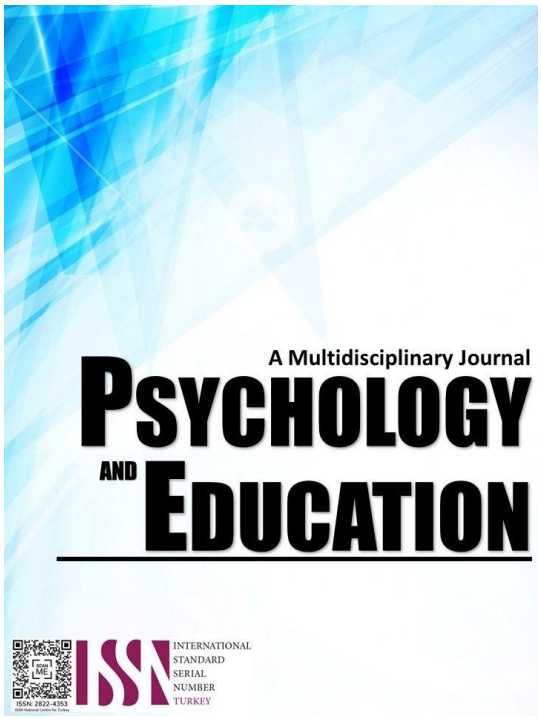
CONCRETE-REPRESENTATION-ABSTRACT SYMBOLS AS A STRATEGY IN TEACHING NUMERACY IN KINDERGARTEN: AN INSTRUCTIONAL TOOL



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Research Article

Concrete-Representation-Abstract Symbols as a Strategy in Teaching Numeracy in Kindergarten: An Instructional Tool

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Abstract

This study introduced the Concrete- Representation- Abstract Symbols Method as an instructional tool for Early Numeracy to the identified Kindergarten Learners of Dumanjug 1 District for School Year 2022-2023 as a basis for an instructional tool. This study used a Mixed Method Research Design simultaneously collecting data for quantitative and qualitative research. A quasi-experimental method was used in the study to determine its effectiveness where the Kindergarten pupils received before the CRA Method and the experimental group experience after the CRA Method. It indicates that the t-value is -21.75935 and the p-value is 0.00 which provides a significant result. With the current situation that the kindergarten pupils are having difficulty in mastering the numeracy skills, it is expedient to utilize different strategies and approaches that can be tested and when proven effective, it should be meant to be shared among all teachers in the kindergarten. This study recommends that teachers can provide lower-level students with hands-on activities and immediate feedback on classwork, so the pupils see success from their effort.

Keywords: *numeracy, concrete-representational-abstract symbols (CRA), quality education, mathematics, kindergarten*

Introduction

Mathematics widely navigates decisions in our daily lives. From birth, children begin to experience and investigate mathematical concepts. It is essential to have a strong support system in Mathematics for children to achieve academic success. Several factors influence children's math learning, including lesson content, learning instruction quality, and attitude toward math learning (Schaeffer et al., 2020). Mathematical abilities are crucial for school performance and children's future educational attainment (Korhonen et al., 2020). To improve and strengthen analytical and numerical thinking the children, it needs academic support from the agents of learning.

Students need to be literate in numbers to use mathematics in everyday life. They must learn to value the use of counting numbers and to be aware that having mathematical knowledge is a skill they must possess using it with purpose. One of the reasons why someone finds it difficult to land a job and hinders his career development is because of poor numeracy. A graduate's numeracy skills become his advantage as employers include tests about it in the hiring process (Durrani, 2017). Therefore, it is essential for children to learn numeracy at an early age as it plays a big role in their journey toward the future (Mealings, 2022). In the case of incompetent mathematical progress, it has become more prominent; however, evidence from comparative studies has suggested that little advancement has been made in finding a solution (Hodgen, 2021).

Furthermore, it was a constant requirement for kindergarten students to be Grade 1 ready. Cotcoton Elementary School has already adopted the K-12 Basic Education Curriculum to meet the DepEd vision and goal. Teachers are encouraged to incorporate cooperative learning practices and technology into their classroom instruction. The grading method adheres to the classroom evaluation mandated in K the o 12 Basic Education Curriculum as specified in DepEd Order No. 8, series of 2015. The effect of restrictions does not only affect those learners who were in already but also the young ones in kindergarten who are not given necessary school readiness instructions. This should be an essential part of the beginning of education at school.

