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Building Mathematical Understanding: The Power Of CRA Approach In Numeracy

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ABSTRACT

The Concrete-Representational-Abstract (CRA) method of teaching mathematics material has had remarkable success in primary education. With the correct assistance of their teachers, beginners can understand the concepts they are studying. Making significant linkages between concrete, symbolic, and abstract levels of thinking is a conceptually supported field of study. CRA is a research-based intervention that recommends math lessons that improve kids' numeracy and mathematical attitudes. This method's requirement for a set order of tasks creates a distinctive learning environment with several advantages for lower-level teachers and students.

This study was created to assess how well the CRA technique is used in numeracy, particularly when estimating and computing whole numbers. The students' work was evaluated as part of a pre-survey to determine how well they understood the course material and how they felt about their capacity to retain it. The student responses were compared to their pre-survey replies after a CRA activity to see if there had been any changes in the students' understanding of tangency and how effectively they could follow the activity. The purpose of this study was to evaluate the viability and efficacy of applying the CRA approach to numeracy.

Keywords: CRA, FLN, Numeracy

I. INTRODUCTION

What is CRA?

The Concrete-Representational-Abstract (CRA) approach is a well-established instructional strategy in teaching numeracy that is designed to enhance students' understanding of mathematical concepts. It involves three stages: Concrete, Representational, and Abstract. CRA is a mathematics instruction intervention that, according to

research, can improve students' math performance. As part of the CRA approach, new concepts are introduced using advantageous tangible objects or useful equipment. The first stage of the learning process involves students manipulating concrete objects physically. The second stage involves learning through pictorial representations of the concrete manipulations.

Importance of CRA in Numeracy

The CRA approach is particularly effective because it aligns with how students naturally develop their understanding of mathematical concepts. By progressing from concrete to abstract, students build a strong, intuitive grasp of mathematics, which leads to better retention and application of knowledge.

Research and Evidence

Studies have shown that the CRA approach can significantly improve students' mathematical performance, particularly for those with learning difficulties. It promotes deeper understanding, reduces math anxiety, and enhances problem-solving skills.

Implementation in the Classroom

Teachers can implement the CRA approach by designing lessons that include activities at each stage. For example:

- **Concrete**: Use manipulatives like counters, blocks, or measuring tools.
- **Representational**: Incorporate drawings, diagrams, and visual aids in lessons.
- **Abstract**: Gradually introduce mathematical symbols, equations, and formal notation.

Challenges and Considerations

While the CRA approach is effective, it requires careful planning and resources. Teachers need to ensure that students have adequate time to explore each stage and make meaningful connections. Additionally, ongoing assessment is crucial to monitor students' progress and adjust instruction as needed. The CRA approach is a powerful instructional strategy in numeracy education. By guiding students through concrete, representational, and abstract stages, it builds a solid foundation for mathematical understanding and application. Teachers can enhance their students' numeracy skills by thoughtfully integrating the CRA approach into their teaching practices.

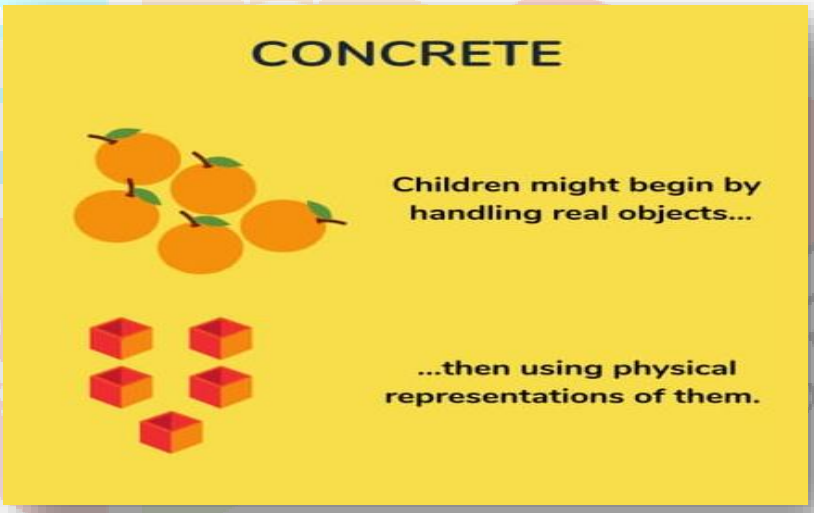
Why do we use the CRA approach in Numeracy?

