



# METHODOLOGIES ADAPTED IN MATHS EDUCATION BY MUKTANGAN TO CREATE AND MAINTAIN INTEREST IN LEARNERS

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## Table of Contents

<b>Abstract</b> .....	<b>2</b>
<b>1. About Muktangan</b> .....	<b>3</b>
<b>2. What is Mathematics?</b> .....	<b>3</b>
2.1. Making Mathematics Meaningful to Children.....	4
2.2. Making Connections and Forming Relationships.....	4
<b>3. CREDA</b> .....	<b>5</b>
<b>4. Muktangan Class Design</b> .....	<b>6</b>
4.1. L.R.G. (Learning Resource Group) .....	6
<b>5. CUDs and LDMs</b> .....	<b>7</b>
<b>6. Student Tracking for Math</b> .....	<b>8</b>

muktangan  
learning & growing together



## **Methodologies Adapted in Maths Education by Muktangan to Create and Maintain Interest in Learners**

### **Abstract**

Teachers need to encourage students to view learning of mathematics as not simply the mechanical use of meaningless procedures but rather as a discipline that they can enjoy and apply both in their daily life as well as in other areas of curriculum.

In Muktangan, maths is taught using the constructivist approach. The focus of this paper is to highlight the process and methodology followed in Muktangan wherein students learn to form relationship and connections in mathematics. Maths teachers follow **CREDA** for teaching mathematics. Tracking tool for each student is developed to record their progress in learning of a concept.

Students learn in many ways; being an inclusive school, students of varied backgrounds and abilities enrol. Thus, teachers are equipped with different methods and strategies of dealing with different mathematical concepts. These different strategies help to create a conducive environment for learning and also to engage all learners to visualize mathematical concepts. These strategies also result into creating lesson plans according to the level of students.

**Key Words:** Muktangan, Mathematics, Inclusive, CREDA, Tracking, Connection, Logical thinking, Visualisation

## 1. About Muktangan

India is a developing country; our education system follows different boards. Here many schools follow the traditional methods of teaching. Research reflects that children from urban low-income families have access to schools with high student-teacher ratios that enforce rote-learning methods. Such practices lead to non-conducive environment in the classroom affecting logical thinking in the children. ASER Report (ASER Report,2014) shows 40% students are unable to do simple math. RTE (Right to Education Act, 2009) report states that all children six to fourteen years of age have the right to education without any discrimination. Hence Muktangan comes into picture.

Muktangan was envisioned as an alternative model that aimed to bridge these prevalent gaps and disconnects in education by providing an inclusive, student-friendly model of education within the mainstream system catering to children from low income families. Supported through the Paragon Charitable Trust in partnership with the Municipal Corporation of Greater Mumbai (MCGM), the first Muktangan preschool was started in 2003 on the premises of a Municipal School in Worli, Mumbai. The original school began with 7 teachers sourced from local, under-served communities who transacted a developmentally appropriate preschool curriculum to 90 students from their own localities. The recognition of the success of the model by members of the same community and the MCGM led to the Muktangan initiative being set up and run in six additional municipal schools in 2007. The model comprises of one-year preservice training for the teachers and ongoing in-service training.

We, in maths department in Muktangan, follow the books prescribed by the state board. Although the syllabus is given by the state board, the textbook sequences are changed in order that students can discover the interrelationships and connection between topics. From Std 1 to Std 8 all the subsections such as number, measurement, geometry, patterns, algebra, and statistics are taken up simultaneously across standards enabling faculty and teachers to readily create activity suitable to the levels of students.

## 2. What is Mathematics?

Mathematics is derived from the Greek word “mathema” which means "knowledge, study, learning".

In Muktangan we define mathematics as the “science of patterns”. We encourage students to identify different kinds of pattern in each mathematical concept. This helps in constructing

connections between different concepts and also establishing inter-relation between different school subjects.

For example,

- a. In geography to locate the position of given cities on the basis of their latitude and longitude on a graph paper can be related to the coordinates in mathematics.
- b. In word problems language (mathematical) is used.

## **2.1 Making mathematics meaningful for students**

Mathematics is to be learnt by both teachers and students together through fun and exploration. Students bring many experiences to the mathematics classroom from their daily lives. Here the job of a teacher is not to ignore these experiences but to find ways for each child to actively build, each on their own unique set of experiences. We as teachers often focus on set of procedures which hampers student's ability, to develop his own understanding by making connections between his experiences both within and outside the classroom.

However according to Carpenter and Lehrer (1999) teacher is key to many students' ability to learn mathematics. Research supports the importance of teachers' development of pedagogical content knowledge, built upon a deep understanding of how students think and develop mathematically. Mukhtangan, a Hindi word ('Mukt' – 'angan') has literal meaning 'free courtyard'. It provides children the freedom to think act individually. Students are encouraged to discover their own processes to reach answers. It is not the answer which is important but rather the process of mathematical thinking. Games and puzzles lead to joint discussion and group thinking.

## **2.2 Making connections and forming relationships**

What happens to a student brain in a primary mathematics classroom?

Leonard (2000) highlighted that lectures guarantee that a particular amount of material is covered but does not guarantee that the students have fully understood the material.

The student's brain is often overloaded with information which he is unable to process and in turn the information gets wasted. Mathematical knowledge is cumulative. Later concepts cannot be understood without an understanding of the earlier ones in the learning sequence. The curriculum is to be delivered in a spiral manner with the earlier concepts being revised and retaught whenever necessary giving students a second chance to understand the

foundational concepts. In Mukhtangan teachers as facilitators create an environment for the students to build their own understanding of concepts (active constructivism) through questioning and using concrete objects.

