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Teaching number system through multi dimensional approach to children with hearing impairment

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Abstract

Children with hearing impairments benefit greatly from early detection and methodical intervention when it comes to writing skill development. Children with hearing impairments require curriculum customization throughout the early learning phase in order to develop their reading and writing abilities. Finger spelling is a crucial way to learn the alphabet's differences and applications. Writing words and phrases correctly requires finger spelling. So the present was conducted on "Teaching Number System through Multi Dimensional Approach to Children With Hearing Impairment" was conducted special and Inclusive schools in Coimbatore district. The pilot study used a quasi-experimental design without a control group. The sample of 50 hearing impaired were selected as the experiment group. The dependent variable was the knowing the number system such as Number sense, number name, number value, after number, before number, ascending order, descending order whereas the independent variable was the age group.

Keywords: Hearing impairment, writing skill, Tamil Finger spelling, Number name, arithmetic knowledge, usage of Tamil Alphabets

Introduction

Universalization of schooling has two implications: is considering the quality access to education and material for all children in school mathematics. On the other hand, prepare children to face challenges in life since there are dropouts of children at primary level. Mathematics are about a certain way of thinking and reasoning. Mathematics is a compulsory subject in schools. Baroody (1998) ^[3] provides a summary of research on three different views of mathematics that have been identified among teachers:

- Mathematics as a collection of unrelated basic skills
- Mathematics as a coherent network of skills and concepts (mathematics as a static body of knowledge)
- Mathematics as a way of thinking (inquiry process, mathematics as a dynamic field)

In primary schools, math curriculum incorporated with the principle of simple to concrete and concrete to abstract. Teaching of Mathematical concepts such as number operations. Shapes, measurement and data handling are the basic skills essential in Mother tongue (Tamil) need to build math vocabulary of words. Teaching of math must be introduced with concrete activities using manipulative objects was the first step which helps children to understand the basic logic functioning. This develops the children to improve the higher level of thinking. In addition to mathematical kit, mathematical games using computer software and puzzles are useful to the children to build their knowledge. A review of some of the educational abstracts reveals the trend in mathematics. Research conducted by Kapur (1997) ^[8] in the Fifth Survey of Education Research (1988-92) had pointed out that "the main object of mathematics education research is to be of help in improvement of classroom learning and teaching. It is therefore natural that a large number of studies should be concerned with different aspects of this problem". He went on to suggest various dimensions of this research, including study of effective teachers, instruction based on the use of computer aided and other technology, error analysis, styles of learning among different groups of students, remedial teaching methods, study of attitudes, socio-economic and other personal factors influencing learning. More than two decades later, many of these

issues, in their true sense (in the way we understand the domain and purposes of mathematics education and research in mathematics education), are yet to be researched.

Menon (2004, 2007, 2009) ^[11, 12, 13] has been trying to explore possible alternatives to a variety of topics in primary mathematics curriculum like angles in geometry, place value and understanding of numbers and word problems. This series of studies is highly influenced by the Realistic Mathematics Education approach developed by the Freudenthal Institute (Vanden Heuvel-Panhuizen, 2001) with which Menon combines a Vygotskian perspective (Menon, 2009) ^[13].

The study by N R Das & Karuna Baruah (2015) ^[6] describes prevailing academic scenarios of a representative group of secondary schools in Assam (India) with special references to students performance in general and mathematics performance in particular. The study reveals that mathematics performances of schools are positively correlated with (a) the academic performance of school indicated by school leaving pass percentage and also (b) with the performances in subjects other than mathematics.

Related literature studies given by Subramanian and Verma (2009), Naik and Subramaniam (2008) ^[2], Subramaniam and Naik (2007). These studies use one or more interpretations of fraction (measure, share/ quotient, ratio, operator) and use models for building children's understanding in the primary school and illustrate their reasoning in various problem situations.

Parameswaran (2010) studied the factors which influence high school students' understanding of abstract definitions like graphs or concepts like limits and infinitesimal quantities when they encounter these for the first time.

Rawool (2001, 2007) efforts to document and analyze the effect of simulation of teaching practice on trainee teachers to learn to teach. The programme itself and the study tried to identify elements that are critical for helping trainee teachers to develop a theoretical framework about teaching and learning, finding motivations for student to engage in learning designing and organizing non-traditional learning environments.