If students can answer, without having to memorize the solutions, they will have a far deeper comprehension of the concept. When teaching young children to read, we accept that they must have seen why the word is there to understand it. If children had no notion what a dog was or had never seen a picture of one, putting the letters d-o-g together would be meaningless and abstract.

What is "Concrete" Representation in the CRA approach?

New concepts are introduced via tangible objects or useful tools as part of the CRA approach. These may be physically managed, allowing kids to investigate various mathematical ideas. These are sometimes referred to as math manipulatives and can consist of general mathematical tools like base ten blocks or ten frames or common household items like straws or dice.

Children may find math's abstract nature perplexing, but using concrete things allows them to "look" and understand what is actually happening. There has previously been a misperception that, concrete resources are only for students who struggle with mathematics. In actuality, there are numerous techniques at every level and FLN to attain Numeracy to employ concrete resources. Using real-world resources helps all pupils, regardless of aptitude, to ensure that knowledge extends beyond systematic learning. Children can communicate and explain a notion with the help of useful materials that encourage reasoning and conversation. Teachers are also able to watch pupils to determine the extent of their comprehension and for a better understanding of where misconceptions may arise. It helps the behavioral changes of the learners with reference to the numerical ability which expand their divergent thinking and ability.

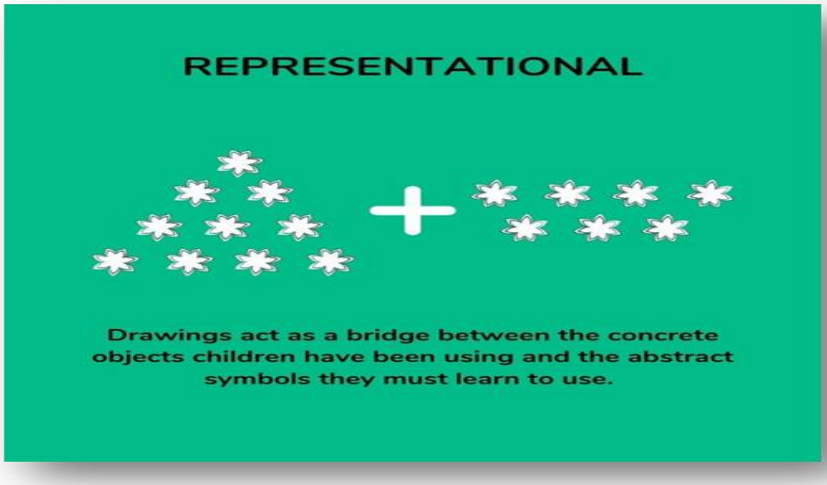


(Tangible objects help children to represent numbers by observing the concrete method)

How can we portray the "Representational" part of the CRA approach?

Children move on to creating visual representations of the things or brief sketches of them after they are comfortable with a notion utilizing tangible resources. By doing this, they no longer manipulate the tangible resources but continue to gain from the visual aid they offer.

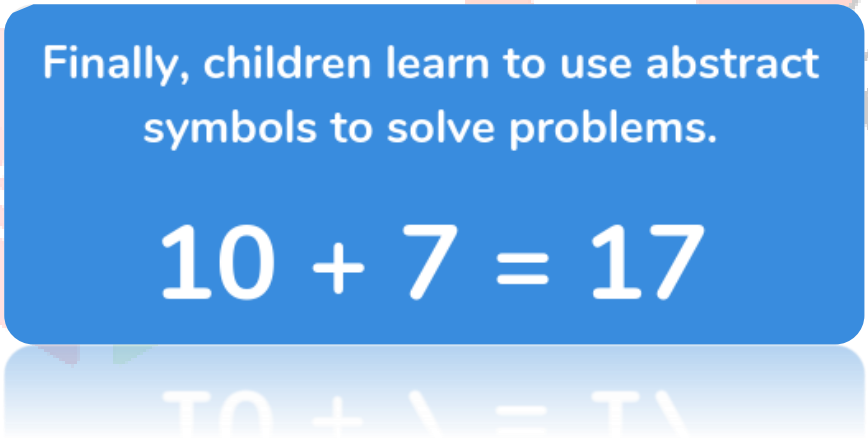
The bar model, which is frequently used in more complicated multi-step problem solving, is one of the most popular techniques employed in the representational stage.



