



EFFECTIVENESS OF CONCRETE-PICTORIAL-ABSTRACT (CPA) APPROACH TO IMPROVE NUMBER SENSE OF GRADE 2 LEARNERS

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ABSTRACT

This study was conducted to determine the Effectiveness of Concrete-Pictorial-Abstract (CPA) Approach to Improve Number Sense of Grade 2 Learners in Dr. H. Serafica Elementary School, in Brgy. Bayog, Elementary School. The findings of the study were the bases for the proposed Enhancement Plan. This study employed a quantitative research design, specifically a quasi-experimental pretest-posttest control group design, to determine the effectiveness of the Concrete-Pictorial-Abstract (CPA) approach on the number sense of Grade 2 learners. The design was suitable because it allowed for the comparison of learning outcomes between students exposed to the CPA approach (experimental group) and those taught using traditional methods (control group), while assessing the impact of the intervention over time. In this design, the independent variable was the instructional approach, represented by the use of the CPA method, while the dependent variable was the number sense of the learners, measured through their performance on pretests and posttests. By administering a pretest,

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the researcher established a baseline for each group and controlled for pre-existing differences in mathematical ability.

The posttest, administered after the intervention, measured the improvement in learners' number sense, allowing for a clear evaluation of CPA's effectiveness. The experimental group received mathematics instruction using the CPA approach, beginning with concrete manipulatives, followed by pictorial representations, and culminating in abstract numerical problems. The control group followed the regular mathematics curriculum without the structured CPA intervention. This comparison ensured that any observed differences in learning outcomes could be attributed to the CPA approach rather than external factors.

The Test of Difference Between Pre-Test and Post-Test Scores of Learners shows the comparison of learners' performance before and after the instructional intervention. The table provides information on pre-test and post-test results, the computed statistical value, the critical value, the decision regarding the null hypothesis, and the interpretation of the findings. It is designed to evaluate the effectiveness of the instructional approach in improving learners' comprehension and overall academic performance. As reflected in the table, learners initially demonstrated a moderate level of readiness, with many requiring review and reinforcement before the intervention. After the implementation of the instructional strategy, the post-test results showed a significant increase, indicating that learners achieved mastery of the content.

The noticeable improvement between pre-test and post-test performance demonstrates that the intervention effectively enhanced learners' skills and understanding,

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highlighting the positive impact of structured teaching approaches on academic outcomes.

The statistical analysis indicated that the difference between pre-test and post-test performance was significant, leading to the rejection of the null hypothesis. This confirms that the improvement in learners' performance was not due to chance. The interpretation clearly indicates a significant improvement in learners' performance, validating that the instructional strategy successfully addressed learning gaps and strengthened comprehension abilities. The results imply that the instructional intervention had a meaningful and positive effect on learners' academic performance. The overall average rating in the post-test reflects a marked improvement from the initial assessment, suggesting that the intervention successfully elevated learners' readiness and mastery of the content. The result implies that the teaching strategy effectively enhanced learners' understanding, problem-solving skills, and overall confidence in applying learned concepts.

Keywords: *Effectiveness, Concrete-pictorial-abstract approach, Number Sense, Grade 2*

INTRODUCTION

The Concrete-Pictorial-Abstract (CPA) approach is an instructional strategy that sequentially guides learners from hands-on, tangible experiences to visual representations, and finally to abstract mathematical symbols and operations. In relation to the development of number sense, this approach is particularly effective because it allows learners to build a deep understanding of numbers and their relationships rather than relying on rote memorization. At the concrete stage, learners manipulate physical objects such as base-ten

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blocks, counters, or unifix cubes, enabling them to internalize concepts such as place value, addition, and subtraction. The pictorial stage then bridges the concrete and abstract by encouraging learners to draw diagrams, use number lines, or create ten frames, helping them visualize mathematical relationships. Finally, in the abstract stage, learners apply conventional mathematical symbols and algorithms with confidence, as they have a strong conceptual foundation. This progression fosters flexibility, estimation skills, and relational understanding, which are key components of number sense, allowing learners to not only perform calculations but also understand the “why” behind the operations.