Roos (2013) conducted a longitudinal study examining the use of fingerspelling in classroom settings. The study involved six young children learning Swedish Sign Language and focused on their use of fingerspelling in preschool classes. The children were observed at the age of four years, with particular attention given to how they used fingerspelling to understand and analyze names and word structures. The study also included informal observations of teachers' strategies for helping children learn new vocabulary. It was observed that most teachers introduced new words by chunking them and fingerspelling one or two letters at a time, rather than fingerspelling the entire word at once. This approach appeared to provide children with manageable units for learning and understanding new words.

Bull *et al.* (2018) ^[4] – examined the relationship between the Approximate Number System (ANS) and mathematics ability among children with hearing loss. The study compared 75 children with hearing loss and 75 typically hearing children. Children with hearing loss showed poorer performance in approximate number acuity, mathematical reasoning, working memory and short-term memory. The researchers found that ANS, working memory and short-term memory contributed significantly to differences in

mathematical achievement.

Teaching number concepts through multiple representations and activities, rather than relying only on verbal explanations. Number quantities can be introduced using concrete objects, dot patterns, pictures, numerals and visual comparisons

Carrigan *et al.* (2022) ^[5] - . investigated early numeracy development among deaf and hard-of-hearing children. The study included 44 deaf/hard-of-hearing children and 79 typically hearing children and examined the relationship between language and number acquisition. The study emphasizes that language access is important for the development of early numerical knowledge.

For children with hearing impairment, number-system instruction should connect:

Sign language → quantity → number word/sign → numeral → written representation

This provides multiple pathways for understanding numbers.

Mathematics in Indian Schools

Mathematics is about a certain way of thinking and reasoning. Mathematics is a compulsory subject in schools. Baroody (1998) ^[3] provides a summary of research on three different views of mathematics that have been identified among teachers:

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Change in Teaching-Learning Process

The Education system is changing from Teaching into a Learning process. The aim of education is not to fit people into a system but to help them develop their human powers. (Hutchins, 1968). The mathematics education must create a situation in schools: to understand the structure of math concepts and ideas, creating environment that creates joyful learning, practice math for their daily life experiences, explore children to understand meaningful problem and develop logical thinking to enhance conceptual understanding.

The development in Teaching –Learning process at primary level made changes in the innovative idea i.e., Activity based teaching, Child centric approach and joyful learning. The Education departments were taken in service and pre-services programmes. For an effective classroom, the changes must happen in all aspects to enrich the knowledge of children in mathematics

Engage children in math classroom through many ways.

- Provide hands-on activity-based learning method which currently the state has been following
- Peer to peer learning may be collaborative, encourage the children to share their experiences and observations
- Modeling
- Relate the concept to their everyday life experiences and socio-cultural context
- Teaching children in the mother tongue of Tamil language.
- Teach vocabulary to express their own mathematical ideas by framing questions
- Motivates children in terms of appreciation and reinforcement for every good response
- Experimenting to understand the structure of concepts
- Providing experiences beyond textbooks
- Encourage self-learning to use library resources
- Technology has fast emerged in the life of school children. Future classroom will certainly expect teachers to use online resources and software.

Difficulties in Today's Mathclassroom

A few exploratory studies explore to understand the following factors affecting for poor achievement in mathematics.

- Problem among children in understanding the language
- Inadequate classroom teacher preparation
- Mathematical anxiety and fear about calculation and computation
- Poor socio-economic factors
- Lack of inclusive education teachers
- Need of curriculum reform or change
- Lack of technology usage
- Need to increase activities and games
- Lack of Remedial teaching of concept

Significant math deficits can have serious consequences on the management of everyday life as well as on job prospects and promotion. Most common are difficulties with efficient recall of basic arithmetic facts and reliability in written concepts and computation. When these problems are accompanied by a strong conceptual grasp of mathematical and special relation, it is important not to bog the student down by focusing only on remediating computation. While important work on, such efforts should not deny full math education to otherwise capable. The present study aims at finding out "Effectiveness of Multi Dimentional Package for Developing number concept for Children at Primary Level "

Need and Importance of the Study

Mathematics helps the common Man who understands how the world around him functions. Math learning difficulties are common, significant and worthy of serious instructional attention in both regular and special educational classes. Children may respond to repeated failure with withdrawal of effort, lowered self-esteem and avoidance behavior. Many children experience difficulty bridging informal math knowledge to formal school math. To build these connections takes time, experiences and carefully guide instruction. The use of structured, concrete material is important to securing these links not only in the early elementary grades, but also during concept development stages of higher-level math.