(Concrete objects children have been using the abstract symbols they learn to use)

What is an "Abstract" representation in the CRA approach?

Children can progress to the abstract stage provided they have a firm comprehension of the concept using concrete resources and visual imagery. Children need access to the previous two levels when they are utilizing abstract symbols to model problems - mainly numerals. Children must frequently switch back and forth between each stage for the best learning to occur. By doing this, concepts are strengthened and conceptualized.



RESEARCH QUESTIONS OF THE STUDY:

- ✓ How far CRA approach is better than traditional method of teaching Numeracy?
- ✓ What is CRA approach?
- ✓ How does the implementation of CRA approach influence the learning achievement of Grade III students in Mathematics of different schools of Bankatira cluster?

METHODOLOGY OF THE STUDY

This Section deals with Methodology of the study which includes

(i) Research type and Design, (ii) Population and participants (Sample), (iii) Sampling techniques, and (iv) Techniques of Data Analysis.

(i) Research type and Design

A **quasi-experimental approach** with a control pre-test and post-test is used in this study. Because the sample was chosen using the purposive sampling technique, this type of research is conducted **(conditional sample)**. This is in line with Gibbons and Herman's (1996) explanation that, when random assessment is impractical, quasi-experimental research is typically utilized to examine educational programs.

Before the treatments (learning activities) started, a pre-test was administered. Each of the five treatments, which were administered, included teaching and learning resources for numeracy. A post-test was given to the students at the conclusion of the lesson.

(ii) Population and participants (Sample)

Under Bankatira cluster, which is in Remuna BEO, Balasore the researcher has taken.

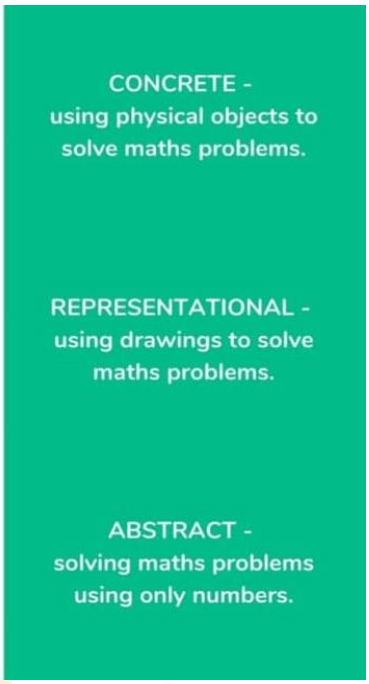
- 23 Elementary pupils from Khamatana U.G.U.P School, Khamatana made up the first sample. 11 students received traditional/conventional instruction, while 12 students received instruction using the CRA technique.
- 15 Elementary pupils from Sahupada Pry School, Sahupada made up the second sample.8 pupils received conventional/traditional instruction, whereas 7 students used the CRA approach.
- 12 Elementary pupils from Gandarda Pry School, Gandarda made up the third sample. 6 students received instruction using the CRA technique, and 6 other students received traditional/conventional instruction.

(iii) Sampling Techniques

Purposive sampling was used to take the sample[conditional]. Students who were enrolled in the III grade were among the factors considered when selecting the sample for this study. The III graders were picked out of the other classes since they missed two years of schooling due to the COVID-19 outbreak and lacked basic numeracy skills.

The research did not interfere with the academic schedule leading up to the final exams.

THE CRA APPROACH



1. Teach pre-requisite mathematical concepts.
2. Teach and practice modelling procedure concretely.
3. Connect the concrete to representation of the concrete.
4. Practice modelling procedures representationally.
5. Connect the representation to the abstract symbols.
6. Practice the abstract modelling of the procedure.

