the numeracy level of the participants through the pre-post numeracy test given to Grade 3 pupils last July 27, 2018, and August 24, 2018. The pre- post-test administered was composed of 5-item addition and 5-item subtraction of whole numbers using column form.

Research Site

The study was conducted at Calamba City, the 1st class city in the province of Laguna, Philippines, known as the "Resort Capital of the Philippines" because of its numerous hot spring resorts and the hometown of the Philippine National Hero, Dr. Jose P. Rizal.

At the heart of the city is the biggest elementary school, Jose Rizal Memorial School, JRMS or commonly known as Central 1 was categorized as the mega school in Calamba East District 3, Division of Calamba City. It has a land area of 15,501 sq. m. At present, it has a total population of 4, 551 pupils where 588 children belong to Kindergarten, 60 are SPED, 1879 Primary and 2026 intermediate, four utility workers, and three security guards who are compensated by the school's MOOE and under the supervision of Principal IV. This central school offers kindergarten, complete elementary, MADRASAH, Special Program in the Arts and Mathematics, and Science Innovation Program to cater to all

different individuals by giving them the quality education accessible to all and fully implementing the K to 12 Program. It is also piloting the Special Program in the Arts to enhance talented pupils from Kindergarten to Grade 6 and ALS for the out of school youth. Teamwork is a commonplace marketing tactic to make "Central 1 Palaban, Central 1 Number 1."

On the other hand, San Juan Elementary School, which is found at Brgy. San Juan, Calamba City, was categorized as one of the performing medium schools in the division and included in Calamba East 3 District. SJES is now a fast-growing school, which has been possible through the collaboration of teachers, parents, SPG, and other stakeholders. San Juan Elementary teachers are all committed to providing quality education for their learners. They are giving the learners more conducive classrooms, effective teaching strategies, and learning materials like multimedia. The school continues to uplift itself throughout the years with the help of its stakeholders. To enhance pupils' all-round development, SJES provides a wide range of academic and non-academic activities, organizes a series of clubs/ organizations on all subjects, and implements remediation and intervention programs. Their services and programs are designed and implemented to enable pupils to reach their full potential and enhance their skills, especially in reading, writing, and arithmetic.

Moreover, both schools commit to the realization of DepEd's vision, mission and core values in ensuring the delivery of quality basic education to every pupil adhering to transparent, ethical and accountable governance with the mantra, "Una sa lahat, serbisyong tapat at karapat-dapat."

Figure 2. The Study Site

Participants

A total of 70 selected Grade 3 pupils participated in the present study. Fifty-six percent (n= 39) from Jose Rizal Memorial School and forty-four percent (n=31) from San Juan Elementary School. The researcher decided to consider one average section per school to easily identify the pupils' learning abilities, thus easier to facilitate the class.

Instrumentation

The pre-post-test that consisted of 5-item addition and 5-item subtraction served as the instrument of this study. The grade 3 pupils' responses to the numeracy test were interpreted using a continuum prepared by the researcher. Presented below is the continuous scale:

Score	Numeracy Level
8-10	Numerate
5-7	Instructional
0-4	Non- Numerate

After this, common errors and misconceptions were identified to provide teaching strategies to correct them. The participants were exposed to use the grid as a graphic organizer to teach addition and subtraction of whole numbers in column form. After the test, pupils' answers were transcribed and analyzed using mean, frequency, and percentage to determine the numeracy level from the pre-post-test responses. For the Pre-test/ Post Test, the items were measured using the z-test to determine the significant difference on the numeracy level before and after using grids as a graphic organizer.

RESULTS AND DISCUSSIONS

Grid as a graphic organizer was an intervention adapted to one of the teaching strategies in the K to 3 Early Language and Numeracy Program (ELLN). This was done to help improve the numeracy of the learners, particularly in the proper alignment of numbers to master the four fundamental operations, specifically column addition and subtraction of numbers.

Table 1. Frequency-Percentage Distribution of Grade 3 pupils of JRMS and San Juan ES in terms of Numeracy Level during the Pre-Test and Post Test

Numeracy Level	Pre–Test						Post – Test					
	JRMS		San Juan ES		Total	%	JRMS		San Juan ES		Total	%
	No.	%	No.	%			No.	%	No.	%		
Numerate	0	0%	0	0%	0	0%	18	46.15%	2	6.45%	20	28.57%
Instructional	9	23.08%	4	12.9%	13	18.57%	16	41.03%	11	35.48%	27	38.57%
Non-Numerate	30	76.92%	27	87.1%	57	81.43%	5	12.82%	18	58.07%	23	32.86%
Total	39	100%	31	100%	70	100%	39	100%	31	100%	70	100%

Table 1 shows that before using the grid as a graphic organizer in teaching column addition and subtraction of whole numbers, 57 out of 70 or 87.43 % of the selected grade 3 pupils were non-numerates, 13 or 18.57% were instructional and 0% numerate.