Qi Lin (2022) investigated the effect of distributed leadership and teacher autonomy on professional collaboration, emphasizing how clear communication and structured guidance enhance understanding and productivity in learners. While this study focused on leadership in schools, the findings resonate with the CPA approach in mathematics education, as structured, step-by-step scaffolding enhances learners’ ability to internalize concepts and apply knowledge effectively. Lin found that progressive, scaffolded guidance enabled learners to develop autonomy and confidence, which parallels how the CPA approach builds strong number sense: starting with manipulatives, progressing to visual models, and culminating in abstract reasoning. This literature underscores the importance of deliberate, structured approaches in teaching, whether in leadership or mathematics, to improve performance and conceptual understanding (Lin, 2022).

From the researcher’s perspective, several strategies can enhance the development of number sense, including manipulatives, visual aids, mental math exercises, and problem-

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solving tasks. Among these, the CPA approach stands out as it integrates all these strategies within a sequential framework that aligns with learners' cognitive development. Concrete experiences with physical objects anchor understanding, pictorial representations enhance visualization and internalization, and abstract symbols allow learners to generalize concepts and perform operations efficiently. The researcher observes that students taught through CPA demonstrate higher engagement, better conceptual understanding, and increased confidence in mathematics compared to students taught using traditional, abstract-first methods.

Despite its effectiveness, implementing the CPA approach is not without challenges, which can affect learners' academic performance in mathematics. Time constraints pose a significant difficulty, as concrete and pictorial activities require more classroom time than traditional methods. Limited resources, such as insufficient manipulatives, create barriers to hands-on learning. Additionally, some learners initially resist the CPA approach, perceiving manipulatives as "play" rather than real mathematics, which can hinder engagement and understanding. Teacher preparedness is also critical; educators without proper training may fail to facilitate the transitions between concrete, pictorial, and abstract stages, leading to misconceptions or incomplete understanding. Parental skepticism can further complicate the process, as parents accustomed to traditional methods may undervalue the hands-on activities essential to building number sense.

Pursuing this study on the CPA approach is essential to address the gaps in learners' number sense and mathematics achievement. By examining how sequential, scaffolded instruction impacts conceptual understanding and problem-solving skills, the study aims to

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provide empirical evidence supporting effective teaching strategies. It also seeks to inform educators, school administrators, and policymakers about best practices in mathematics instruction, ultimately contributing to improved student engagement, academic performance, and long-term mathematical fluency. The findings of this study will help bridge the gap between abstract mathematical instruction and meaningful, intuitive understanding, reinforcing the importance of the CPA approach as a cornerstone of effective mathematics education.

This study was conducted to determine the Effectiveness of Concrete-Pictorial-Abstract (CPA) Approach to Improve Number Sense of Grade 2 Learners in Dr. H. Serafica Elementary School, in Brgy. Bayog, Elementary School. The findings of the study were the bases for the proposed Enhancement Plan.

Specifically, the study sought to answer the following questions:

1. What is the performance of the grade 2 learners in Mathematics subject before the integration of Concrete-Pictorial-Abstract
2. What is the performance of the grade 2 learners in Mathematics subject after the integration of Concrete-Pictorial-Abstract?
3. Is there a significant difference between the performances before and after the integration of Concrete-Pictorial-Abstract?
4. What enhancement plan can be proposed based on the findings of the study?

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Statement of Hypothesis:

Ho: There is no significant difference between the pretest and posttest scores before and after the integration of Concrete-Pictorial-Abstract.

METHODOLOGY

Design. This study employed a quantitative research design, specifically a quasi-experimental pretest-posttest control group design, to determine the effectiveness of the Concrete-Pictorial-Abstract (CPA) approach on the number sense of Grade 2 learners. The design was suitable because it allowed for the comparison of learning outcomes between students exposed to the CPA approach (experimental group) and those taught using traditional methods (control group), while assessing the impact of the intervention over time.

