A Mixed Method Study on the Cultural and Academic Correlates of Pre-Mathematical Skills among Early Grade Learners

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Abstract- *It is empirical from the research findings of last couple of decades that mathematics learning has a significant contribution to individuals' cognitive as well as intellectual abilities. Mathematics is one of the best means to inculcate the enrichment of different higher order thinking skills like critical thinking, creative thinking, and analytical thinking as well as reasoning skills. When we analyze the style and strength of mathematics learning of learners it is understood that Mathematisation of mind starts at the early childhood when learners start acquiring pre-mathematical skills. Pre-mathematical skills are the set of mathematical skills learned by early grade learners including pre-school learners. These skills include learning to count numbers, learning the proper sequencing of numbers, learning to determine which shapes are bigger or smaller, learning to count objects on a screen or book, the correct pronunciations of numbers. These also include the primary ideas on volume, measurement and concepts of more/ less etc. In the present study seventy early grade learners are studied. In the first half of this paper Pre-Mathematical Skill is quantitatively analyzed in relation to academic correlates like years in schooling process, medium of instruction, public or privately managed schools and cultural correlates like ethnicity as well as socio-economic experience of the learners. The second part deals with the analysis of qualitative information on Pre-Mathematical Skills followed by educational implication of the study.*

Key Words: *Pre-Mathematical Skill, Mathematization, Thinking Skills.*

Introduction

Since the dawn of civilisation, mathematics has been recognised as one of the central stands of the human intellectual activity. A person may be rich or poor, healthy or weak, white or black, may rural or urban sector, lowest or highest class of society, but mathematics is a must for one and all. Our modern way of life would hardly have been possible without mathematics. Mathematics develops power of acquiring and applying knowledge as well as lead towards thinking, reasoning, judgment and generalization. Realizing the importance of mathematics in daily life, it has been incorporated as a compulsory subject in all stages of school curriculum. In

Indian context irrespective of opinion of different stakeholders analysed, many a time it is commonness in misunderstanding is that getting something correct or getting something incorrect is more important in mathematics. But NCF 2005 clearly depicts that enhancement of learner's abilities for mathematisation of mind is the most important goal of mathematics education. The narrower sense school mathematics is supposed nurture functional capabilities relating to numbers and their number operations, measurements, decimals and percentages. The higher aim is to develop the child's capabilites to think and reason mathematically, to pursue assumptions to their logical conclusion and to handle abstraction. It includes a way of doing things, and the skill and the attitude to formulate and solve problems etc.

Mathematics Achievement

Mathematics occupies an important place at all levels of schooling. Mathematics is a tool used in many fields of life and industries; including banking, health, natural science, engineering, social science and applied mathematics. Applied Mathematics gave rise to another disciplines such as statistics and game theory.

Everybody uses mathematics whether they realise it or not. Shoppers use mathematics to calculate change of tax, and sales prices. Cooks use mathematics to modify the amount a recipe will make. Vacationers use mathematics to find time of arrivals and departures to plan their trips. Even home owners use mathematics to determine the cost of materials when doing projects. Mathematics is like oxygen; without it we can't live. This subject seeks to understand the pattern that permeates both the world around us and mind within us.

In order to understand mathematics a learner needs abilities like attenti, memory and higher order thinking skills. The present research gives importance to meta-cognition and emotional intelligence, so we have to go in the direction of higher order thinking skills (HOT). Higher order thinking involves learning of complex judge-mental skills such as critical thinking and problem solving. Higher order thinking is more difficult to learn or teach but is useful in novel situations. In Bloom's classification of HOTS, for example skills involving analysis, evaluation and synthesis are thought to be of higher order thinking. Bloom's taxonomy was created in 1956 under the leadership of educational psychologist Dr. Benjamin Bloom. He identified three three domains of learning i.e. Cognitive: mental skills (Knowledge), Affective: feelings or emotional (Attitude) and Psychomotor: Manual or physical skills.

These three domains are classified into further subdivisions starting from the simplest behavior to most complex ones. This includes recall or recognition of specific facts, procedural patterns and concepts that serve in the development of intellectual abilities and skill. There are six major categories which are listed below. Starting from the simplest behavior to most complexes, the categories can be thought as degrees of difficulties. That is, first one should be normally mastered before the next one can take place. The present study deals with the achievement of learners in mathematics in the cognitive domain. The following table gives a detailed description of the cognitive domain.