Cotcoton Elementary School teachers determined from data collection that the school has low levels of literacy and numeracy during the development of the School Improvement Plan. Furthermore, the school must navigate some extremely difficult aspects of the route. According to the PHIL-IRI findings, 12.24% of students in Grades 1-6 identify as frustrated. 65% of students in the Early Grade Mathematics Assessment (EGMA) were non-numerates, which means they had not mastered the subject's skills. One underlying reason for this gap is a lack of focus on concrete learning, a negative attitude toward learning the subject, a short attention span, and poor mathematical retention in the subject areas.To address learning

challenges, teachers look for interventions and innovations that meet the needs of kindergarten students as a head start in the educational process. The article by Ahmad (2022) suggested that when a child learns to do math at early age, it would result to better academic performance and be more often confident in their decisions. Therefore, it's good for children to lean numeracy at early age.

The essence of utilizing the Concrete-Representational-Abstract method is to break down abstract concepts into simplified topics in order for the learners to understand and comprehend the concepts with the use of the physical and visual aids (Durrani, 2017). In this method, manipulation of concrete and tangible objects is facilitated in providing direct-purposeful meaningful learning experiences especially those learners in the early years. The Concrete-Representational-Abstract method is anchored from Brunner's Theory wherein the three stages of cognitive development were specified such as the action-based or the enactive, the iconic or the image-based, and lastly, the symbolic or the language-based (Dennis et al., 2017).

Basically, learners will be able to attain concrete experiences or action-based where they can manipulate and explore. They can create images out from the manipulation and they can construe representation of idea where they can make more sophisticated diagrams and representations (Hinton, 2019). With this diagrams, abstract or symbolic notation will take place. The learning experiences can provide significant learning opportunities that may assist them to have an image figure because the process in attaining this is not through linear fashion but can be built into visual models (Flores, 2022). This can be absorbed in a symbolic way from complex ideas wherein this can be deepened and substantiated. Concrete manipulatives are very essential in the kindergarten level where the foundation of numeracy skills should be developed and honed (Korhonen et al., 2020).

The researcher considered initiatives to solve learning difficulties and challenges to reduce non-numerates of Grades 1-3 learners from 65% to 0% from SY 2022-2025. One of the innovations is using concrete-representational-abstract (CRA) methods in learning instruction. A variety of representations are being used to show different concepts is what CRA is all about. This enhances one's conceptual understanding and rationalizing mathematics (Flores, 2022).The Concrete- Representation- Abstract Method was also the subject of Dennis et al. (2017). It was intended to examine and supplement evidence-based data and be recommended to the teachers as an intervention to increase the number of learners who finds Mathematics interesting. The authors added that by identifying how many students that needs intervention, better education can be acquired. This study aims to enable the researchers to determine the effectiveness of the Concrete-Representation-Abstract Symbols as an underpinning for an instructional tool in teaching Early Numeracy at Cotcoton Elementary School and Lawaan Elementary School-Dumanjug 1 District.

Research Questions

This study assessed the Concrete- Representation-Abstract Symbols Method as an instructional tool for Kindergarten Pupils in the identified Elementary Schools of Dumanjug 1 District, Cebu, for School Year 2022-2023 as a basis for an instructional tool.Specifically, this study answered the following questions:

1. What is the pupils' level of understanding of number concepts before and after using the Concrete-Representation-Abstract Symbols Method, particularly addition, subtraction, and fraction?
2. Is there a significant difference before and after using the Concrete- Representation Abstract Symbols Method of teaching and learning early numeracy?
3. What is the academic performance of the pupils in learning numeracy?
4. What are the teachers' experiences before and after using CRA Method in teaching early numeracy?
5. Based on the result of the study, what instructional tool in teaching numeracy can be proposed?

Hypothesis

At a 0.05 alpha level of significance, the hypothesis of the study was tested. There is no significant difference between before and after using the Concrete Representation and Abstract Symbol Method in teaching and learning Early numeracy in kindergarten pupils.

Methodology

Design

This study used a mixed method research design specifically a Sequential Explanatory research design. This design is usually used to studies wherein an

experimental quantitative data be triangulated with the qualitative data. The research deployed an instrument that will provide a significant value of knowing the knowledge difference of the learners in numeracy and after that, the teachers were interviewed in looking for justifying the gathered numerical data. Using this method, the results will be a good reference in making the output of the study.

Respondents of the Study

The respondents of this study were 70 Kindergarten pupils in Cotcoton Elementary School and Lawaan Elementary School, Dumanjug District 1. The ethics of volunteerism research were upheld before the instrument was administered to the respondents. The respondents will aware that their participation is voluntary and that they could revoke their consent at any time and guarantee that the respondents' information will be managed with the utmost confidentiality and anonymity.