In this design, the independent variable was the instructional approach, represented by the use of the CPA method, while the dependent variable was the number sense of the learners, measured through their performance on pretests and posttests. By administering a pretest, the researcher established a baseline for each group and controlled for pre-existing differences in mathematical ability. The posttest, administered after the intervention, measured the improvement in learners' number sense, allowing for a clear evaluation of CPA's effectiveness.

The experimental group received mathematics instruction using the CPA approach, beginning with concrete manipulatives, followed by pictorial representations, and culminating in abstract numerical problems. The control group followed the regular mathematics

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curriculum without the structured CPA intervention. This comparison ensured that any observed differences in learning outcomes could be attributed to the CPA approach rather than external factors.

The main local of the study was in Dr. H. Serafica Elementary School in the Schools Division Ormoc. The respondents of the study were the School heads and Teachers.

Data was collected using a researcher-designed Number Sense Test, validated by mathematics educators for content and construct validity. The test was included problems assessing basic operations, number relationships, place value, and problem-solving skills appropriate for Grade 2 learners. Pretests and posttests were scored quantitatively, providing measurable data for analysis.

Sampling. The respondents of the study were the Grade 2 learners Dr. H. Serafica Elementary School. There were 7 males and 12 females with a total of 19 respondents that were involved in this study that were being identified and the primary means of reach is during the actual conduct of the study as well as during the gathering of data in the school where the study was conducted. Another way of contacting them are through cell phones.

Research Procedure. To begin this research, the researcher first submitted a formal Transmittal Letter requesting approval from the Schools Division Office, which was led by the School Division Superintendent. This letter described the goals of the study and emphasized its significance in improving learners' educational experiences. Copies of the letter were distributed to the Public-School District Supervisor, the School Principal, and the teachers

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working directly with the participating pupils, in addition to the Schools Division Office. Before the intervention, both the experimental and control groups took a pretest designed to measure learners' number sense. The pretest assessed basic operations, place value, number relationships, and problem-solving skills. This step aimed to establish a baseline for each learner's understanding and ensure comparability between groups.

The experimental group then underwent mathematics instruction using the Concrete-Pictorial-Abstract (CPA) approach over a designated period of four to six weeks. Each lesson followed a structured progression, beginning with the Concrete Stage, where learners manipulated physical objects such as blocks and counters to explore mathematical concepts. This was followed by the Pictorial Stage, where learners translated their concrete experiences into visual representations like drawings, diagrams, or number lines. Finally, the Abstract Stage introduced numerical problems using symbols, equations, and algorithms, enabling students to connect prior concrete and pictorial experiences to abstract understanding. Meanwhile, the control group continued to receive standard mathematics instruction without the structured CPA methodology, following the existing curriculum.

After completing the intervention, both groups took a posttest similar in format and content to the pretest. This assessment measured the improvement in learners' number sense and evaluated the effectiveness of the CPA approach compared to traditional teaching methods. All test scores were collected, tabulated, and analyzed using descriptive statistics, such as mean and standard deviation, as well as inferential statistics, including paired t-tests for within-group comparisons and independent t-tests for between-group comparisons. This

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analysis determined whether the CPA approach significantly enhanced number sense among Grade 2 learners.

Throughout the study, the researcher ensured that ethical considerations were strictly observed. Informed consent was obtained from parents or guardians, participation was voluntary, and learners' information was kept confidential. Any challenges encountered during the implementation, such as learners' resistance or limitations in resources, were documented and addressed to ensure smooth and effective research execution.

Ethical Issues. The right to conduct the study was strictly adhered through the approval of the principal. Orientation of the respondents both their subject teachers.

Treatment of Data. The following statistical formulas were used in this study:

The quantitative responses were tallied and tabulated. The data was be treated statistically using the following statistical tool.

Simple Percentage. This was utilized to assess the performance of the Grade 2 learners in Mathematics.

