

NUMERACY

Numeracy is being incorporated into the Ghana's Educational Curriculum in order to develop individuals who can cope with everyday life, which demands the use of mathematical concepts like how to compute, measure, estimate and interpret mathematical data. Numeracy strengthens students' learning in all school subjects through providing them with grounded understanding of the quantitative aspects of each subject.

In Ghana, many workshops and in-service training courses have been organised for teachers on how to teach Mathematics effectively and efficiently. Unfortunately, teaching and learning of mathematics continue to pose challenges to most basic school teachers. In all the workshops, Numeracy is considered as the backbone of Mathematics.

Numeracy can be described as the knowledge, skills and appreciation needed for students to understand and utilise mathematical ideas, techniques and applications. Numeracy involves students in integrating such skills as interpreting quantitative information, performing straightforward calculations mentally, estimating values that are known and unknown, and developing an intuitive knowledge of measurement units.

In Ghana, the curriculum includes not only the topics or contents and activities, which are taught but also the whole educational experience of pupils inside and outside the classroom and the school environment. The primary school syllabus is designed to put a great deal of emphasis on the development and use of basic mathematical knowledge and skills. The major areas of content covered in all the six classes of primary school are as follows:

- Number
- Shape and Space
- Measurement
- Collecting and Handling Data
- Problem Solving
- Investigation with numbers (number patterns)

The basic mathematics syllabus spells out three main profile dimensions. These are Knowledge, Understanding and Application. Knowledge constitutes the lowest level of teaching, learning and assessment whilst Application constitutes the highest level. The specified dimensions for teaching, learning and assessment are arranged into two as follows:

	Primary 1-3	Primary 4-6
Knowledge and understanding	40%	30%
Application of knowledge	60%	70%

A table of specification is used to set test items. This is also known as tests plan or test blue print.

To make the teaching of mathematics effective, in Ghana, various good practices of a mathematics teacher have been taught in workshops. These are:

- Development of generic skills
- Group work
- Preparation and use of Teaching Learning Materials (TLMs)
- Preparation of scheme of work
- Lesson planning
- Good communication skills
- Teacher should serve as a guide and facilitator
- Teaching from concrete through semi-concrete to abstract
- Word story problems should be related to pupil's environment
- The use of the principle of multiple embodiment
- The use of correct mathematical languages/terms
- The use of mathematical puzzles and games
- Considering gender issues when teaching
- Assignments for evaluation
- Preparation of marking schemes
- Consulting colleagues for information when and where necessary
- Marking of pupils exercises promptly
- Guiding pupils to make corrections and marking them.

In evaluating mathematics it is recommended that most of the evaluations must be applications related to pupil's environment. Example, in evaluating a lesson on addition, a question like "how much does Abu pays for 2 pens and 3 pencils if a pen cost ₵200 and a pencil cost ₵100?" may be asked. The teacher is supposed to test and analyse the raw score based on the class average mark into the following categories;

- below class average
- class average
- above class average

Mathematics teachers will continue to be primarily responsible for developing an understanding of mathematical concepts, rules, principles, relationships and procedures, but Numeracy must also be supported in other subject areas. Almost all subjects can include some meaningful opportunities for students to apply mathematical knowledge. Most students in the basic schools learn best if they are involved in meaningful activities that require the use of manipulative materials. Second cycle students also benefit from hands-on experiences with instruments and tools. A great deal of discussion and work with concrete materials should precede any introduction of symbolic abstractions.

The general aims of mathematics in Ghana are:

1. Children should be introduced to mathematics instead of arithmetic.
2. Mathematics is a medium of communication.
3. At the early stages, mathematics should be related to the child's own environment through appropriate experiences in the development of the relevant concepts.
4. Different procedures in solving mathematical problems are necessary and should be encouraged.
5. Individual children will achieve mastery of fundamental mathematical concepts and facts at different rates.

There are also two main objectives of the primary mathematics syllabus:

1. To develop the basic idea of sets, relations and objectives;
2. To develop the basic physical and geometrical ideas and relationships about shapes.

Gender Issues in Relation to Numeracy.