Table: 1 Cognitive Domain

Category	**Keywords**
Knowledge (Recall data or information)	Arranges, defines, describes, identifies, knows, labels, lists, matches, names, outlines, recalls, recognizes, reproduces, selects, states.
Comprehension (State the problem in one's own words)	Comprehends, converts, defends, distinguishes, estimates, explains, extends, generalises, gives examples infers, interprets, paraphrases, predicts, rewrites, summarises, translates.
Application (Applies what was learned in the novel situations in the work place)	Applises changes, computes, constructs, demonstrates, discoves, manipulates, modifies, operates, predicts, produces, relates, shows, solves, uses.
Analysis (Concepts into component parts)	Analyses, breaks down, compares, contrasts, diagram's, deconstructs, differentiate, discriminates, distinguishes, identifies, relates, selects, separates.
Synthesis (Put the parts together to form a whole)	Categorises, combines, compiles, composes, creates, devices, designs, explains, generates, modifies, organizes, reconstructs, relates, tells, writes.
Evaluation (Make judgments)	Appraises, compares, criticises, critiques, defends, describes, discriminates, evaluates, explains.

Background of the Study

The present study is the extension of a mathematics achievement study where the researcher was involved in assessment of mathematical skill among early grade learners for government of Odisha. In this process students were assessed by giving test of their lower grade i.e. class two and three students were assessed with question of class one, class four and class five students were assessed with questions of class two and so on. The questions were competency based where the students were supposed to make small mathematical operations in order to answer the questions. The results of this assessment were quite surprising. Students were not performing up to the expectation. The following table depicts the results of the assessment test.

Table : 2 Seaves Assessment Test

School No.	Number of Students appeared the Test	Students Scored 60% in Maths
1	22	1
2	25	7
3	21	21
4	21	19
5	25	20
6	10	6
7	9	6
8	30	22
9	16	10
10	30	25
Total	209	160

Form table 2 it is evident that 24% of class two and class three learners donot have the competency level of class one. This poor result motivated the reserchers to go for in depth study about reasons behind the above observation. It is well accepted that pre-mathematical skill plays a very crucial role in learning mathematics at all levels of schooling. Hence components of pre-mathematical skill were analysed in order to design the pre-mathematical skill checking assessment technique.

Pre Mathematical Skill

Pre-mathematical skills are skills learned by preschoolers and early graders including learning to count numbers, learning the proper sequencing of numbers, learning to determine which shapes are bigger or smaller, and learning to count objects on a screen or book. Pre-math skills are also tied into literacy skills to learn the correct pronunciations of numbers. Following atr the categories of pre mathematical skills:

Practice Estimating Measurements

Learners practice estimating measurements and amounts. For example: How many blocks will fit in that box? How many glasses of water will it take to fill that sand pail? Test to see how close estimates were. Repeat estimations and testing, to improve estimation skills.

Understanding Time

Learners understand time as something measured by clocks, in hours and minutes. Begin to develop understandings of lengths of time, by having time limits set on activities – for example: "Let's color for 5 more minutes." "Everyone has 10 seconds to sit down: 10, 9, 8, 7…." Start to develop an understanding of timings of a day – after breakfast, after lunch, before nap time – and begin to understand time in larger units, such as days: yesterday, tomorrow.

Making Comparisons

Learners focus on how big, little, long or short things are, and figure out how to tell them. Compare objects of different sizes and lengths, using the same unit of measurement. Find convenient units of measurement other than rulers – for example, cereal boxes or yogurt containers. Use measurements in daily activities – water play, cooking, science experiments.

Connecting Types of Measurement

Learners begin to connect kinds of measurements with common tools of measurement and units of measurement, including:

- bathroom scales tell us how heavy a person is (weight) in pounds
- rulers and yardsticks tell us how tall (height) or long (length) something is, in inches and feet
- thermometers tell us how warm (temperature) something is, in degrees

Counting out Loud

Learners count out loud from 1 through 10 (or beyond). Begin to recognize and name written numbers from 1 through 10.

Counting Objects

Learners count objects, one at a time, using one number name for each object, up through 10. Answer "how many?" questions about groups of objects. Use fingers to count.

Sorting Objects into Groups

Learners sort objects into groups by shape, color or size. Re-sort objects into different groups - for example, after sorting blocks by size, re-sort them by color. Pair objects by shape, color or size.

Numbers in Everyday Life

Learners develop awareness of numbers in everyday life, and think through answers to questions about what the numbers tell them. What numbers are on this price tag? What do you think these numbers tell you? What is the number inside your shoe? Is the number same in everybody's shoes? What do you think these numbers tell you?