T-Test for Mean Difference- This tool was used to calculate the academic performance of the Grade 2 learners in Mathematics.

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RESULTS AND DISCUSSION

TABLE I

PRE-TEST PERFORMANCE OF LEARNERS

Score Range	Description	Frequency	Percentage (%)
28 – 35	Grade Ready	3	15.79%
21 – 27	Light Refresher	9	47.37%
15 – 20	Moderate Refresher	7	36.84%
0 – 14	Full Refresher	0	0.00%
Total		19	100%

Weighted Mean: 22.20 – Moderate Refresher

Mean Percentage Score (MPS): 52.03%

This table presents the Pre-Test Performance of Learners in terms of score range, descriptive rating, frequency, percentage distribution, weighted mean, and Mean Percentage Score (MPS). The table summarizes the learners' initial performance before any intervention, categorizing their scores into four levels—Grade Ready, Light Refresher, Moderate Refresher, and Full Refresher—and provides an overall assessment through the weighted mean and MPS. This data serves as a baseline to determine learners' preparedness and the areas needing improvement prior to instruction.

As shown in the table, only a small portion of learners (15.79%) were assessed as Grade Ready, indicating that a few learners demonstrated sufficient mastery of the subject matter at the outset. The largest group of learners (47.37%) fell under the Light Refresher

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category, suggesting that nearly half of the learners required some review to achieve optimal performance. Meanwhile, 36.84% of learners were classified under Moderate Refresher, highlighting a significant portion who needed considerable support in their understanding. Notably, no learners (0.00%) fell into the Full Refresher category, showing that none were completely unprepared.

The data reflects that most learners required reinforcement in foundational skills before the intervention, with nearly half needing only light review and over a third requiring moderate review. The weighted mean of 22.20, interpreted as Moderate Refresher, and the MPS of 52.03% confirm that learners' pre-test performance was below the expected mastery level, indicating gaps in understanding and skills that needed to be addressed. These findings provide a clear picture of the starting point for instructional planning.

The results imply that learners had varying levels of preparedness, with the majority requiring some form of reinforcement to enhance comprehension and mastery. The distribution shows that while a few learners were ready for the grade level, most needed either light or moderate review, and the overall weighted mean of 22.20 (Moderate Refresher) and MPS of 52.03% imply that targeted instructional strategies are necessary to elevate learners' performance to higher levels. The data highlights specific areas where intervention can be most effective in bridging gaps and supporting learners' academic growth.

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Table 2

POST-TEST PERFORMANCE OF LEARNERS

Score Range	Description	Frequency	Percentage (%)
28 – 35	Grade Ready	19	100%
21 – 27	Light Refresher	0	0.00%
15 – 20	Moderate Refresher	0	0.00%
0 – 14	Full Refresher	0	0.00%
Total		19	100%

Weighted Mean: 33.38 – Grade Ready

Mean Percentage Score (MPS): 83.44%

This table presents the Post-Test Performance of Learners in terms of score range, descriptive rating, frequency, percentage distribution, weighted mean, and Mean Percentage Score (MPS). The table summarizes the learners’ achievement after the implementation of the instructional intervention, categorizing their scores into four levels—Grade Ready, Light Refresher, Moderate Refresher, and Full Refresher—and provides an overall assessment through the weighted mean and MPS. This post-test data serves to evaluate the effectiveness of the intervention and reflects learners’ academic gains compared to their pre-test performance.

As shown in the table, all learners (100%) achieved scores within the Grade Ready category, indicating that every participant demonstrated mastery of the subject matter after the intervention. No learners were classified in the Light Refresher, Moderate Refresher, or

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Full Refresher categories, highlighting that the instructional approach successfully addressed gaps in knowledge and skills. This uniform distribution demonstrates a significant improvement in learners' comprehension and readiness for the grade-level content.