- Lack of role models: - Mathematics instructors are mostly males, who do not serve as role models for the female gender.
- Peer Influence: - Some girls have the notion that mathematics is not something girls do so they do not have the desire to pursue the study of mathematics. These girls adversely have influence on others.
- Family and Social background: - Most Ghanaians believe that women are not as good at mathematics as men are and therefore think that to support women in numeracy is just waste of resources so they feel reluctant to support girls in numeracy.
- Lack of girl friendly learning environment: - The textbooks, for example, portray boys' involvement in mathematical activities than girls.
- Some people also argue that numeracy belong to the psychic realm, which is a masculine element, and that studying them requires leaving the body, which is the female element, behind. Women who do well in mathematics are, therefore, given names such as "iron lady", "Yaa Asantewaa" or "witch".
- Low level of awareness concerning appropriate and supportive gender sensitive teaching methods by mathematics teachers.
- Girls are mostly ridiculed by their male counterpart whenever they (girls) make mistake in class. This results in low participation rate of girls in mathematical activities.
- Lack of motivation from teachers, parents and the society in general.

Rationale

Numeracy in Ghana's curriculum is justified by the demands of modern life (i.e. both within and outside the educational institutions). Everyday activities like counting objects and money, reading clock and comparing prices of market products before buying exhibit the use of numeracy. People tend to select techniques according to number criteria; such as the purpose of calculation, the degree of precision and accuracy needed, the size and types of numbers, and helpful contextual cues in the environment.

Numeracy, as we all know, has a broad content, which needs a lot of time to deal with. It involves the Concept of number, Data analysis, Graphing, Measuring, Problem-solving, Shapes and Space and what have you. In this wise, I have decided to limit myself to how Number Concept is developed in my country, Ghana. Emphasis will be laid on the lower primary (i.e. grades 1-3). Below are the lists of sub-topics treated under the Number concept in ascending order:

- Pre-number work/activities
- The Concept of Numbers 1-5
- The Concept of Zero
- The Concept of Numbers 6-9

- Addition and Subtraction of numbers 0-9
- Multiplication and Division of numbers 1-9
- Two-digit numbers
- Addition and Subtraction of two-digit numbers
- Multiplication and Division of two-digit numbers
- Three and four digits numbers
- Addition and Subtraction of three and four digits numbers
- Multiplication and Division of three and four digits numbers
- Fractions and Decimal fractions

Teaching/Learning Materials: marbles, pebbles, empty containers, bottle tops, sticks, Cuisenaire rods, square papers, addition and multiplication charts, abacus, Dennis multi-based block, bundling sticks and loose ones.

Pre-number Work/Activities

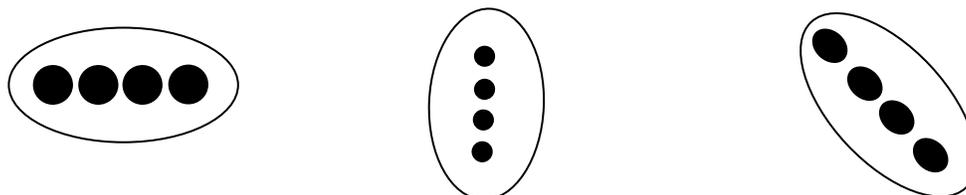
This is the stage where children are taken through a lot of activities before the idea of real number work. The activities involve Grouping; Sorting; Ordering; Comparing/Matching and the Idea of Conservation. These activities help children to develop vocabularies such as: more than; less than; fewer than; as many as; equal to; longer than; shorter than; flat; round; rolling; and others.

Under **grouping**, children are given concrete objects such as marbles, pebbles, sticks and empty containers to be grouped according to their taste without any restriction. When they finish grouping, teacher asks them to say the motive behind their groupings. Children can give answers like the same colour, size, shape, and height. Teacher then lead children on a discussion of sorting according to similarities. These similarities may be of any type or nature, any colour, size, shape, taste, brightness or even personally abstract things like favourite food, drinks, cookies or music. Most objects can belong to several different groups; for example, a bowl can belong to colour, size and shape.

The idea of ordering is then developed. Children are asked to arrange objects according to their size, height, or quantity. Here, vocabularies such as bigger than, taller than, shorter than and others are acquired.

Next is the idea of **comparison or matching**. Here children are made to develop the concept of many, equal, few, more and less as they do compare or match objects in different groups.

Children are then helped to develop the **idea of conservation**. For example, three groups of four objects each are arranged horizontally, vertically and diagonally as shown below.