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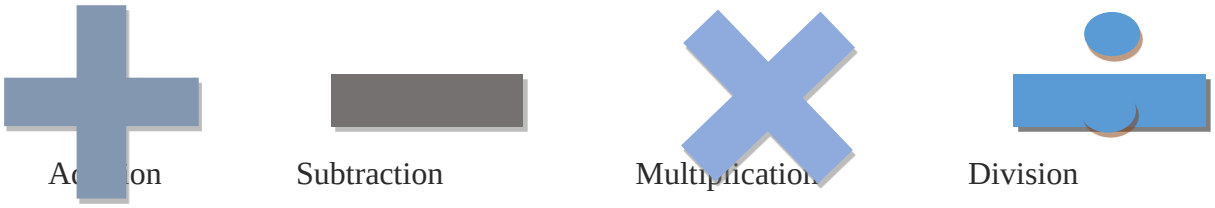
7. Make the connection between all three models to help students.

(*To monitor their thinking and choice of representation. Provide opportunities for student choice.)*

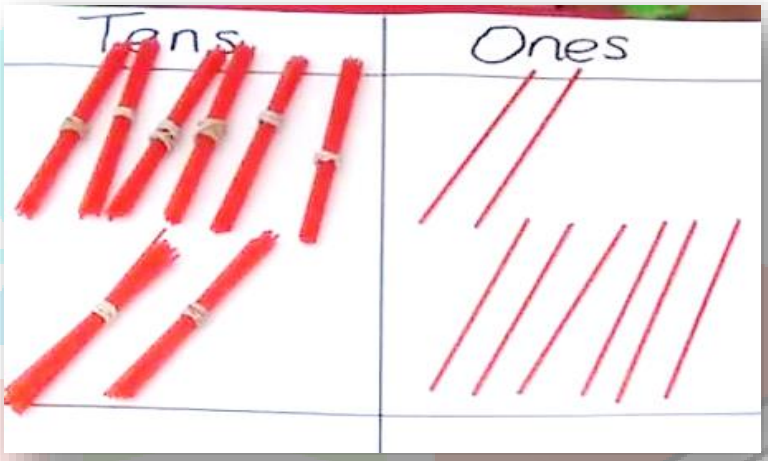
The CRA technique is more important for achieving numeracy goals in FLN.

"The Four Operations" are being used to model how CRA walks.



Addition Subtraction Multiplication Division

Children found it beneficial to utilize familiar objects when learning column addition in its preliminary stages. For instance, straws or lollipop sticks can be bundled into groups of ten and used separately to represent the tens and ones. When kids feel comfortable utilizing these tools to create two-digit numbers, they can lay them out on a baseboard to represent the two numbers in a column addition computation.