The data indicate that the intervention led to a substantial increase in learners' academic performance, with every participant achieving the highest descriptive rating. The weighted mean of 33.38, interpreted as Grade Ready, and the MPS of 83.44% confirm that learners not only improved individually but also collectively reached a level of mastery that exceeded pre-test expectations. The consistency of high performance across all learners underscores the effectiveness and reliability of the instructional approach implemented.

The results imply that the instructional strategy was highly effective in improving learners' comprehension and overall academic performance. With all learners attaining the Grade Ready category, a weighted mean of 33.38, and an MPS of 83.44%, the result implies that the intervention successfully enhanced learners' understanding, skills, and readiness for the grade-level content. The absence of learners in the lower performance categories further emphasizes that the approach addressed prior deficiencies and promoted significant learning gains.

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TABLE 3

TEST OF DIFFERENCE BETWEEN THE PRE-TEST AND POST-TEST SCORES OF LEARNERS SCORES

Aspects	Test Scores (Mean)	Computed t	Critical t ($\alpha = 0.05, df = 18$)	Decision on Ho	Interpretation
Pre-Test vs Post-Test	Pre = 22.20 Post = 33.38	15.63	2.10	Reject Ho	Significant improvement in learners' performance

This table presents the Test of Difference Between Pre-Test and Post-Test Scores of Learners, showing the comparison of learners' performance before and after the instructional intervention. The table provides the mean scores for both the pre-test and post-test, the computed t-value, the critical t-value at $\alpha = 0.05$, the decision regarding the null hypothesis, and an interpretation of the results. It is designed to evaluate the effectiveness of the instructional approach in improving learners' comprehension and overall academic performance.

As reflected in the table, learners initially obtained a pre-test mean indicating a moderate level of readiness, with many requiring light to moderate review before the intervention. After the implementation of the instructional strategy, the post-test mean showed a significant increase, indicating that all learners achieved mastery of the content. The large difference between the pre-test and post-test mean scores demonstrates that the

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intervention effectively enhanced learners' skills and understanding, highlighting the positive impact of structured teaching approaches on academic performance.

The computed t-value far exceeds the critical t-value, leading to the rejection of the null hypothesis. This statistical outcome confirms that the improvement in learners' performance is significant and not due to chance. The interpretation clearly states that there was a significant improvement in learners' performance, validating that the instructional strategy successfully addressed learning gaps and strengthened comprehension abilities.

The results imply that the instructional intervention had a strong and meaningful effect on learners' academic performance. With the pre-test mean of 22.20 and the post-test mean increasing to 33.38, alongside a computed t-value of 15.63 surpassing the critical t-value of 2.10, the result implies that the teaching strategy effectively enhanced learners' understanding and mastery of the content. The overall average rating in the post-test (33.38) reflects a marked improvement from the initial assessment, suggesting that the intervention successfully elevated learners to the Grade Ready level.

CONCLUSION

Based on the results of this study, the Test of Difference Between Pre-Test and Post-Test Scores of Learners demonstrates that the implementation of the Concrete-Pictorial-Abstract (CPA) Approach significantly improved learners' comprehension and overall academic performance. Learners who initially demonstrated moderate readiness showed marked improvement after the intervention, achieving mastery of the content. The significant

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difference between pre-test and post-test performance confirms that the instructional strategy effectively addressed learning gaps, enhanced understanding, and strengthened problem-solving skills. Overall, the findings indicate that the CPA approach positively impacted learners' confidence, readiness, and ability to apply mathematical concepts, highlighting its effectiveness as a structured and research-based teaching strategy.

RECOMMENDATION

Based on the findings of this study, the following recommendations are proposed:

The Teacher should continue implementing the Concrete-Pictorial-Abstract (CPA) Approach to strengthen learners' comprehension, number sense, and problem-solving skills, while incorporating varied activities that cater to different learning styles to sustain engagement and mastery.

The Learners should actively participate in the CPA-based activities, consistently practice problem-solving exercises at home, and apply the strategies learned in class to reinforce their understanding and improve confidence in mathematics.