An extremely handicapping, though less common math disability, derives from significant visuals- spatial-motor disorganization. The formation of foundation math concepts is impaired in this small sub group of children. Methods to compensate include avoiding the use of pictures or graphics for conveying concepts, constructing verbal versions of math ideas and using concrete material as anchors. The organizational and social problems that accompany this math disability are also in need of long term appropriate remedial attention in order to support successful life adjustment in adulthood.

Teaching basic concept to develop the skill and ability to manipulate the objective in mathematics. This study helps the children to develop the concept and application in their living aspects.

So the present study has resulted in drawing the following conclusions which may be utilized in improving the present state of affairs in the math language of students. Since, the investigator intended to proposed this study would promote development of arithmetic abilities through critical thinking-based package.

Statement of the Problem:

The present study aims to collect the data about the effectiveness of Critical Thinking Based Package as a strategy for developing arithmetic concepts in children at primary level. So, the study is entitled as "Effectiveness of Multi Dimensional Package for Developing number concept for Children at Primary Level

Objectives of the Study

- To identify the current level of number concept among children at primary level.
- To prepare a testing tool to assess the number concept among children with hearing

Impairment

- Picture with Written Mode,
- Picture with Sign Language Mode,
- To develop the intervention package for developing number concept through Multi
- Dimensional Approach for children with hearing Impairment at primary level
- Find out the impact of intervention Package for developing number concept among children with hearing Impairment at primary level with respect to variable such as
 - a) Age
 - b) Gender

Hypothesis

- There is no significant difference in developing number concept before and after intervention of Multi Dimensional Approach among Children with Hearing Impairment at primary level
- There is no significant difference in developing number concept before and after intervention of Multi Dimensional Approach among Children with Hearing Impairment at primary level with respect to various modes
 - a) Picture with Written Mode
 - b) Picture with Sign Language Mode

- There is no significant difference in developing arithmetic concept before and after intervention of Multi Dimensional Approach among Children with Hearing Impairment at primary level with respect to various variable
- a) Age
 - b) Gender

Methodology

Quasi Experimental research is the most useful and powerful method. Hence the investigator will follow the quasi-experimental method to conduct the study on “Effectiveness of Multi Dimensional Package for Developing number concept for Children at Primary Level” The dependent variable was the knowing the number system such as Number sense, number name, number value, after number, before number, ascending order, descending order whereas the independent variable was the age group.

The approaches can be grouped into four dimensions:

Table 1: Multidimensional Approaches Used for Teaching the Number System to Children with Hearing Impairment”

Dimension	Approaches
Conceptual and Counting Approaches	Verbal counting, one-to-one correspondence, cardinality, subitizing
Visual and Concrete Approaches	Ten-frames, hundreds chart, base-ten blocks, open number line
Place Value and Computational Approaches	Partial sums, expanded form, number sequencing
Communication and Exploratory Approaches	Finger spelling/number signs, number discovery, finding out activities

Sample

A random sampling technique will be adopted to select the students enrolled in primary and secondary schools at Coimbatore District. The sample consists of 50 students, in the age group of 9–12 years. Twenty-five boys and twenty-five girls’ students making total 50 were assigned for quasi experimental group randomly. The particulars of the sample are presented under the table.

Table 2: Details of the Sample selected

Number of Students			Grand Total
Age	Boys	Girls	
6-9	13	12	25
9-12	12	13	25
Total	25	25	50

Variables of the study

The variables selected and its level are presented as follows

Independent variable

- **Age:** Age is considered to be variable to find if a significant difference exists between the students of different age groups (9 to 13 years)
- **Gender:** Gender is chosen as to determine to find out the significant difference in effect of CTB package in

developing arithmetic concept among children at primary level.

- **Grade:** Education Standard status is taken as the variable to study whether grade influence the effect of CTB package in developing arithmetic concept among children at primary level.

Dependent variable

The performance of the students in their grade level curriculum based arithmetic concept before and after will be consists as the dependent variable.