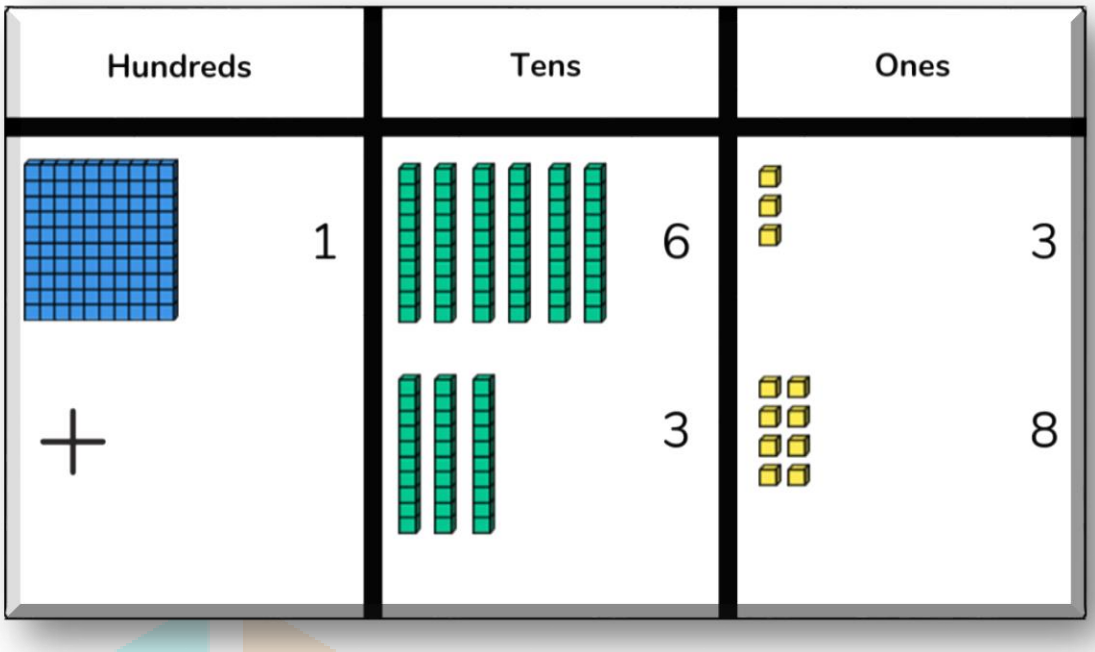


(In the Concrete approach, a teacher uses lollipop sticks to distinguish between the digits.)

Before processing the calculations involving exchanging/regrouping, students first finish computations where the units do not add up to more than nine. Children can annotate the baseboard with the digits being used in addition to the concrete resources, which strengthens the connection between the abstract formal technique and the concrete resources.

When kids are comfortable using the physical resource, they can then record them symbolically while also documenting the numerals to ensure that connections between the concrete, symbolic, and abstract levels are continuously being created.

The following phase is for kids to advance to using more formal mathematical tools base. Straws should be introduced together with 10 blocks so that kids may see what's the same and what's different as their confidence builds and they use the best and blocks. Children can be taught how to add 3-digit and 2-digit numbers together using the 100-column method.



(A simple illustration of the representational stage of column addition using blocks of base 10)

Children should note the numbers on the baseboard and could also record representational representations in addition to the tangible resources. Base 10 blocks can be swapped out for place value counters once students are entirely comfortable with the meaning of digits and the base-10 nature of our number system. Contrary to base 10 blocks, this aids kids when they advance to the abstract. All of them are the same size.

(An illustration of using a counter as a transitional step between physical and abstract processes.)

Children should utilize the baseboard without regrouping when this is introduced, just like with the other resources. then moving on to calculations that require regrouping.

Children should have the chance to record the digits with the physical resources, just like with the other tools, and then move on to recording representationally once they are comfortable. Children can be introduced to numbers, calculating column editions, using place value counters.

DATA ANALYSIS

Conventional method						
			Pre-Test (10 marks)		Post-Test (10 marks)	
Sl. no.	*Name of School*	*No. of Pupils*	*Mark secured*	*Avg*	*Mark secured*	*Avg*
1.	*Khamatana UGUP*	*11*	*38.5*	*3.5*	*44*	*4*
2.	*Sahupada PRY*	*08*	*32*	*4*	*36*	*4.5*
3.	*Gandarda PRY*	*06*	*22.5*	*3.75*	*24*	*4*
	Total	***25***	***93***	***3.72***	***104***	***4.16***

Table No. 1

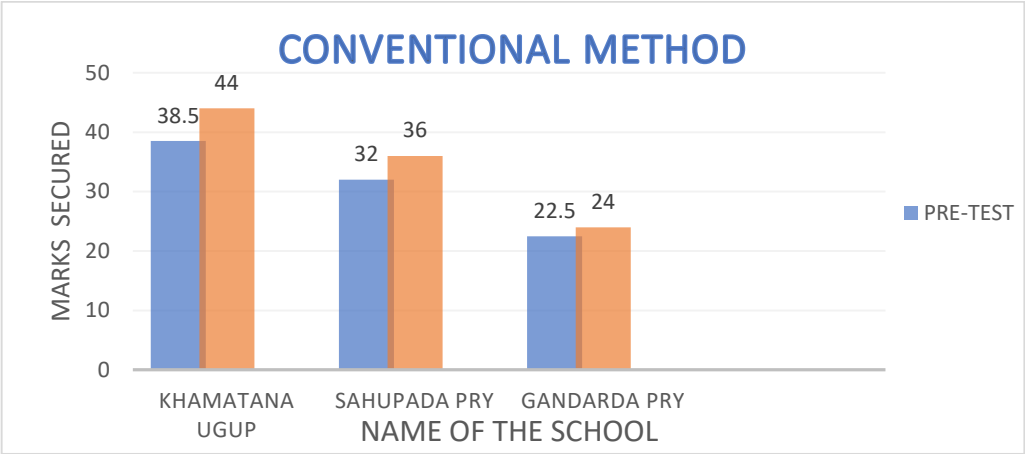
CRA Approach						
			Pre-Test (10 marks)		Post-Test (10 marks)	
Sl. no.	*Name of School*	*No. of Pupils*	*Mark secured*	*Avg*	*Mark secured*	*Avg*
1.	*Khamatana UGUP*	*12*	*36*	*3*	*93*	*7.75*
2.	*Sahupada PRY*	*07*	*29.75*	*4.25*	*56*	*8*
3.	*Gandarda PRY*	*06*	*24*	*4*	*49.5*	*8.25*
	Total	***25***	***89.75***	***3.59***	***198.5***	***7.94***

