WESTERN CAROLINA UNIVERSITY

Strategies for Teaching Primary Maths

Dr. Tom Oren

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Students:

Chevonette James-Henry

Anita McNeil

Tanesha Rose

Rationale

According to the Ministry of Education, in 2011, forty five thousand six hundred and fifty four (45,654) students sat the Grade Four Numeracy test with forty nine point two (49.2) per cent or twenty two thousand four hundred and sixty nine students (22,469) attaining overall mastery in all three of the combined curriculum strands. These includes: Number (number representation and operation), Geometry and measurement as well as Algebra and statistics (Maths Big Problem, 2012).

The Jamaican Education system has seen a major fall back in Mathematics over the years and more of our students are finding the subject area difficult and as a result are struggling to become successful.

According to Dr. Tamika Benjamin, National Mathematics Co-ordinator in the Ministry of Education, "The data shows that while we have seen some improvements in the performance of our students, the average Jamaican Primary school student continues to struggle with critical but basic mathematics ideas." (Ministry Rolls Out National Mathematics Policy, Ingrid Brown, 2013).

In this research, we seek to provide useful strategies and methods to assist primary school teachers in proper planning and preparing mathematics lessons that would cater to the diverse needs of all the learners in the classroom. We will focus on recommendations that would support the use of technology, cooperative learning, ongoing assessment, differentiated instructions and classroom environment to foster and enhance the teaching of mathematics. The recommendations will stem complacency and allow teachers to not only prepare students to pass standardized exams but to help students acquire the level of knowledge needed to effectively apply mathematical ideas to solve problems.

Situational Analysis

Numeracy, like literacy, provides key skills to enable children and young people to be successful at school and life beyond it. It is a prerequisite for success in a changing society where one need to be ready to adapt to new jobs, new career pathways and new technologies. To be numerate is to use mathematics effectively to meet the general demands of life at home, school and society in general.

In Jamaica there is concern about the unsatisfactory performance of students in mathematics at all levels of the education system. The Grade three and grade four standardized test shows the dismal results of students in both cohorts who sat the test over a five year period.

Grade Three Diagnostic Test

Year	Percentage Mastery				
	2003	2005	2006	2010	2011
Number	16.4	30.1	35.9	44.0	49.6
ESTIMATION AND MEASUREMENT	12.8	24.2	25.1	51	35.4
GEOMETRY	30.8	34	56.1	53.1	36
ALGEBRA	28.4	25.5	56.8	44.9	44.7
STATISTICS	13.9	34.2	57.5	36.6	40.7

The test which assesses mastery of concepts developed in the Grade 1-3 data indicates low levels of mastery across all five strands of the curriculum.

Grade 4 Numeracy Test

Performance on the Grade 4 Numeracy Test 2009 –2012	
Year	Percentage Mastery
2009	45
2010	41
2011	49
2012	54

As shown in Table 2, the Low levels of performance continued in Grade 4 with less than 50% of a given cohort attaining mastery on the Grade 4 Numeracy Test.

Math

Strategies

1. The Classroom Environment

The mathematics classroom is an environment in which students are actively engaged in the learning process. Students discuss mathematics, create products, use manipulatives, make real world connections, solve meaningful problems, use technology, write about mathematics, ask questions and make conjectures. The classroom should be arranged to facilitate flexible grouping and multi-tasking. This allows teachers to meet the needs of students with a wide range of abilities. Opportunities are provided for students to work individually and in cooperative groups. Mathematical tools are available and accessible for students to use.
(http://k-12.pisd.edu/currinst/elemen/math/Classroom_Environment.htm

a. **Math Tool Area (Manipulatives Collection)**

To help facilitate the use of appropriate tools strategically, an organized area to hold grade-level appropriate math tools is essential to student work. This math center should house clearly marked, accessible, and portable containers of manipulatives such as base ten blocks, calculators, counting chips and other assorted counters, clocks, coins, geoboards, student-sized number lines and number grids, measurement tools, pattern blocks, tangrams, playing cards, and ten frames.

b. **Calendar Board**

Using *a* well-designed Calendar Board can provide on-going review, preview, and discussion about mental math and problem solving strategies.

c. Mathematics Literature Collection

A mathematics literature collection can be set up parallel to a classroom library. It should include fiction and non-fiction selections, mostly on grade-level with some above and below level. These books can be organized by author, topic, level, or genre. Like the manipulatives collection, the books should be labeled clearly so students may use and replace them easily. Mathematics literature can help extend the math students are learning, placing it within a real-world context, and can help students engage in their mathematical studies http://mathcoachcafe.weebly.com/setting-up-the-math-classroom.html

d. Math Word Wall

A Math Word Wall consists of words and phrases that students should learn to use when explaining their mathematical thinking and solving problems. Each entry should include a definition and a picture, diagram, or visual representation. The entries should be large enough for students to see from a distance.

