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TEACHING SLOW LEARNERS IN MATHEMATICS: YUGAL REMEDIATION MODEL AS ALTERNATIVE METHOD

YUSHA'U, M. A. Ph.D.

ABSTRACT

Considering the importance of teaching and learning of mathematics today one of the greatest challenges to a mathematics teacher is teaching mathematics to children who are slow learners. Slow learners are considered to be those children who are of limited intelligence with any or a combination of identifiable dysfunctionalities like attention deficit disorders (ADD), dyscalculia, dyslexia, dysgraphia, dyspraxia, dysnomia, hyperactivity or other related problems. Slow learners are being characterized as functioning at ability significantly below grade level and consistently scoring low on achievement tests. Most mathematics teachers have little or no consideration about the needs of slow learners in mathematics classrooms. As part of the means to improve the achievement level of slow learners this paper discuses the definition of slow learners, basic causes of slow learning, identifiable characteristics of slow learners and suggests the use of YUGAL as alternative teaching method that could best be used in teaching slow learners. The paper recommends mathematics teachers to use YUGAL remediation model appropriately when teaching mathematics to slow learners.

Key words: teaching mathematics; slow learners; remediation model; alternative method

Introduction

The greatest challenge to a Mathematics teacher is teaching a child who is a slow learner. It is an admitted fact that every class has a composition of 20% to 30% or more slow learners. The slow learners do not fall into the category of special education children as they do well outside the classroom and show no evidence of having a medical problem. They simply do poorly in Mathematics subject.

Singh (2004:290) opines that:

> a good teacher always gives individual attention to slow learners. It is now an admitted fact that not all children do learn quickly. It is the gifted children who learn quickly and quite a large number of children coming to school learn slowly. Slow learners lack in understanding, comprehension and expression.

However, today's secondary schools educational emphasis is less on occupational learning and more on academic preparation. Thus, there is a growing need for help to remediate slow learners so as to provide them the best possible opportunities to close the gap created by their pairs and meet the challenges posed by the changing world.

This paper, therefore, takes an in-depth look at the various definitions given to slow learners by educationists, the basic causes of slow learning, characteristics of slow learners and suggests the alternative method to be use in teaching slow learners.

Definitions of Slow Learners

The term slow learning has been commonly used by teachers and educationists in describing students who have learning problems. Slow learners are those children who are of limited intelligence (Williams, 1970).

According to the Special Educational Needs Resources (SENR) a child is defined as having Special Educational Needs"

If he or she has a learning difficulty which needs special teaching. A learning difficulty means that the child has significantly greater difficulty in learning than most children of the same age. Or, it means a child has a disability which needs different educational facilities from those that schools generally provide for children of the same age in the area. The children who need special education are not only those with obvious learning difficulties, such as those who are physically disabled, deaf or blind. They include those learning difficulties that are less apparent such as slow learners and emotionally vulnerable children. It is estimated that up to 20% of school children may need special educational help at some stage in their school career.

Majority of our secondary school students today are those with moderate learning difficulties in Mathematics which result in them learning at a slower rate than other students of the same age in the same school. These categories of students can be successfully supported to reach their potentials with the help of remedial teaching. The need for this remedial teaching could be seen from the performance of Usmanu Danfodiyo University Model Secondary School Sokoto students in Mathematics as indicated in the table 1 below.

Table 1. Usmanu Danfodiyo University Model Secondary School Sokoto Mathematics Examination Result First Term 2007/08 Session

Class	Total Number of Students Per Class	Number of Students that Scored 50% and above (Credit Level)	Percentage of Students that Scored 50% and above (Credit Level)	Number of Students that Scored 40% - 50% (Slow Learners)	Percentage of Students that Score 40% - 50% (Slow Learners)	Number of Students that Scored below 40%	Percentage of Students that Scored below 40%
SS 3	42	10	23.81%	05	11.90%	27	62.29%
SS 2	69	29	42.03%	33	47.83%	07	10.14%
SS1	86	16	18.60%	27	31.40%	43	50.00%
JS 3	70	21	30.00%	19	27.14%	30	42.86%
JS 2	60	04	06.67%	08	13.33%	48	80.00%
JS 1	97	60	61.86%	25	25.77%	12	12.37%
Total	424	140	33.02%	117	27.59%	167	39.39%

Source: *Usmanu Danfodiyo University Model Secondary School (UDUMSS, 2008)*

The result presented in Table 1 clearly indicated that more than 60% of UDUMSS students are below average in Mathematics subject. This confirmed significantly the presence of slow learning or other learning difficulties or the combination of both. Shaw, Grimes and Bulman (2005:02) cited Mercer (1996) considers slow learners to be Children, who are doing poorly in school, yet are not eligible for special education. Their intelligence test scores are too high for consideration as a child with mental retardation. Their intelligent test scores are likely too low for their to be a large intelligence-achievement test score discrepancy usually required for eligibility as a child with learning disabilities.