Training Package

The number concept for each grade will be used the guidance of the experts. (Already it’s available in their subject book). Major concern is to use the critical thinking-based Multi Dimensional package for enhancing number concept among children at primary level. The content of the critical thinking-based package will be based on their grade level curriculum. Critical thinking-based package consists of Number system,

Tools selected

As the present investigation is to analyze the Multidimensional Approaches Used for Teaching the Number System to Children with Hearing Impairment at Primary Level

Description of the tool:

The tool was constructed in the following sections.

- Selection I – The checklist consists of personal data of the individual.
- Selection II- The number concept for each grade level based on their curriculum

Design of the Study

Procedure: The study will be conducted in 4 phases.

- **I phase**
The samples will be selected and rapport will be created with the samples.
- **II Phase**
Pre test will be conducted based on number concept for both groups of same age to assess their existing arithmetic abilities in math language on the basis of obtained scores in the test.
- **III Phase**
Once the pretest will be completed, an effective intervention will be implemented with the help of multi dimensional approach based package on critical thinking to reach and teach the experimental group of children at primary level for developing their arithmetic skills based on their grade level.
- **IV Phase**
A post test will be conducted after the one month of intervention is over. The already applied math test based on their grade level curriculum in pre test will be used as posttest. The scores comparison will be made to see the difference in pre and post test on gained scores of the students.

Table 3: Teaching the Number Sense to Children with Hearing Impairment

Particulars	Categories	No. of Samples	Pre- test %	Post- test %
Age	6– 9 years	25	28.96	74.83
	9 – 12 years	25	31.48	74.82

Table 3 shows that , The pre-test and post-test findings based on age indicate a considerable improvement in the performance of participants in both age groups. Among the 6–9 years age group (n=25), the mean percentage increased from 28.96% in the pre-test to 74.83% in the post-test, showing an improvement of 45.87 percentage points. Similarly, among the 9–12 years age group (n=25), the percentage increased from 31.48% to 74.82%, representing an improvement of 43.34 percentage points. The findings demonstrate that both age groups benefited substantially from the intervention. The slightly higher gain among the 6–9 years group suggests a marginally greater improvement, while the almost identical post-test scores indicate that the intervention was effective irrespective of age group

Table 4: Development of Number Name Skills among Children with Hearing Impairment

Particulars	Categories	No. of Samples	Pre- test %	Post- test %
Age	6– 9 years	25	12.96	64.53
	9 – 12 years	25	22.48	68.42

From the above table 4, it indicate that , the 6–9 years age group (n=25), the pre-test score was 12.96%, which increased to 64.53% in the post-test. This shows an improvement of 51.57 percentage points. Among the 9–12 years age group (n=25), the pre-test score was 22.48%, which increased to 68.42% in the post-test. The improvement was 45.94 percentage points. Both age groups demonstrated a substantial increase in post-test performance compared with their pre-test performance. The 6–9 years group showed a greater improvement (51.57 percentage points) compared with the 9–12 years group (45.94 percentage points). However, the 9–12 years group obtained a slightly higher post-test score (68.42%) than the 6–9 years group (64.53%).

Table 5: Teaching and Learning of Number Value among Children with Hearing Impairment

Particulars	Categories	No. of Samples	Pre- test %	Post- test %
Age	6– 9 years	25	30.48	75.09
	9 – 12 years	25	31.29	74.21

The table 5 states that, the findings indicate that the participants in both age groups had relatively low to moderate performance during the pre-test, with scores of 30.48% and 31.29%, respectively. Following the intervention, there was a marked improvement in performance, with both groups achieving approximately 74–75% in the post-test.

The 6–9 years age group demonstrated a slightly higher gain of 44.61 percentage points compared with the 42.92

percentage-point gain observed among the 9–12 years group. However, the difference in improvement between the two groups was relatively small.

The nearly similar post-test scores suggest that the intervention was effective for participants in both age groups. The results further indicate that the intervention produced positive outcomes irrespective of age, with both younger and older participants showing considerable improvement

Table 6: Developing Next Number Knowledge in Children with Hearing Impairment

Particulars	Categories	No. of Samples	Pre- test %	Post- test %
Age	6– 9 years	25	21.66	72.83
	9 – 12 years	25	21.98	78.82

The table 6, indicate that both age groups had low levels of performance during the pre-test, with scores of 21.66% and 21.98%, respectively. Following the intervention, there was a marked increase in performance in both groups.