Addition	
+	Increased by
add	more than
together	combined
total	together
In all	total of
altogether	added to
all	sum

Equal	
=	same
same as	the same as
Is equal to	equals

Subtraction	
-	minus
left	greater than
less than	less than
total	more than
In all	how many less
altogether	decreased by
reduced by	difference
from	fewer than

Multiplication	
X	factor
product	product
times	*
multiply	Multiplied by

Division	
÷	out of
quotient	ratio of
per	percent
Divide equally	divide

2. Problem Solving

Problem solving gives students a context to help them make sense out of the mathematics they are learning. Problems can be used to introduce new concepts and extend previously learned knowledge.

Some benefits of Problem Solving are:

- It bases students' mathematical development on their current knowledge;
- It promotes and develop autonomous learners
- It enhances transfer of knowledge
- It produces positive attitudes towards mathematics;
- It helps memory
- It teaches thinking, flexibility and creativity;
- It teaches general problem solving skills;
- It encourages cooperative skills;

http://nzmaths.co.nz/why-teach-problem-solving

Problem Solving Strategies

1. Make a Table

Strategy: Understand the problem, Plan how to solve the problem, make a table.

2. Working Backwards

Strategy: Understand what you need to find, Plan how to solve the problem, Work backwards and Solve.

Technology

Technology is an essential tool for teaching and learning mathematics effectively; it extends the mathematics that can be taught and enhances students' learning. Calculators, computer software tools, laptops, tablets and other technologies assist collection, recording, organization and analysis of data. With these devises students can extend the range and quality of their mathematical investigations and encounter mathematical ideas in a more realistic settings. (National Council of Teachers of Mathematics, 2005).

a. Virtual Manipulatives

Virtual Manipulatives is an online teaching aid which enable students and teachers to represent concretely the abstract concepts that they are learning in mathematics class and to link these concepts to prior knowledge. According to National Council of Teachers Of Mathematics virtual manipulatives help students make important connections among the concrete manipulations of objects, the visual images of those objects, abstract mathematical ideas and the processes underlying these concepts. (National Council of Teachers of Mathematics, 2005)

b. Cartoon

Using technology to get students engaged in a mathematical lesson can be done with a cartoon television sitcom. The Simpsons have a lot of mathematics references from arithmetic to calculus. Much of it is written to have inside jokes with those who understand different levels of mathematics. Simpsonmath.com offers where to find the mathematics references in episodes, transcripts for the mathematical reference, explanations for the inside math jokes, and activity sheets

c. Websites

There are many websites that teachers can use for engaging and enhancing learning in a classroom and for students own practice at home.

A+ Click helps students of all grade levels practice problem solving skills and to use creative thinking. Math Pickle gives teachers a way to play mathematical games, solve puzzles, and have math competitions in their classroom.
Super Kids offers worksheets, games, and "brain food" for students.
For teachers, Education World offers professional development, lesson plans, and resources.
http://mathdiscussions.wordpress.com/teaching-math-using-technology/

2. Differentiated Instruction

Researchers at the National Center on Assessing the General Curriculum define differentiated instruction as a process to approach teaching and learning for students of differing abilities in the same class. The intent is to maximize each student's growth and individual success by meeting each student where he or she is at rather than expecting students to modify themselves for the curriculum. (Hall, 2002)

Differentiated Strategies

Effective strategies for differentiated mathematics instruction include:

- Provide access to a variety of materials which target different learning preferences and reading abilities.
- develop activities that target auditory, visual, and kinesthetic learners.
- establish stations for inquiry-based, independent learning activities.
- create activities that vary in level of complexity and degree of abstract thinking required.
- use flexible grouping to group and regroup students based on factors including content, ability, and assessment results.
- use Anchor activities
- for special students get resources that are available. For example get an assistant to help students with Special Needs with one-on-one tutoring.

Anchor Activities

These are ongoing assignments and assessment that students can work on independently throughout a unit, a grading period or longer.

www.mathsolutions.com/presentation

Some Anchor Activities:

- Brain busters
- Activity box
- Learning packets
- Math "problem of the day"
- Journals or learning logs
- Websites

4. Cooperative Learning

Cooperative learning involves a small group of learners who work together as a team to solve a problem, complete a task, or accomplish a common goal. Cooperative learning can be used to foster effective mathematical communication, problem solving, logical reasoning and the making of mathematical connections (NCTM, 1989). Among many other national organizations, support for cooperative learning comes from the National Council of Teachers of Mathematics. The council's Curriculum and Evaluation Standards for School Mathematics (1989) recommended that teachers provide opportunities for students to work together in small groups to solve problems. Research indicates that cooperative learning experiences in the mathematics classroom foster improved attitudes toward the subject matter and the instruction (Johnson and Johnson 1991).