Connecting Counting to Adding

Learners Count three blocks in a row ("1, 2, 3") then keep counting on when two more blocks are added to the row ("...4, 5").

Recognizing Common Shapes

Learners begin to recognize and name common shapes, including circles, squares and triangles. Look for and identify shapes in the classroom, the playground, outside, and at home - for example: books, food trays and dishes, street signs, windows and doors, etc.

Comparing Shapes

Learners tell if two shapes are the same shape, or if the same size. Use words like bigger/smaller, longer/shorter to describe differences. Sort objects into groups by shape, color or size. Pair objects by shape, color or size.

Positions and Directions of Shapes

Learners play and build with, arrange and line up objects, then identify the positions and direction of shapes, using words such as: on, off, over, under, on the top, at the bottom, over, under, in front of, behind, above, below, etc.

Finding Patterns

Learners find patterns in what they see around them – for example, prints in fabric used in their clothing, wallpaper borders, arrangement of petals on a flower. Create patterns by arranging or building with blocks, making paper chains or stringing beads, drawing or coloring, etc. Work on duplicating patterns, and extending simple patterns.

Everyday Measurements

Learners begin to understand measurement as “how many” units of the same size. Identify different things in everyday life that are measured, and why – for example, how long a foot is (to get the right size shoe); how wide a door is (to cut wood the right size); how cold it is outside (so we know if we need a sweater or coat); how much water to put into the bowl (so we can follow a recipe).

Objectives

- To analyze the influence of Cultural correlates on pre-mathematical skills of early grade learners.
- To analyze the influence of academic correlates on pre-mathematical skills of early grade learners.

Hypothesis

- Boys and girls will differ significantly in their mean score of pre mathematical skills.
- Tribal and non tribal learners will differ significantly in their mean score of pre mathematical skills.

- Class I and Class II will differ significantly in their mean score of pre mathematical skills.
- Public and private school learners will differ significantly in their mean score of pre mathematical skills.

The following figure 1 explains the correlates related to the pre mathematical skills of early grade learners.

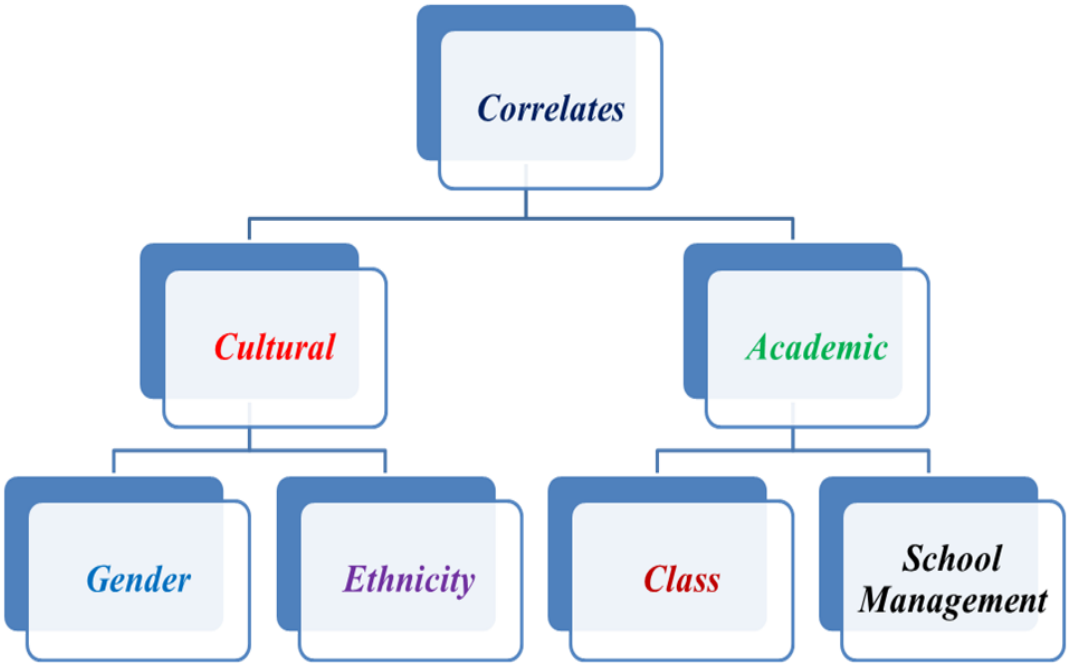

Figure: 1 Correlates of Pre Mathematical Skills

Methodology

The present study is a mixed method study conducted through a quautitalive- quautitalive approach. A total of 143 learners were taken as sample in this study. Table 6.1.3 describes the diversity in the sample of this study.