Instrument

This study utilized two (2) instruments in conducting the Kindergarten Instructional Numeracy Tool. For the qualitative, the researcher makes interview guide questions for demographic profiling of the respondents and teachers' experience before and after using the intervention. In quantitative, the researcher modified the Kindergarten Instruction Numeracy Tool in identifying the performance of the respondents while applying the Concrete- Representation- Abstract Symbols Method. In order to identify the learning gaps in numeracy skills, the pretest questionnaire will first be used as a diagnostic assessment tool. The source instrument is adopted the "Numeracy Checklist" instrument created by the Department of Education - Division of Cebu Province. The researcher created an instructional numeracy tool that applies the concrete-representation-abstract symbols method for the post-test instrument. With the aid of physical and visual aids, this tool will assist Kindergarten students in developing and improving their skills while increasing their understanding of abstract concepts. Furthermore, the tool is validated according to the Most Essential Learning Competencies in Kindergarten Curriculum. With this tool, we can evaluate the effectiveness of the Concrete- Representation- Abstract Symbols Methods in teaching Early Numeracy.

Data Gathering Procedure

The commencement of the data gathering will be realized after obtaining the approval to conduct the study from the immediate heads. Upon getting the approval, the reproduction of the instruments was disseminated to the respondents. The process took one or two weeks to accomplish. All answers are tallied and analyzed upon retrieval of the questionnaire.

Statistical Treatment

1. To establish the profile of kindergarten pupils, the simple percentage formula was used.
2. To find out the level of performance in the kindergarten instruction level of the kindergarten pupils, the Mean Percentage Score (MPS) formula was utilized.
3. To determine whether or not there was a significant difference in the mean scores obtained of the kindergarten pupils in literacy and numeracy, the t-test was used.

Results and Discussion

Table 1. *The Academic Performance of the Kindergarten Pupils for the Second Quarter*

Respondents	*Mean*	*Standard Deviation (SD)*	*Description*
	30.70	8.33	Beginning (B)

Ranges: 100%-81% Outstanding (O); 80%-61% Consistent (C); 60%-41% Developing (D); 40%-21% Beginning (B); 20%-1% Did not Meet Expectation (DNME)

Table 1 shows the academic performance of the kindergarten learners in the second quarter. It can be gleaned that the highest score is 45 interpreted as developing with 5 counts and the lowest score is 14 interpreted as did not meet expectation. The mean score which is 30.70 having 8.33 as its standard deviation is interpreted as beginning which indicates the overall average of the kindergarten pupils for the second quarter is not ideal. The results of the academic performance depicts that there is need to look for an intervention to augment the gap in learning numeracy.

Early numeracy skill is a predictor in knowing the academic performance of a kindergarten pupil in the future (Thomas et al., 2021). Looking into, monitoring and evaluating their scores are helpful steps in testing strategies and new approaches that can aid them to master the skill (Aunio et al., 2019). According to Bradford et al. (2023), the academic performance of the kindergarten pupils is an essential reference in

allowing teachers to look for different ways to improve the teaching-learning process especially in numeracy skills. This implies that the data in table 4 is pertinent in testing strategies that are necessary in improving the academic achievement of the pupils.

Table 2. *The Level of Performance in Numeracy Before and After Using the Concrete- Representation-Abstract Symbols Method in terms of Number Concepts, Addition, Subtraction, and Fractions using the Concrete Representation and Abstract Method.*

		Mean	*Standard Deviation*
Experimental Group (Respondents)	Pretest	14.01	3.31
	Posttest	23.43	1.47

Table 2 revealed the Numeracy skills assessment result of the experimental group which has a total of 70 respondents. It can be gleaned that the pre-test obtained a mean score of 14.01 and 23.43 for the post-test. Furthermore, the standard deviation indicates 3.31 in the pretest and 1.47 in the post-test result. As a result, the school has navigated some extremely difficult aspects of the route of teaching numeracy among the kindergarten pupils. During the pre-test, it shows that the respondents have low numeracy skills and learning delays in solving and understanding number concepts, addition, subtraction, and fraction. Fortunately, in the posttest, wherein the instructional numeracy tool was administered using Concrete-Representation- Abstract Symbols as an intervention tool, it gives a good result.

An effective method and plan are needed to address the persistent problem of poor math performance. It is essential to do this because academic success can be determined using skills in mathematics. Despite the importance of mathematics, it has been found that both teachers and students have difficulty grasping the subject (Hidayat & Prabawanto, 2018). Effective instructional methods should be closely followed in order to improve students' problem-solving abilities for math situations encountered in the real world (Root, 2021). The Concrete- Representation-Abstract Symbols Method has been shown to be the most successful method for raising student math performance in a classroom (Ruştiolu, 2022).