The numeracy level of Grade 3 pupils after using a grid as graphic organizer revealed that the non-numerate pupils were lessened to 23 out of 70 or 32.86%, instructional pupils increased to 27 or 38.57%, and numerates became 20 or 28.57%.

This finding provides evidence of the possible benefits pupils may get in using the grid as a graphic organizer. Moreover, findings in the study of Lee-Post (2019) suggest that "students' numeracy and problem-solving skills are raised if they develop an aptitude for quantitative-oriented coursework that equips them with the set of quantitative information-processing skills needed to succeed in the 21st century society and global economy."

Table 2. Frequency-Percentage Distribution of Grade 3 pupils of JRMS and San Juan ES in terms of Common Errors and Misconceptions in Adding and Subtracting Whole Numbers

Common Errors and Misconceptions in Adding and Subtracting Whole Numbers	Pre–Test						Post –Test					
	JRMS		San Juan ES		Total		JRMS		San Juan ES		Total	
	F	%	f	%	F	%	f	%	f	%	f	%
Fail to understand the place value of the digits in the calculation	45	12%	48	15%	93	13%	3	1%	20	6%	23	3%
Adding a column where it does not exist	7	2%	4	1%	11	2%	0	0	3	1%	3	0%
Reversing the digits when they did regrouping	9	2%	4	1%	13	2%	0	0	2	1%	2	0%
Getting the regrouping process correct but forget to add what they have regrouped	16	4%	19	6%	35	5%	6	2%	14	5%	20	3%
When working with 3-digit numbers, pupils did not understand that the hundreds columns exits when the numbers in the original calculation do not contain any hundreds;	18	5%	26	8%	44	6%	9	2%	19	6%	28	4%
Misconceptions regarding adding zero as a place holder.	3	1%	9	3%	12	2%	0	0	4	1%	4	1%
Subtracting the smaller digit in a column from the larger digit regardless of which appears on top.	34	9%	30	10%	64	9%	17	4%	30	10%	47	7%
Recording the regrouping process in the written form without understanding what the process represents conceptually	43	11%	31	10%	74	11%	35	9%	28	9%	63	9%
Misconception regarding subtracting zero as a place holder;	36	9%	31	10%	67	10%	21	5%	25	8%	46	7%
Subtracting numbers that involve regrouping when zero is present as a placeholder.	40	10%	29	9%	69	10%	29	7%	24	8%	53	8%
Total	251	64%	231	75%	482	69%	120	31%	169	55%	289	41%
					Errors and mis-con-cep-tions						Errors and Mis-con-cep-tions	

Table 2 shows the identified common errors and misconceptions committed by the grade 3 pupils in Adding and Subtracting Whole Numbers. It revealed that out of 700 correct responses from the 70 participants with a 10-item pre-test, the Grade 3 pupils had committed 482 or 69% common errors and misconceptions. Due to improper alignment of numbers, pupils failed to understand the place value of the digits in the calculation. This is the number 1 common error done by both pupils of JRMS and San Juan Elementary School. The column method for addition and subtraction builds on pupil understanding of place value and different strategies, including knowledge of number bonds in 20 and the 'make ten strategy.' A key misunderstanding that students may have when solving column addition and subtraction is to treat each number as a separate number rather than representing ten or one digit (Mathematics Mastery, 2014).

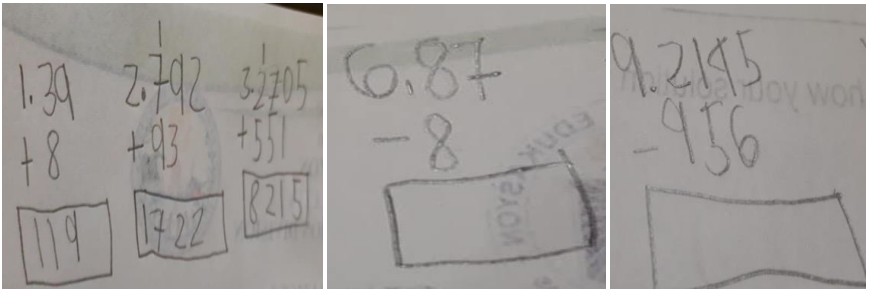

Figure 3. Majority of the errors and misconceptions of Grade 3 pupils

Pupils try to record the regrouping process in the written form without understanding what the process represents conceptually. This results in 11% of errors committed due to abstract rush recording when teaching the column method of subtraction. The majority of the pupils subtract the smaller number from the bigger number regardless of whether they are minuend or subtrahend. Their conceptual thinking is "for subtraction you always start with the bigger number and subtract the smaller number." (Mathematics Mastery 2014). The progress of most students' level of conceptual understanding moved from misconception to partial understanding or even to full understanding. Graphical representation, concept mapping, cooperative learning, games and online videos are remedial activities imparted, which, in turn, are effective in conceptual understanding (Necor, 2018).