Table: 3 Diversity of Sample

Ethnicity →	General				SC				ST			
Management →	Public		Private		Public		Private		Public		Private	
Gender →	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Students Sampled in class I	12	12	8	8	10	10	5	5	8	8	5	5
Students Sampled in class II	12	12	8	8	10	10	5	5	8	8	1	0

Tools and Techniques

Based on construct of pre mathematical skills eleven competencies were identified and an assessment plan of 30 marks was prepared.

Data Analysis

After the administration of the test the data analysed. Following tables enlighten area where students are found to have low level of competencies.

Table: 4 Competencies Class I Students

Ethnicity →	General				SC				ST			
Management →	Public		Private		Public		Private		Public		Private	
Gender →	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Pre math Skill ↓ / Students Sampled → / Number of Students Not having the skill ↘	12	12	8	8	10	10	5	5	8	8	5	5
Estimating Measurements	10	9	4	6	5	8	3	2	6	6	3	1
Understanding Time	12	9	4	4	4	9	2	1	4	6	2	1
Making Comparisons	1	0	0	0	0	1	0	0	2	0	0	0
Predicting Quantities	11	9	0	2	3	7	2	1	4	6	3	0
Measurements Scales	10	10	6	3	7	7	3	1	5	6	4	1
Understanding Numbers	0	0	0	0	2	1	0	0	0	0	2	1
Classification of Objects	3	4	0	0	1	4	0	0	3	0	1	0
Connecting Counting to Adding	1	2	0	4	0	2	0	0	0	0	1	1
Recognizing Common Shapes	10	6	1	1	6	6	0	0	5	1	0	0
Positions and Directions	1	3	0	0	1	0	0	0	0	1	1	0
Finding Patterns	4	5	0	0	3	3	0	0	5	2	0	0

Table: 5 Competencies of Class II Students

Ethnicity →	General				SC				ST			
Management →	Public		Private		Public		Private		Public		Private	
Gender →	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Pre math Skills ↓ / Students Sampled → / Number of Students Not having the skill ↓	12	12	8	8	10	10	5	5	8	8	1	0
Estimating Measurements	8	6	6	2	9	5	3	2	3	5	1	-
Understanding Time	6	6	2	0	8	3	2	0	1	5	0	-
Making Comparisons	1	1	1	0	1	1	0	0	0	0	0	-
Connecting Types of Measurement	8	6	5	1	9	2	2	0	2	2	0	-
Everyday Measurements	10	7	5	0	9	4	3	0	4	4	0	-
Counting Out Loud	0	0	0	0	4	1	0	0	0	0	0	-
Classification of Objects	3	3	1	0	7	1	0	0	1	0	0	-
Connecting Counting to Adding	4	4	1	0	2	1	2	2	2	2	0	-
Recognizing Common Shapes	5	5	2	0	8	0	0	0	2	3	0	-
Positions and Directions	1	1	1	0	4	0	0	0	2	0	0	-
Finding Patterns	1	1	0	0	6	0	0	0	1	2	0	-

Findings

- Learners have poor pre-mathematical skills irrespective of their classes.
- Boys and girls do not differ significantly in their mean score of pre mathematical skills.
- Tribal and non tribal learners donot differ significantly in their mean score of pre mathematical skills.
- Class I and Class II donot differ significantly in their mean score of pre mathematical skills.

- Public and private school learners differ significantly in their mean score of pre mathematical skills.
- Except finding pattern and classification of objects girls are having better pre math. Skills than the boys in all the levels.
- Related Compqring and understanding number learners are not facing problems.
- Learners are facing problems in process skills like estimation, classification, measurement and recognition of shapes.
- Class II learners of public school have better pre mathemtical. Skills.

Conclusion and Recommendation

Form this study it is concluded that culture does not have significant influence on pre mathematical skill of learners. Academic correlates are more influencing pre mathematical skills. To a large extent pre mathematical skills are gender independent. However, it is advised that teachers are to be trained on pre mathematical skills. Learners are to be given more and more practice on pre mathematical skills before introducing mathematics to them. Parents should be made aware of pre mathematical skills. More in depth study should be conducted in order to have a better understanding on the cultural correlates of pre mathematical skills.

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