Table 3. *Test of Significant Difference*

	n	*df*	*t-value*	*p-value*	*Remarks*	*Decision*
Pre-test	70	69	-21.75	0.00	Significant	Reject the Null Hypothesis
Posttest	70	69				

Table 3 shows the test of significant difference of the pre-test and posttest scores of the experimental group. In this table, the t-value is -21.75935 and p-value is 0.00. It can be gleaned that the p-value provides a significant result. With this, the null hypothesis should not be accepted. With the 70 kindergarten pupils as respondents of this study, the instructional intervention which is a numeracy tool was tested and verified in terms of its effectivity. With the current situation that the kindergarten pupils are having difficulty in mastering the numeracy skills, it is expedient to utilize different strategies and approaches that can be tested and when proven effective, it should be meant to be shared among all teachers in the kindergarten.

Teaching numeracy among kindergarten pupils is not easy but it is full of fun. This can be manifested on how the teachers find its way to make the teaching-learning process as absorbing as it should be. In the study of Artigas (2023), differentiated instruction was employed in teaching numeracy concepts wherein it garnered a significant difference the same with this study which the numeracy tool was used. Different models can be associated with the way how mathematics is taught in the early years. The study of de Chambrier et al. (2022) corroborated the result of this study by proving that a response to intervention model is effective in teaching kindergarten pupils. Lei and Hu (2020) provided findings on how kindergarten teachers performed action research on how to teach numeracy in the kindergarten. It is important to look into how a kindergarten teacher improves the way the subject is being taught, especially numeracy. By using this instructional intervention, teachers in the kindergarten will be able to have an improved way of providing meaningful learning experiences in the classroom.

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Table 4. *Qualitative Analysis*

Statements	*Subthemes*	*Themes*
Teacher 2: I can observe that my learners are able to interact with one another because of the concrete examples that can concretize their understanding.	Concrete Examples improve interaction	The Power of Concrete Examples
Teacher 1: With the different examples given to the kindergarten learners, I can say that they improve the way how they communicate with their classmates.	Concrete Examples improve communication	
Teacher 4: Some of my kindergarten pupils are having a hard time in understanding a simple math problem. With this strategy, they are able to comprehend and to think critically of the math problems.	Concrete Examples improve comprehension	
Teacher 2: Although this strategy can help the learners to interact with one another, this is also time consuming because the length of their conversation or interaction may not sometimes be controlled.	Time Consuming	The Cost of Quality Education
Teacher 3: I believe that in using this strategy you need to have good and creative instructional materials which in this school we have a problem about this – there's a scarcity of instructional materials.	Limited Instructional Materials	
Teacher 1: I can see how the kindergarten pupils are doing the activities and they are able to manipulate it. With the manipulation that they are doing, I know that they are also learning.	Hands-on Learning	Road to Meaningful Experiences
Teacher 3: This strategy can help a lot of us in improving our way of teaching the basic concepts of numeracy in kindergarten especially if there are enough instructional materials available in school.	Helping Tool	
Teacher 4: In my own observation and personally I can say that the learners are learning. They are able to understand and interact while manipulating something in the activity. I think that learners are developing their skills in numeracy holistically.	Holistic Approach	

The Power of Concrete Examples

The first theme emphasizes how the concrete examples be of great use in teaching numeracy in the kindergarten. With the utilization of concrete examples, learners are able to interact with one another. They are able to connect and relay their message regarding on how to accomplish the activity. The concrete examples are also a way to how the understanding of the kindergarten pupils be concretized. This is also supported by the observations and personal experiences of the teachers in the kindergarten.

Teacher 2 said that,

"I can observe that my learners are able to interact with one another because of the concrete examples that can concretize their understanding."

Teacher 2 was able to see how the concrete examples are of great help in making the abstract ideas and concepts in numeracy among the kindergarten pupils translated into simpler understanding through interacting from one another.

Teacher 1 mentioned that,

"With the different examples given to the kindergarten learners, I can say that they improve the way how they communicate with their classmates."

Teacher 1 noticed that through the concrete examples in the intervention, kindergarten pupils are able to communicate well with their classmates making it a fun learning experience.

Teacher 4 also narrated that,

"Some of my kindergarten pupils are having a hard time in understanding a simple math problem. With this strategy, they are able to comprehend and to think critically of the math problems."

Teacher 4 shows the performance of her kindergarten pupils. She can attest that her pupils are really having challenges in comprehension especially to simple problem in numeracy. She noticed that with the intervention being used, her kindergarten pupils are able to understand math problems better and able to think critically as well.