Children are asked to say which of these groups has more objects. If a child is able to say that they have equal objects then he/she has reached the age of conservation. If not then teacher has to use matching or comparing for children to understand that no matter how objects are arranged, being small or big, the number of objects in the groups are the same. The teacher has to give children another example to ascertain their understanding.

The Concept of Numbers 1-5

Based on the pre-number activities, children can now group, sort, order, arrange and compare objects. The idea of number is started by using concrete objects but now with number names. The children should be made aware that the numbers do not refer to any particular object but rather the quantity of objects. In the teaching of the “one” many different objects of “one” should be shown to the children. Numbers two, three, four and five should follow suit. Using ‘one’ for example, a marble, an orange, a stick, or a finger may be used to demonstrate. The children pick each object and then mention the number name “one”. Children should not be made to associate any number name with any object. Pictures are used in conjunction with the objects whilst children still recite the number names.

Children are helped to say the number names in a familiar context such as rhymes, songs, stories, counting games and other activities. For example, use rhymes or songs like;

- One, two, three, four, five once I caught a fish alive.
- One mango, two oranges, three pawpaw, four banana, five apples.
- One jump, two stop, three clap, four sit, five stand.
- Five little ducks went swimming one day.... as we count back.

Children are made to recite the number names as teacher writes the numerals/symbols on the chalkboard.

One \longrightarrow **1**
Two \longrightarrow **2**
Three \longrightarrow **3**
Four \longrightarrow **4**
Five \longrightarrow **5**

The idea of Jerome Bruner is introduced after this stage. That is, Enactive, Iconic and Symbolic. This means using concrete objects through semi-concrete objects to symbols. As real objects are used, pictures are also drawn to represent the same objects as the number words as well as numerals.

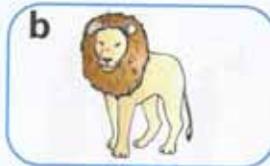


Children at this stage learn how to write the numerals as they call out the number names. They are made to write in sandtrays, in the air, on slate and then in books. Children are then given groups of objects to assign numerals to them either on the chalkboard or in their books.

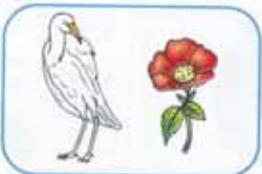
1
one



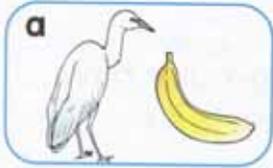
Which group has one object?



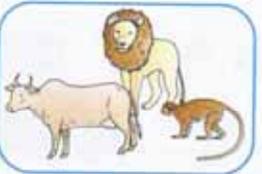
2
two



Which group has two objects?



3
three



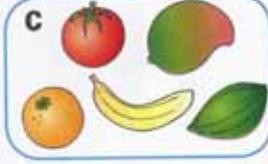
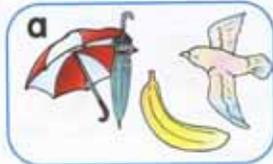
Which group has three objects?



4
four



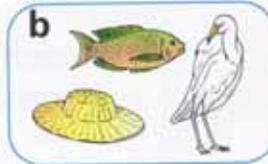
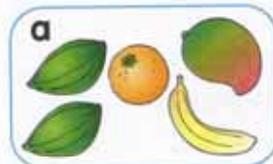
Which groups have four objects?



5
five



Which groups have five objects?



Counting

Count: **one**

1

one

Say:



one bird



one ball



one girl



one finger

Count: **one, two**

2

two

Say:



two birds



two balls



two children



two pencils



two fish



two fingers

Count **one, two, three**

3

three

Say:



three oranges



three spoons



three eggs



three pencils



three fish



three fingers

Count: one, two, three, **four**

4

four

Say:



four balls



four cups



four bananas



four fingers

Count: one, two, three, four, **five**

5

five

Say:



five eggs



five plates



five bananas



five fingers

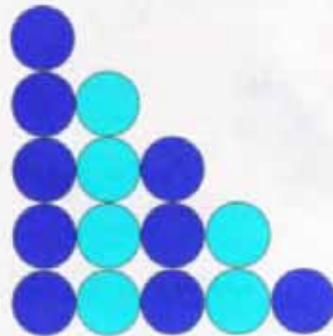
one

one, **two**

one, two, **three**

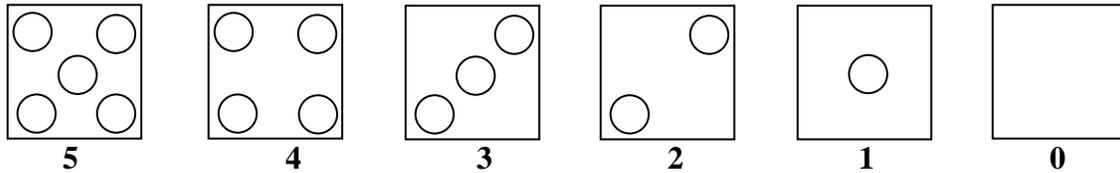
one, two, three, **four**

one, two, three, four, **five**



The Concept of Zero

One may ask/wonder why zero is taught after the numbers 1-5. The idea is that children find it difficult to understand the concept of emptiness so with the idea of numbers 1-5, we use reduction to get empty, nothing or zero. Teacher, for example, puts five objects in a box and asks children to remove them from the box one by one till there is nothing left.



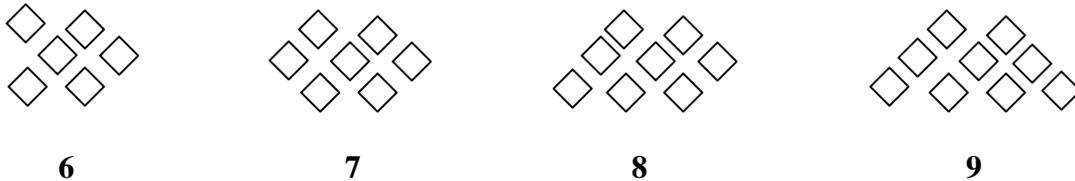
Questions such as these are asked.

- How many dogs are in the classroom?
- How many children have two heads?
- How many children drive to school?

Since all these questions give the same answer, which is 'nothing', the children at this stage can understand the concept of zero.

The Concept of Numbers 6-9

This concept builds on the concept of 0-5. Objects are grouped to represent the numbers as children recite the number name. Concrete objects, semi-concrete and symbols are then introduced.



They learn how to write the numerals in the sand tray, in the air, on the slate and in their books. Objects are grouped for children to assign numerals from 6-9.

With all these, children are then given some pictures or drawn objects to assign numbers from 0-9. They are also asked to arrange group of objects in ascending and descending orders.

Number rhymes are learnt at this stage. Examples of such rhymes are

- One, two, three, buckle my shoe, four, five, six, shut the door, seven, eight, nine lay them straight
- One, two, three, four, five, pounding 'fufu' near the door, six, seven, eight, nine, lunch is ready don't be late.

Children are made to

- Recite the numbers sequence consistently back to zero
- ◆ Starting from five
- ◆ Starting from nine

- Start from a given number and stop at another
- ◆ Start with nine, hold it in your head, count back to three
- ◆ Start with four, hold it in your head, count back to zero

Addition and Subtraction of Numbers 0-9

Addition is taught to children as the idea or process of putting things/objects together or the union of objects. The symbol used for addition is $+$ / \cup . In the early stage, concrete objects are used to teach the concept for children to develop the skill of adding or putting objects together before using symbols. For example, to add 3 and 4, concrete objects are used as;

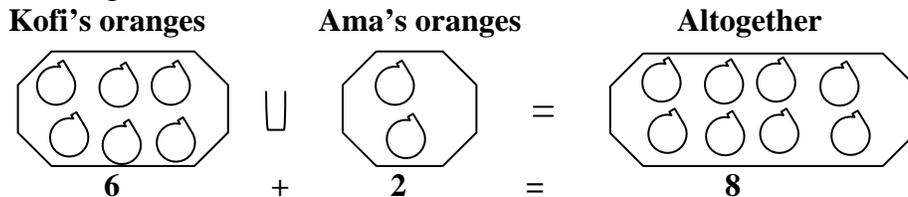


With some more examples in this form, children will be able to understand the concept of concept of addition.

Addition has two aspects;

- i) Combination
- ii) Add unto.

- ◆ In the combination aspect of addition, situations are given separation for children to learn how to put them together. These situations mostly occur in the sentence problem form. For example, Kofi has 6 oranges. Ama also has 2 oranges. How many oranges do they have altogether? Here all that the children have to do is put the oranges involved together, i.e.