According to Piaget, between the ages of 7/8 to 11/12 years children need concrete experiences in order to form the mental images required for performing the mental operations in mathematics. Jodi B. Prideaux, 2007, shows that active learning strategies would motivate and engage students in the learning process, thus resulting in an enhanced understanding of the material.

In Mukhtangan the lessons are planned using CREDA to help students visualise mathematical concepts from simple to complex, concrete to abstract and known to unknown

### 3. CREDA

The concept of CREDA is a learning sequence for helping young children in the Mathematics classroom.

1. Concrete experiences - students explore the given concrete objects
2. Representation- students represent the results of their exploration through drawing or any means of representation
3. Explanation- students talk about and explain their drawing/representation to their teacher and own group
4. Discussion- students discuss the concept with their teacher.
5. Algorithm- last stage students record the problem in standard mathematical notation

Example:

Topic: Multiplication and division

1. *Concrete*: The facilitator gives a jar of counters to the children, asking them to work in pairs. She tells each pair to remove 24 counters and to arrange them in equal groups.
2. *Representation*: The facilitator asks them to draw what they have done.
3. *Explanation*: The facilitator moves around the class asking each pair to explain their drawings.
4. *Discussion*: The facilitator discusses with the children which operation they feel they have been demonstrating.

5. *Algorithm:* The facilitator gives them the written algorithm for multiplication as repeated addition and division as equal grouping and gives them further examples to solve.

CREDA emphasizes that the children first discover for themselves the meaning of division and multiplication, only when they had obtained this understanding the facilitator introduces the algorithm.

CREDA is difficult to execute in a traditional classroom with in the given time where a teacher caters to 40 or more children. Hence classrooms in Muktangnan are designed differently to ensure individual participation and visualisation of the concept.

#### **4. Muktangnan class room design**

The strength of the class is divided into 3 groups keeping in mind the level of each student. This grouping enables to cater students according to their individual differences. In our classrooms the teacher student ratio is 1:14. This small group teaching promotes one to one correspondence where the role of the teacher is more to facilitate and create thinking in individuals rather than rote learning as in conventional classroom. The classes are equipped with various low cost easily available resource material used for activity-based learning. Stackable furniture is used which can be put aside whenever required. This gives more space in the class which helps teachers to utilise floor to perform activities with the children.

Students sit in the class room in a specific semi-circular arrangement. This arrangement helps the teacher to connect with students and to ensure individual participation. It also enables the teacher to observe each student while she is teaching and explaining on the black board.

As Muktangnan believes in learning and growing together, teachers also get promoted along with the students. This promotion helps in understanding the level of each student. Thus, teacher can plan and work according to the individual needs (both EQ and IQ) continuously. Each teacher is allotted two standards which help her, design activities to establish the connection between the concepts in a sequence.

##### **4.1 LRG (Learning Resource Group)**

Being an inclusive school Muktangnan also caters to differently abled children which is almost 12% of the total strength from standard 1 to 10. To cater such students Muktangnan supports a set of teachers to facilitate these students. They are provided with the overall development

including essential content knowledge. These teachers support the children with special needs in the class room.

Muktangan believes in capacity building and ongoing in-service training for the teachers which helps them to execute the concept keeping CREDA in mind. For this CUD (Curriculum understanding and design) LDM (Lesson designing meetings) are conducted for 69 maths/ science teachers across 7 schools.

## **5. CUD's and LDM's**

CUD: – CUD meetings are to enable teachers to think better and better ways of helping children develop into a thinking individual. Teachers are given rigorous and extensive in-service training to build their capacity as maths teachers. They come together once in a week and are trained by senior faculty keeping active constructivism in mind at different levels.

LDM: - the planning done in the CUD meeting is then taken to individual schools. The lessons are effectively designed by the teachers under the proper guidance of the subject faculty keeping in mind the level of individual student placed in three groups in the classroom.

Mathematics is to be learnt both by teachers and students together and the teaching is effective if and only if the teacher identifies the level of each and every child. Under RTE (RTE, 2009) students are to be assessed and taught at their own stages of development, a tool for student tracking is developed keeping in mind the competencies according to NCF. (National Curriculum Framework, 2005)

## **6. Student tracking for mathematical concepts**

The tracking system is a mathematics assessment tool for tracking the progress of each student from standard 1 to 8. It is also helpful for planning diversified learning experience in CUD meetings. The various competencies/ strands for different grades are in the form of rubric. The teacher checks the competencies achieved by the student throughout the year. The unachieved competencies are rechecked in the following academic year to ensure the quality education provided and improved level of the students.

Below is a sample of the table demonstrating the student tracking tool for children of standard 3. A similar tracking tool is in process for all children from standard 1 to 8 across 7 schools

Student Name	Curr ent Standard	Grade 1 - 28				Grade 2 - 37				Grade 3 - 31				Grade 4 - 47			
		2016	2017	2018	2019	2016	2017	2018	2019	2016	2017	2018	2019	2016	2017	2018	2019
Student 1	3	28					37					31					
Student 2	3	28				2	37				3	31				4	
Student 3	3	10	15	20			15	20				15					
Student 4	3	4	7	9			6	9				10					

**Figure .1**

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