The School Heads should support teachers by providing adequate resources, training, and a conducive learning environment to facilitate the effective implementation of the CPA Approach and other research-based instructional strategies.

The Public Schools District Supervisor should monitor and evaluate the integration of the CPA Approach across classrooms, provide professional development opportunities, and

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encourage sharing of best practices to ensure continuous improvement in learners' academic performance.

The Parents should engage in their children's learning by supervising home practice, motivating learners to apply mathematical concepts in daily life, and collaborating with teachers to reinforce the skills learned in school.

The Researcher should document the outcomes of the CPA intervention, reflect on the challenges encountered, and use the findings to enhance instructional strategies and classroom practices in future implementations.

Future Researchers should explore the effectiveness of the CPA Approach in other grade levels, subjects, or learning contexts, consider longitudinal studies to examine sustained impact, and investigate complementary teaching strategies that may further improve learners' comprehension and academic performance.

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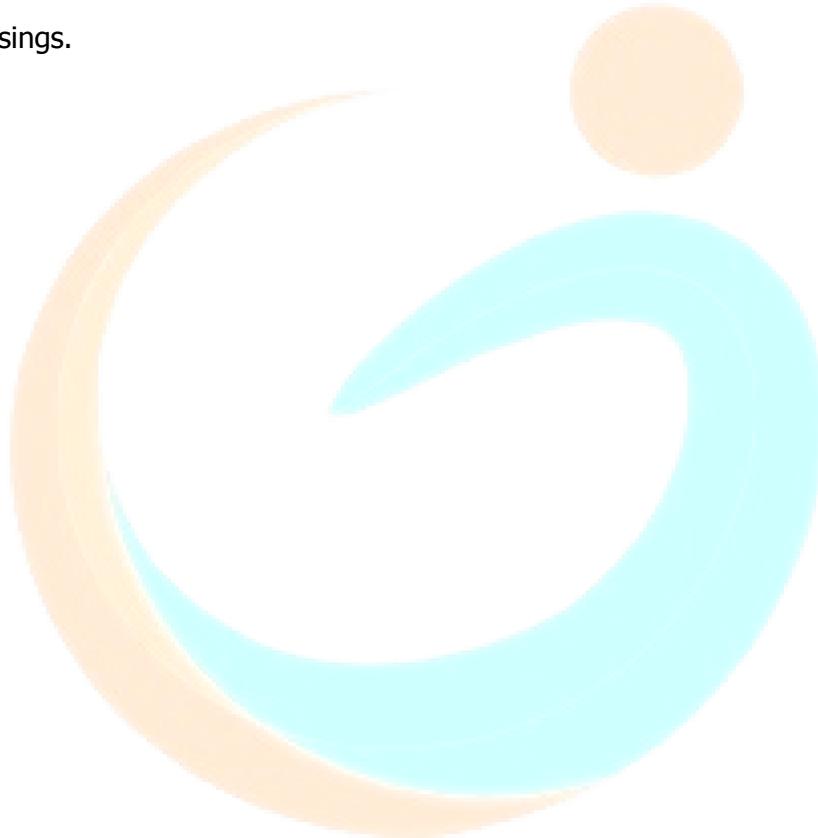
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The author was born on May 28, 1991 in Kananga, Leyte, Philippines. She graduated with flying-colours, earning a Bachelor of Elementary Education from Visayas State University –Villaba Campus. During high school and college, she was deeply involved in elementary-education activities, holding leadership positions in several student organizations. Those experiences inspired her to specialize in elementary education for her master's studies. She is presently completing a Master of Arts in Education, majoring in Elementary Education at Western Leyte College, Ormoc City.

Currently, she works as a Teacher I for the Department of Education and serves as a Grade 2 teacher at Dr. H. Serafica Elementary School, Barangay Bayog, Ormoc City, Leyte. She also coordinates two learner-focused programmed: Gender and Development (GAD) and the Child Protection Policy (CPP). She believes that supervising young children provides the foundation for effectively supervising adults later in life.

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