- ◆ With the add-unto aspect of addition, the situation must be brought together. There is always an existing situation before some other situation is joined to later. For example 6 girls were playing and later 2 more girls joined. How many girls are now playing? Answer: $6 + 2 = 8$

Although, in the symbolic form, the two aspects are the same but the sentences mean different. One is a static addition and the other a moving addition.

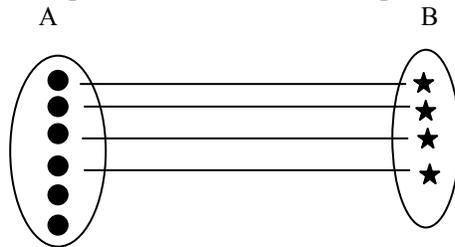
The count on aspect is also introduced into the add-unto situation of addition. For example,

- i) Count on three numbers from four. The result is five, six, seven. The meaning is $4 + 3 = 7$
- ii) Count on four starting from two. The result is three, four, five, six. That is $2 + 4 = 6$.

More story problems are introduced to help children develop an understanding for addition than using just numerals.

Subtraction, on the other hand, is the removing or separating objects, and the symbol is $-$. Subtraction has four aspects. These are take away; comparing/matching; missing addend and separation. Concrete objects are used to introduce any aspect to children at the initial stage.

- ◆ Take away: - Sentences are given to children to perform the activity with concrete objects available. For example,
 - i) There are 7 apples on a table, if you take away 5 apples, how many apples will be left on the table? That is, $7 - 5 = 2$.
 - ii) Kofi had 5 cookies and ate two of them. How many cookies does he still have (left)? That is $5 - 2 = 3$.
- ◆ Comparing/matching: - with this, children are given objects in different groups to compare or match them as one to one to find out the one, which is more. For example,
 - i) Group A has 6 objects and Group B has 4 objects. Match the objects in Group A to those in Group B on one to one correspondence.



How many objects in Group A did not have members in Group B? That is $6 - 4 = 2$.

ii) Abena has 8 oranges and Kwame has 5 oranges. Which of them has more oranges and by how many? That is $8 - 5 = 3$.

- ◆ Missing Addend: - This is where addition and subtraction are used together. A statement is given as addition but the subtraction operation is being performed. For example, Joe has 9 dolls and Connie has 5 dolls. How many dolls does Connie have to gain to get the same dolls as Joe? This statement means Connie needs additional dolls to have equal dolls as Joe. In order to know the number of dolls Connie needs, whatever she has now must be subtracted from Joe's number of dolls. That is $\square + 5 = 8 \rightarrow 8 - 5 = \square$, the answer is 3
- ◆ Separation is normally taught last because it looks a bit difficult and children need to know their numbers very well. This approach is used for children to understand that a number can have so many combinations. For example, separate 7 into any two numbers. That is 5,2; 6,1; 4,3; 7,0. This means $7 - 5 = 2$ or $7 - 2 = 5$; $7 - 6 = 1$ or $7 - 1 = 6$; $7 - 4 = 3$ or $7 - 3 = 4$; and $7 - 7 = 0$ or $7 - 0 = 7$.

Children have to work some more examples like separate 8 into 5 and 3. Name and write any other two numbers that 8 can be separated into.

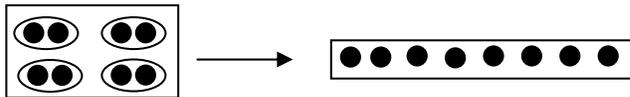
Multiplication and Division of Numbers 1-9

Multiplication is introduced to children as a situation in which there is a number of groups of objects having the same number of objects in each group put together and the symbol is \times . Children may think that addition and multiplication are the same, since both are concepts of putting objects together. Here the teacher make the clarification to children that although the two concepts are putting objects together, addition is just putting objects in groups together without considering the groups having the same number of objects. On the other hand multiplication is putting groups of the same number of objects together.

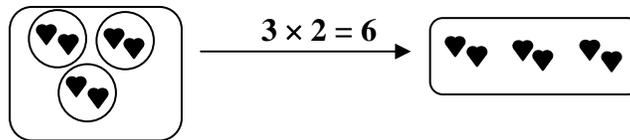
There are three aspects of multiplication. These are; equal groups, repeated addition and Cartesian product.