This theme, The Power of Concrete Examples, is a manifestation that kindergarten pupils can learn numeracy when given concrete examples. The concrete examples can clarify the abstract understanding of the pupils in numeracy. It can also promote interaction and communication among the learners. With this, the intervention aligns its quantitative findings that it is effective.

The Cost of Quality Education

This theme, The Cost of Quality Education, underscores the fact that every quest for excellence in delivering quality instruction comes different challenges and problems. One of the basic issues in the Department of Education (DepEd) is the lack of instructional materials. When a new strategy is tested, it entails materials to be used. This situation is what the teachers in the kindergarten shared.

Teacher 2 said that,
"Although this strategy can help the learners to interact with one another, this is also time consuming because the length of their conversation or interaction may not sometimes be controlled."

The strategy has very ideal results being expected from however, it is also time consuming. It may provide a level of advantages but the limitations are also present. This paves the way to make sure that there is control in managing the class while employing the new strategy.

Teacher 3 mentioned that,
"I believe that in using this strategy you need to have good and creative instructional materials which in this school we have a problem about this – there's a scarcity of instructional materials."

The aforementioned experiences of the teachers are basically what is happening not just to hinterland schools but also to coastal schools. Kindergarten is where the foundation of numeracy should be well exemplified such that it is supported with creatively done instructional materials. However, the scarcity of learning resources may play a vital role in hindering this dream.

The second theme encapsulates the downside of this intervention. It is a matter of fact that in every strategy, there will always be the two sides. It is how the teacher manage the weaknesses of a strategy to become the strength and sustaining what is already established as best practices. In every strategy, the results will always be something that can give meaning. If it is positive then, it is meant to be shared and if it is negative, recommendations may be given as to how the strategy will be further explored.

Road to Meaningful Learning Experiences

This theme, Road to Meaningful Learning Experiences, provided a level of hope in fulfilling the UNESCO's Sustainable Development Goal (SDG) number 4 which is the Quality Education. The different learning experiences among the learners and teachers are pertinent in forwarding better implications and findings that other kindergarten teachers can replicate and utilize. The strategy provided significant learning points that should be taken into account. These experiences are also manifested to the words of the kindergarten teachers.

Teacher 1 said that,
"I can see how the kindergarten pupils are doing the activities and they are able to manipulate it. With the manipulation that they are doing, I know that they are also learning."

The teacher was able to observe that the kindergarten pupils are enjoying while learning. Through manipulation, the pupils attained significant learning experiences.

Teacher 3 mentioned that,
"This strategy can help a lot of us in improving our way of teaching the basic concepts of numeracy in kindergarten especially if there are enough instructional materials available in school."

The teacher explained how important it is to apply this strategy in a kindergarten classroom wherein the foundation of learning numbers is happening. Although at some point, instructional materials will matter as its primary concern but when it is provided, this strategy can definitely build a good foundation in learning numeracy.

Teacher 4 added that,
"In my own observation and personally I can say that the learners are learning. They are able to understand and interact while manipulating something in the activity. I think that learners are developing their skills in numeracy holistically."

Teacher showed a positive output of this strategy which was tagged as a holistic approach in teaching numeracy. The intervention marked significant findings which are necessary in analyzing how effective it is in the kindergarten level. Holistic development is very important among the kindergarten pupils because they are starting to build good foundation towards the subject matter. With this, the kindergarten pupils who had meaningful learning experiences in this strategy can have a better way of looking at how to understand, comprehend and analyze numbers.

The last theme signifies that importance of effect that the strategy brings. It can be noted that this theme summarized the entire intent of the study. The meaningful learning experiences parallels to the significant results that this study was able to yield. Furthermore, the strategy can help the teachers to have a better way of teaching the concept about numeracy. This is how quality education is sustained.

Conclusion

This study introduced the Concrete-Representation-Abstract Symbols as a Strategy in Teaching Numeracy in Kindergarten. The strategy was determined to be effective and construed impactful learning experiences among the kindergarten pupils. Honing the numeracy skills of the pupils served as the basic way of making the foundation of education among the learners stable and holistic. The introduction of this strategy painted a picture of how quality education is sustained in the early years of the pupils' educational journey. In this way, understanding Math will never be that hard when the basic skills of numeracy were honed and developed in the kindergarten years.

The study recommends that reviewing the policies and guidelines stipulated in the DepEd order regarding the utilization of instructional materials because having this reviewed will answer the downside of this strategy. Another recommendation is to have this strategy Concrete-Representation-Abstract Symbols be tested and validated across the district or the division for further findings and implications. It is when the validation of the strategy that can make it better and that can serve its purpose in forwarding quality education. Lastly, this study recommends that this strategy will also be tried in other fields.

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