Benefits of Cooperative Learning

Dr. Theodore Panitz, (1996), sees many benefits to using the cooperative-learning approach. He identified the following benefits for Education World.

* Promotes critical thinking skills
* Involves students actively in the learning process
* Improves classroom results
* Models appropriate student problem-solving techniques

* Help students make connections between the concrete and abstract level of instruction.

Cooperative learning activities

- Math Olympics
- Factoring- Jig-saw
- Think-pair-share
- Send/pass a problem on
- Buzz groups
- Numbered heads

Send/pass a problem on

This technique is effective for problem-solving and seeing problems and solutions from varying points of view. Also, the technique supports building critical thinking. Teams identify a problem or issue in math (i.e. Multiplication or faction). Each team writes the problem or issue on the front of a folder or the teacher creates the problem situation and writes the problem on the front of a folder. The following steps are then followed:

1. The team brainstorms solutions in writing and places the ideas in folder to pass on to another team.
2. The members of the second team, without looking at the ideas generated compile another list of solutions and place those in the folder. The folder then goes to a third team.
3. The third team looks at the problem or issue, reads the suggestions provided by the previous two teams and decides upon the two most effective solutions. These are justified in writing and given to the teacher for further discussion.

Ongoing Assessment

Assessment, according to NSW Department of Education and Communities is "the process of identifying, gathering and interpreting information about students' learning. The central purpose of assessment is to provide information on student achievement and progress and set the direction for ongoing teaching and learning."

It important for teachers to engage in ongoing assessment in mathematics so as to garner accurate information on the effectiveness of the material/ resources and strategies used to deliver instructions. “Assessment also provides feedback about students’ progress and will reveal to students what they know against what they do not know.”

Types of Mathematical Assessment

Formative Assessment

Formative Assessment can be defined as all those activities undertaken by teacher and by their students in assessing themselves, which provides information to be used as feedback to modify the teaching and learning activities in which they are engaged. Such assessment becomes ‘formative assessment’ when the evidence is actually used to adapt the teaching work to meet the needs. (Black & Williams, 1998).

Formative Assessment Tools for Mathematics

Graphic Organizers:

Graphic organizers are visual models that can assist students in organizing information and communicating clearly and effectively. Students can use graphic organizers to structure their writing, brainstorm ideas, assist in decision making, help with problem solving and plan research.

Mathematical Problem	Everyday Example
Representation (Diagram, graph, Picture)	My Explanation

Fig 1: Graphic Organizer, Make a Math Connection

wvde.state.wv.us/strategybank/graphicorganizer.html

Other Examples of Formative Assessment

- Students posing and answering questions.
- Students evaluating questions in a textbook exercise to decide which ones they should work on.
- Asking 'What is the same and what is different?', for example, for linear or quadratic functions.
- Asking students to 'find another example . . . and another', for example, a function has x-intercepts 3 and 5.

- Giving an A5 piece of scrap paper for students to record their thinking about what they learned, need to know, would like help with.
- Homework
- Use of mini-whiteboards for students to show their answer to a question.
- Quiz at the beginning of a lesson.
- Student generated test and practice examples.

Summative Assessment

Summative assessment enables teachers, students, and parents to gain an indication of student achievement at an appropriate point in time. This maybe at the end of a unit of work, at the end of a term, or in an end of year examination. (New Zealand Curriculum Guide, August, 2012)

Summative Assessment Activities for Mathematics

These include:

- unseen Examination in controlled conditions (e.g. 3 questions in 3 hours)
- seen exam paper in controlled conditions (as above, but you know the question(s) in advance)
- open Book or Take-Away exam
- multiple Choice Test in controlled conditions (paper-based)
- in-class test
- essay or Report (e.g. on an individual or group project)
- portfolio
- attendance

Conclusion

The data shows that while we have seen some improvement in the performance of our students, the average Jamaican primary-school student continues to struggle with critical but basic mathematics ideas. It is a serious problem and one which have garnered much attention in recent months. However all is not lost, we believe a lot can be done and the onus is upon each classroom teacher to implement strategies to combat this huge crisis.

This research paper presents various strategies which if used effectively and consistently will produce tremendous results. Classroom Environment, Technology, Problem Solving, Differentiated Instruction and Ongoing Assessment are all strategies which can be used in the daily classroom to develop the learners understanding, comprehension. Computation and implementation skills.

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