- With the equal groups, concrete objects are used for children to put them together. For example,

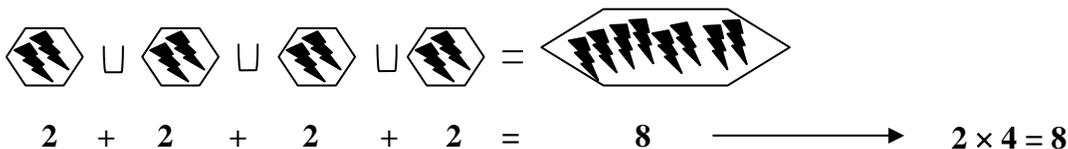
- What is four groups of 2? Teacher explains to children that there are four groups, each containing 2 objects. That is, $4 \times 2 = 8$



- There are 3 children in a room each has 2 cookies, how many cookies do they have altogether.



- Repeated addition, here multiplication is taught as ‘addition with same number of objects for a number of times’.



Add 3, 3 times $\leftrightarrow 3 + 3 + 3 = 9 = 3 \times 3$

Put together 4, 2 times $\leftrightarrow 4 + 4 = 4 \times 2 = 8$

There are 3 boxes each containing 1 object. How many objects are there in all the three boxes put together? $1 + 1 + 1 = 3 \times 1 = 3$

- Cartesian product provides quite a different context for multiplication of natural numbers. An example of such a problem is;

- i) If 3 boys and 3 girls are dancing, how many different partnerships are possible?

	Boys			
Girls				
				
	×	×	×	
	×	×	×	
	×	×	×	

This means $3 \times 3 = 9$

- ii) If there are 3 shirts and 2 trousers. How many pairings can be made?

	Shirt			
Trousers				
		×	×	×
×		×	×	×
×		×	×	×

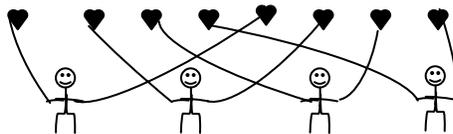
That is $3 \times 2 = 6$

Division is introduced to children as the process of sharing objects equally among pupils or things and the sign used is \div . There are two aspects of division as partitive (sharing) and quotitive (grouping). With this, teacher explains that each member in the group should have the same number of objects.

- Sharing is the idea where number of people involves picks the objects one at a time till all the objects get finished.

For example;

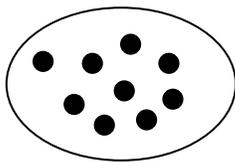
- i) If 4 children are sharing 8 cookies. How many cookies will each child get?



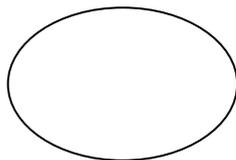
That is $8 \div 4 = 2$

- ii) How many oranges will each child receive if there are 9 oranges to be shared equally among three children? Here, each child picks an orange at a time till all the oranges finish then the number of oranges picked by each child is counted.

Before sharing



After sharing

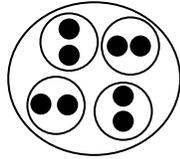


Each child's share



That is $9 \div 3 = 3$

- Grouping is another aspect of division. This is putting the objects equally in groups as the number of people suppose to have the objects. For example,
- i) How many oranges will be in each group, if there are 8 oranges and 4 groups?



That is $8 \div 4 = 2$

- ii) How many groups of apples will be there, if there are 6 apples and 2 apples in each group?



$6 \div 2 = 3$

- iii) How many cookies will be in each group, if there are 6 cookies and 2 groups?



$6 \div 3 = 2$

To conclude, the following suggestions should be considered in order to make the teaching and learning of numeracy effective and efficient:

- **workshops and symposia should be organised for basic school mathematics teachers on strategies and practices for promoting numeracy in Ghana;**
- **gender issues should be well addressed to encourage more girls to develop interest in numeracy;**
- **learning in the content areas should promote the ability of students to function effectively in quantitative situations;**
- **students require opportunities to encounter, solve and discuss real-life experiences utilising quantitative information in all of the required areas of study and other school subjects;**
- **it is important to develop students' intuitive knowledge of mathematical concepts and techniques through practical experiences involving a variety of concrete materials.**

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