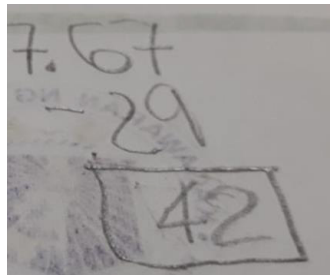

Figure 4. Pupil's answer showing error and misconception

The 10% of the common errors and misconceptions were committed when calculations involve numbers with zero as a placeholder. Pupils may not consider the entire calculation but treat each column as a separate subtraction, and then they misunderstand the concept of subtraction from scratch. Here, pupils need to develop their understanding of zero as a placeholder. They need to use zero to represent numbers as placeholders. They need to be encouraged to still think about the calculation as a whole. Also need to develop their understanding of what happens to a nun they add or subtract zero (Mathematics Mastery, 2014).

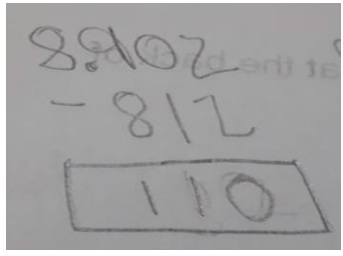

Figure 5. Pupil's answer showing error and misconception

The rest of common errors and misconceptions did not understand that the hundreds of columns exist when the numbers in the original calculation do not contain hundreds; reversing the digits when they were regrouped; and adding a column where it does not exist. Centillas and Larisma (2016) in their study entitled "Error Analysis of Trigonometry Students in a Technological University," stated that students have learning complexities, which are attributed to the error, committed. Thus, students had learned some concepts defectively.

On the other hand, after using the grid as a graphic organizer, the result of the post-test was 289 or 41% common errors and misconceptions showing a decrease of 193 or 27% from the pretest. These errors and misconceptions were crucial things among young learners because they lack the general cognitive skills needed for higher-order and critical thinking skills.

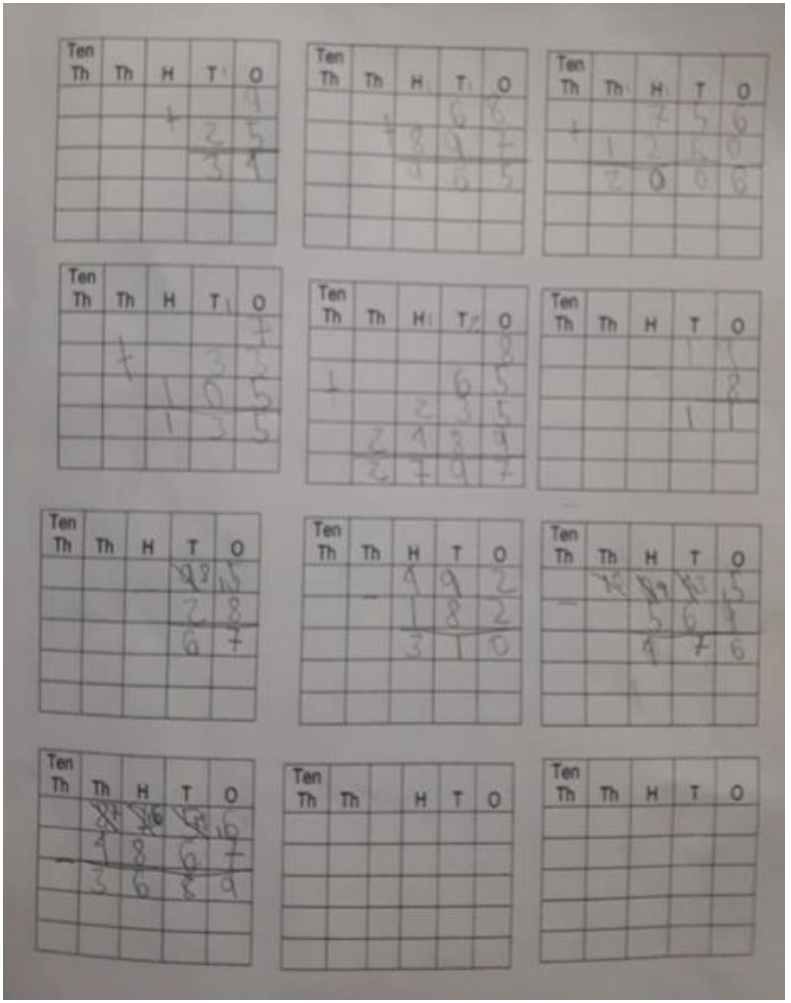

Figure 6. Pupil's Answer Using the Grid as a Graphic Organizer

Significant Difference in Pretest and Posttest Scores of the Target Learners

Table 3. Summary of Values for Testing Significant Difference Between the Pre-Test and Post-Test Scores of the Participants in the Numeracy Test