Table No. 2

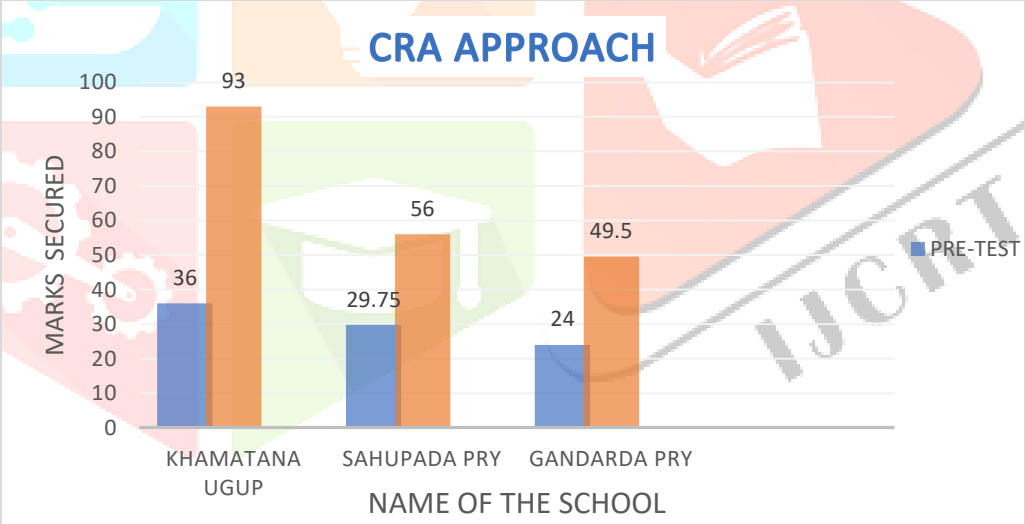
RESULTS

- 25 students were given pre-test having 10 marks and scored 93 in total out of 250 and average was 3.72 and after receiving the Traditional Method, these students scored 104 in total and average was 4.16 after post-test.
- Another group of 25 students were given pre-test and scored 89.75 out of 250 and average was 3.59 and after receiving the new methods of learning i.e. the Concrete Representational Abstract (CRA)

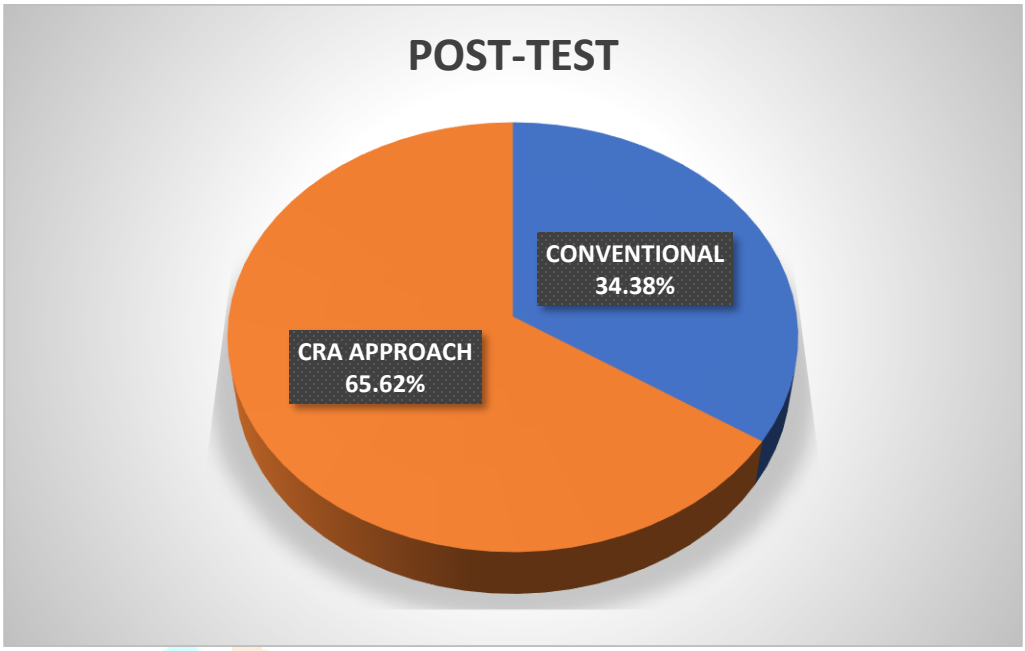
approach and after the follow-up test, these same students received a score of 198.5 out of 250 and average was 7.94.