MacMillan, Gresham, Bocian & Lambros (1998) hold the view that slow learners may have special educational needs; they do not fit neatly into the special education system. Understanding the basic causes of slow learning will absolutely help teachers in their design for the new intervention.

Basic Causes of Slow Learning

Slow learners may have any combination of identifiable dysfunctionalities like attention deficit disorders (ADD), dyscalculia, dyslexia, dysgraphia, dyspraxia or dysnomia or hyperactivity and sometimes none. Other causes identified by researchers include students' problems (visual motor coordination, negative attitude towards Maths, divergence opinions or views on concept, generalization and skills, lack of maturity on future need). Teachers' problems

(knowledge of subject matter, personality, methodology, strategy and method of evaluations). Parental' problems (negative attitude toward their children success, intensive pressures toward attainment of academic success by the children).

However, there are basic causes of difficulties with Mathematics as advocated by Mathematics educators. These are:

Incomplete mastery of number facts, which involved basic computation and recalling of Mathematical facts (5x3+2x5÷5=5).

Computational weakness inconsistency at computing misuse of operational sign or carrying of numbers to the next step(s).

Difficulty transferring knowledge students' inability to make connections from previous knowledge to the present level. i.e. the use of Pythagoras's theorem to solve triangle problem(s).

Incomplete understanding of the language of Mathematics – students having difficulties with the terminologies of language and symbols used in Mathematics. i.e. =, ≤, ≥, K etc

Visual, spatial and perceptual difficulties – students' inability to effectively visualize mathematics concept which greatly affect the judgement on Mathematical objects and perceptual skills.

Students' learning difficulties in Mathematical Concepts, Principles, Terms and Symbols (Galadima, 1988; Wright, 1996; Inekwe, 1997; Geary, 1999; Howell, 2000; & Yusha'u, 2004).

Characteristics of Slow Learners

Researchers, educationists and psychologists offered plethora characteristics of slow learners. Mercel (2003) reported the characteristics of slow learner in a study conducted in the United States of America:

Functions at ability but significantly below grade level.
Is prone to immature interpersonal relationships.
Has difficulty following multi-step directions.
Lives in the present and does not have range goals.
Has few internal strategies i.e. organizational skills, difficulty transferring and generalizing information.
Scores consistently low on achievement tests.

Works well with "hands-on" material (i.e labs; manipulative, activities).
Has a poor self-image.
Works on all tasks slowly
Masters skills slowly, some skills may not be mastered at all.

Other common characteristics of slow learners given by Sheree and Kelly are; their measured intelligence is 75% - 90% of the average child, the ability to read comes about a year later than most and the rate at which they learn is 4/5 to 9/10 that of their normal rate; slow learners abstract thinking is difficult and their attention span is short; they react slower than average, self-expression and self-esteem are awkward and low respectively. It is always hard for them to figure things related to multiple instruction. Most slow learners function below grade level in all subject areas and generally score consistently low on achievement test. Sheree and Kelly(n.d) concluded that slow learners are not capable of learning but cited Carrol(n.d) who wrote, "slow learners are handicapped in the regular classroom to approximately the same degree as students with average abilities when competing with gifted students. However Sheree and Kelly now believe that slow learners are able to learn although the mastery of skills comes much slower. Also, Cooney, Davis & Henderson (1975) identified characteristics of slow learners in Mathematics to be:

Negative attitudes toward mathematics;
They are totally convinced that they cannot understand mathematics or do anything of mathematical nature;
Seeing themselves as complete mathematical failures;
They are prime candidates for all defensive behaviours;
They sometime exhibit hostility by refusing to work or annoyed other students through disrupting _behaviour such as making nasty remarks to colleagues or throwing of objects.

Intervention methods for slow learners

In an attempt to deal with students who are slow learners, teachers usually design intervention instructions that would be most suitable or select teaching methods that are most appropriate.

Mark (2005) suggests that efforts should be made by teachers to help students to overcome mathematics problems through the following steps:

Educational pedagogy must be broad enough to encompass the many learning styles of students

Teaching methods under a holistic approach can include incorporating visual tools and models, utilizing hands-on-lessons, allowing cultural connections, acknowledging the multiple intelligences of every student and advocating gaming both inside and outside of school.