	Total Number of Participants	Mean	Standard Deviation	z-test	Level of Significant
Pretest	70	3.11	1.663	13.258	0.05
Posttest	70	5.87	2.001		

H_o: There is no significant difference in the numeracy level before and after using grids as a graphic organizer

Table 3 reflects the summary of values for testing the significant difference between the pre-test and post-test showing that out of ten- items test, the mean score of the pupils in the pretest is 3.11 with a standard deviation of 1.663 while the mean score in the posttest is 5.87 with a standard deviation of 2.001. The standard deviation in the posttest is higher than that of the pretest since the accumulated scores during the pretest is of lesser dispersion than the posttest. Likewise, the standard deviations show the minimum dispersion of scores from the mean of each subscale.

To determine if the difference is significant, the z-test was applied. The computed z-value of 13.256 was computed to the tabular value of 2.0 at 0.05 level of significance. Since the z-test value is greater than the tabular value, it is proven that there is a significant difference in the numeracy level before and after using grids as a graphic organizer. It is evidently shown that the gained score in the posttest was attributed to the use of Grid as Graphical Organizer in facilitating the Numeracy level of Grade 3 Mathematics Teaching.

It should also be noted that there is a significant difference in the numeracy level of Grade 3 pupils of JRMS and San Juan ES after using the grid as a graphic organizer because the pre-test and post-test results were different from each other. It gives a perception that the Grade 3 pupils performed better in the post-test after using grids as one of the strategies to solve the common errors and misconceptions in finding the sum and difference of whole numbers using column form. This was justified by the mean (X_1 = 3.11) in the pre-test and (X_2 = 5.87) mean in the post-test. The results imply that the Grid as Graphical Organizer has a significant effect on the numerical level of Grade 3 pupils in mathematics.

Moreover, the study conducted by Chukwu and Dike (2019) showed that Jigsaw Puzzle and Graphic Organizer are effective instructional strategies for enhancement of pupils' academic performance. Thus, the findings indicated that the pupils acquire the necessary skills in addition and subtraction of the whole number and exhibit mathematical awareness. Additionally, the results demonstrated that pupils learn and use sufficiently well with the Grid as Graphical Organizer strategies in developing numeracy levels.

CONCLUSIONS

The effect of the grid as a graphic organizer in teaching Mathematics has helped improve pupils' numeracy level from non-numerates to instructional and independent learners. Grids help in the proper alignment of numbers and thorough understanding of the place value of numbers, regrouping, and place holder for the feature of visualization. This also facilitates cognitive learning skills among pupils to improve their capacity for active learning.

The pupils' numeracy level upon the entrance of Grade 3 belongs to the non-numerate level. That based on their answers in the pre-test, the common errors and misconceptions in addition to whole numbers, falls on the concepts of place value, regrouping, reversing, calculation, not existing numbers, and zero as placeholder. On the other hand, common errors and misconceptions in column subtraction were subtracting smaller numbers from bigger numbers regardless of being a minuend and subtrahend, regrouping, and the concept of zero as a placeholder.

Moreover, after the use of the grid as a graphic organizer, the progress of the pupils' numeracy from the non-numerate level has been improved to the instructional level and instructional level to an independent level. However, there are still non-numerate learners that need immediate remediation and intervention.

Lastly, the null hypothesis is that there is no significant difference in the numeracy level before and after using grids as a graphic organizer. Hence, it can be concluded that there is a change in the pupils' numeracy level before and after taking the test. Therefore, their scores in the pre-test and post-test differed significantly when tested at 0.05 level.

TRANSLATIONAL RESEARCH

This study's findings may be translated through sharing this teaching strategy to other Math teachers from Grades 1 to 6 for this not only limits to the two fundamental operations but multiplication and division. This can also be used in teaching place value of numbers, fractions, decimals, geometry, symmetry, graphing and plotting of points and a lot more. The identified common errors and misconceptions in adding and subtracting whole numbers may help diagnose and remediate activities using grids. The grid as a graphic organizer may benefit all Math teachers and pupils in teaching and learning math easy and exciting because this is reproduced in larger or bigger fonts depending on its use in any particular math topics or concepts. Finally, the results of this study will be useful to other researchers who plan to further investigate the pupils' common errors and misconceptions in the four fundamental operations in Mathematics. It is our hope that this and future research will help Filipino teachers improve their practice and give them a voice in the literature on educational assessment (Ballada & Aliño, 2018).

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