(Comparison of Pre-Test and Post-Test Marks in Conventional Method)



(Comparison of Pre-Test and Post-Test Marks in CRA Approach)



(Conventional and CRA Approach Post-Test Results Comparison)

DISCUSSION

It has been found that in traditional approach there is no substantial improvement in their learning and what has been increased it is not up to the minimum level of learning.

In second observation it has been clearly identified that in general pre-test is administered but still there is no substantial results found. After administration of CRA approach there has been substantially improvement in learning concept and scored more than which was never. Pre-test score 89.75 is increased to 198.5 after post-test and averagely increased 4.35.

The results show that both teaching methods, Traditional Method and CRA approach, second one is more impact on students learning. They eagerly enthusiastically try to learn through constructive approach which improve their inquisitiveness and interest in Mathematics.

Here the teachers are only the facilitator to facilitate the learners through CRA approach and build of the new concept of learning of Numeracy.

It is important to note that these results are only based on a small sample of students, and further studies with larger samples are needed to determine the overall effectiveness of the two teaching methods. Also, other factors such as the students' background knowledge and learning styles may have influenced their scores, so it is important to take these into consideration when interpreting the results.

CONCLUSION

The foundational literacy and Numeracy are the milestone of the beginners those who are coming to schools. The approaches which have been implemented, bridge the gap between lack in and concrete knowledge to construct a new knowledge. The findings of this study show how crucial it is to include both physical and abstract ways to express mathematical ideas in both teaching and learning. While the use of abstract representations offers a way to link these concepts to more general mathematical ideas and real-world applications, the use of concrete manipulatives, visual representations, and other firsthand materials aids students in developing a foundational understanding of mathematical concepts. It has been demonstrated that using a blend of tangible and abstract representations effectively promotes numeracy and enhances math instruction.

Students who received instruction using the CRA approach considerably improved their numeracy skills compared to those who got traditional instruction. The total academic performance of pupils who used the CRA technique fell into the high improvement category. While conventionally educated pupils' achievement fell into the area of mediocre improvement. Since the results of this study show that students who received learning with the CRA approach improved significantly more than students who received learning with the conventional approach, the application of learning with the CRA approach may be an alternative solution to developing and improving students' numeracy of FLN.

The outcomes of this study also shed light on the CRA approach's potential as a tool for developing numeracy, particularly among students who might have difficulty with conventional methods of arithmetic instruction. The CRA approach can assist children in developing a lifetime love of math and a sense of its significance in daily life by creating a deeper grasp of mathematical concepts. However, there are certain limitations to this study, and more investigation is required to properly grasp the potential of the CRA technique. Future research can look at the long-term impacts of this strategy and investigate how it might be used in other branches of mathematics, like geometry, algebra, and calculus. Additionally, additional investigation is required to identify the most efficient methods for implementing the CRA approach in the classroom.

In conclusion, this study has shown that the Concrete Representational Abstract (CRA) strategy, as opposed to the conventional technique, is more effective at enhancing numeracy skills. Students were able to develop a deeper knowledge of mathematical topics and enhance their capacity to apply these concepts to real-world scenarios using the CRA technique.

Hence, teachers should inculcate in this era to improve the CRA approach in low cost and know cost TLM for better learning and understanding.

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