On how to help slow learners, Alan (2007) advised teachers to use what he termed as his "three transfer":

Be patient but consistent
Do not reward unfinished task
Challenge the child.

There are available suggestions and guidelines but perhaps few models on how to help, teach and improve the standard of slow learners. Investigation proved that majority of the researches done in the area of improving mathematical learning difficulties among students was through the use of mastery learning model of Bloom (1968)

Mastery Learning

According to Davis and Sorell (1995), mastery learning is not a new concept; it was introduced into American education over 70 years ago. It is a process whereby student(s) achieve(s) the same level of content mastery but at different time intervals. Davis and Sorell (1995) also report that the mastery learning concept was introduced in the American Schools in the 1920's with the work of Wasburne (1922) as cited in Block, (1971). The program is said to flourish during that particular decade; but however due to lack of the technology to sustain the program, interest among developers and implementers diminished. It was later revived in the form of programmed instruction in the late 1950's with the main objectives of providing students with the needed instructional materials that would enable them to learn at their own pace and received feedback at regular basis on each level of mastery. During the 1960's Bloom's (1968) model for learning Mastery emerged with a new focus and intention, which is up till today remain the classic theoretical formulation on mastery.

Bloom (1968) made a number of specific predictions about the gains from mastery learning procedures among which are;

Ninety five percent (95%) of the students will achieve at the level previously reached by the top 5%.

Typical score in a mastery classroom should be around 98thpercentile. Bloom also argued that; Students do not have to put in much more time

on school tasks to achieve level of proficiency. Although students taught for mastery may need more time to reach proficiency in the initial stages of a course.

Describing the position of Bloom (Fehlen, 1976) reports that Bloom maintains the assertion that besides mastery of that material to be learned, mastery learning increases the attitude and interest of students.

Bloom (1968) suggests that mastery learning procedures are likely to enhance learning outcomes in most all subject areas. However, he suggests that effects will be largest in Mathematics and science since learning in these subject areas is generally more highly ordered and sequential (Guskey and Gates, 1986).

However, extensive researches have been done since Bloom's (1968) introduction of mastery learning model and suffice here are the condensation of some of the researches and findings. Hence, the effect of mastery learning:

Guskey and Gates (1986) conducted a meta-analysis on the areas of student achievement, student retention, student effect, and time and teacher variables. They found overwhelming positive results on student achievement; students retained what they had learned at both short and long term period; both teachers and students developed positive attitude towards teaching and learning, etc.

Guskey and Pigott (1988) conducted their analysis on group-based and found positive effect on student achievement as a result of the application of a group-based mastery learning strategies.

Kulik, Kulik and Bangert-Downs were reported by Davis & Sorell (1995) to have conducted a meta-analysis involving 108 evaluation of mastery learning programs using the following yardsticks; examination performance at the end of instruction; attitude towards instruction, content and course completion. The findings revealed positive effect on examination and positive correlation in student's attitude and mastery of content.

Mevarech, Slavin and Karnerit were also reported by Devis & Sorell (1995) to have conducted their research by comparing mastering learning, mastery learning with teams, teams alone, and traditional instruction on student achievement. These studies were similar in their design, yet the end result varies. Mavarech reported that mastery learning was the indicator that significantly increased achievement. While Slavin and Karnri reported

that student achievement was affected by the team treatment and not the mastery learning treatment.

Dunkelberger and Heikkinen (1984) performed their study by investigating on repeatable testing of the mastery learning. Achievements were examined using subjects who were allowed to repeat tests and subjects who were allowed only one attempt at the test. The findings of the study revealed no significant correlation between achievement and repeatable testing. The authors were of the view that cognitive gains obtained from mastery learning are related to a combination of remediation and retesting, not retesting alone.

Okey (1974, 1977) examined the materials necessary to be used in teaching mastery learning, teachers and students attitudes toward mastery learning and student achievement. From the study significant positive effects were discovered in all areas.

After highlighting what is expected from the teachers handling slow learners. Now the central question is. Is there any alternative method to be used in teaching slow learners? And the answer to this question is YES! Hence, the alternative method

The Alternative Method

In light of the serious problems associated with slow learning in mathematics, additional research is warranted to examine the existing methods for intervention and remediation. At present, research supports the use of mastery learning and individual teacher efforts for addressing slow learners difficulties.