The 6–9 years group improved from 21.66% to 72.83%, while the 9–12 years group improved from 21.98% to 78.82%. The greater gain observed among the 9–12 years group suggests that the intervention may have been particularly effective for the older participants.

The difference in pre-test scores between the two groups was very small (0.32 percentage points), indicating that their initial levels of performance were almost similar. However, after the intervention, the 9–12 years group attained a post-test score approximately 6 percentage points higher than the 6–9 years group. Overall, the findings suggest that the intervention was effective in improving the targeted skills or performance of participants in both age groups, with comparatively greater improvement among the 9–12 years age group.

Table 7: Developing Before Number Knowledge in Children with Hearing Impairment

Particulars	Categories	No. of Samples	Pre- test %	Post- test %
Age	6– 9 years	25	20.96	77.23
	9 – 12 years	25	28.48	72.32

From the above table 7, The analysis based on age indicates a considerable improvement in the performance of participants from pre-test to post-test in both age groups. Among the 6–9 years age group (n=25), the pre-test percentage was 20.96%, which increased to 77.23% in the post-test, indicating an improvement of 56.27 percentage points. Among the 9–12 years age group (n=25), the pre-test percentage increased from 28.48% to 72.32%, representing an improvement of 43.84 percentage points. Although the 9–12 years group had a comparatively higher pre-test score, the 6–9 years group demonstrated a greater improvement and achieved a higher post-test score. The findings suggest that the intervention was effective in enhancing the targeted skills or performance of participants in both age groups, with comparatively greater improvement observed among the 6–9 years participants.

Table 8: Enhancing Ascending Order Skills through a Multi-Dimensional Approach among Children with Hearing Impairment

Particulars	Categories	No. of Samples	Pre- test %	Post- test %
Age	6– 9 years	25	18.96	76.83
	9 – 12 years	25	22.48	73.82

From the above table 8, The analysis based on age reveals a considerable improvement in the performance of participants from pre-test to post-test in both age groups. Among the 6–9 years age group (n=25), the pre-test percentage was 18.96%, which increased to 76.83% in the post-test, indicating an improvement of 57.87 percentage points. Similarly, among the 9–12 years age group (n=25), the pre-test percentage increased from 22.48% to 73.82% in the post-test, representing an improvement of 51.34 percentage points. Although the 9–12 years group had a slightly higher pre-test score, the 6–9 years group demonstrated a greater improvement and achieved a higher post-test score. The findings indicate that the intervention was effective in enhancing the targeted skills or performance among participants in both age groups, with comparatively greater improvement observed among the 6–9 years age group.

Table 9: A Multi-Modal Approach to Developing Descending Order Knowledge among Children with Hearing Impairment

Particulars	Categories	No. of Samples	Pre- test %	Post- test %
Age	6– 9 years	25	24.96	68.53
	9 – 12 years	25	33.48	76.42

After the intervention, the result of table 8 exhibit that , there was a substantial improvement in the performance of both groups. The 6–9 years group improved by 43.57 percentage points, whereas the 9–12 years group improved by 42.94 percentage points.

Although the younger group demonstrated a marginally greater improvement, the older group achieved a higher post-test score. The difference in improvement between the two groups was only 0.63 percentage points, suggesting that the intervention produced a broadly similar level of improvement across the two age groups. Overall, the results suggest that the intervention was effective in improving the targeted skills/performance among participants in both age groups. The higher post-test score of the 9–12 years group indicates comparatively better achievement after the intervention

Conclusion

“Numbers and letters, they are known as Eyes to humans, they are.” Kural 392

In general, the educational needs for all children are unique in nature. Language disabilities even subtle ones, can interfere with math learning. In particular, children have a tendency to avoid verbalizing in math activities, tendency often exacerbated by the way math is typically taught in other countries. CTB package is used to transform the classroom processes into learning centric with a set of bench mark and it provide additional inputs for students in the content. The Activities incorporated in CTB will encourage students to kindle the inquisitiveness of students in learning mathematics and to make the students to have a diverse thinking

The main focus of the study highlights the impact on “Effectiveness of multidimensional approaches for Developing number concept for Children at Primary Level” before and after training. While doing so, it was proposed to study the acquisition of critical thinking among the students.

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