It is in view of this the author of this paper felt that there is a great need for additional method that could be added to the existing methods in handling slow learners learning difficulties. Recently Yusha'u and Galadima designed a remediation model which they termed YUGAL-Remediation Model to be used by teachers in remediating students' mathematical learning difficulties.

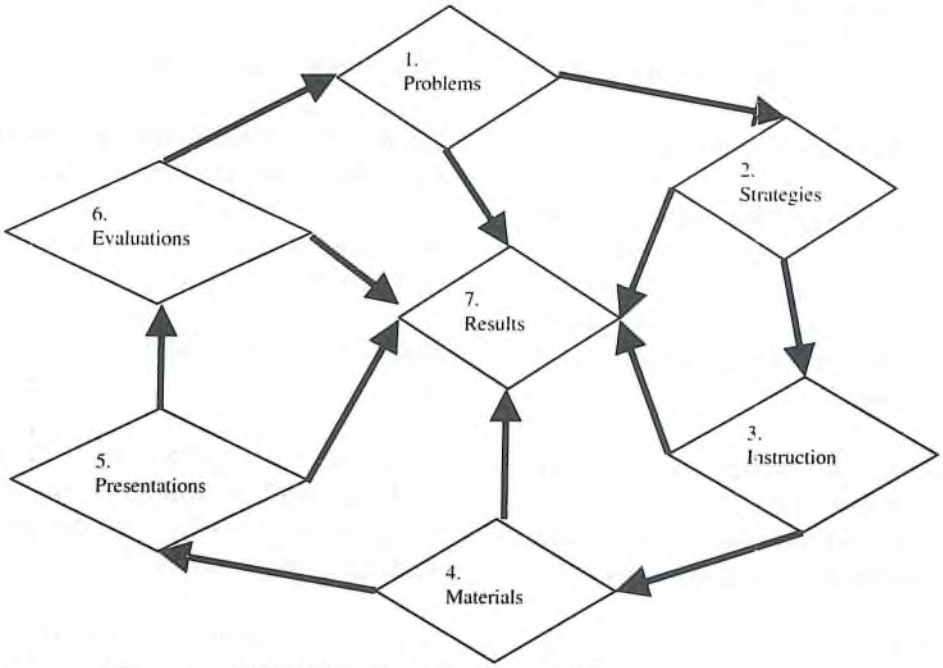
Therefore, this paper is advocating for the use of YUGAL remediation model as an alternative method that could be used in teaching slow learners.

Background of YUGAL Remediation Model

The model was designed in 2005 with the sole aim of diagnosis and remediation in teaching and learning of mathematics in schools of Sokoto State. It was first introduced and

used during a 3-day mathematics workshop for retraining of mathematics teachers in Sokoto State, organized by Mathematical Association of Nigeria (MAN) Sokoto State chapter in conjunction the State Universal Basic Education from 4th – 6th July, 2006 at the then Attahiru Bafarawa Institute for Quranic Studies, Sokoto.

The YUGAL Remediation Model



The seven (7) steps of YUGAL remediation model

Step 1. Identify problems through diagnosis:

Individual student is considered to have a learning difficulties if achievement does not commensurate with age and ability levels in one or more of the following; manifestation of an imperfect ability to listen, think, speak, write, spell or to do mathematical calculation. It also includes directional confusion, sequencing difficulties and short term memory retention problems. Teachers are expected to identify student's specific difficulties diagnostically.

Step 2. Design strategies for remedial instruction:

When problems are identified, the teacher is expected to design appropriate strategy to be used for intervention, this include development of prerequisite skills, developing key concepts and selecting teaching methods that will match the learning personality of students and their prerequisite skills.

Step 3. Plan remedial instructions:

After designing the strategy, the teacher is expected to ordely and sequentially arrange his/her lesson on paper taking into consideration the following essential elements of a lesson plan;

Objective; what students will be able to do as result of the lesson.
Standards; which state content and developmental standards of the lesson.
Procedures; how and what the teacher will do to achieve the objectives
Assessment; what the teacher can do to see if the lesson is taught effectively. This include both formal and informal or both formative and summative evaluations.
Modifications/accommodations; for any special needs students in the class.

Step 4. Select appropriate instructional materials:

A teacher is expected to select appropriate instructional materials according to their importance and for effective usage. Example of such materials include textbooks, models, games, audio-visual aids etc

Step 5. Effect presentations:

Lesson presentation plays a vital role in teaching and learning. A teacher is expected to plan and strategize his presentation ie inductively or deductively.

Step 6. Test and evaluation strategies:

A teacher is expected to test and evaluate his/her strategies through assignments and class works using standardized questions.

Step 7. Compare past and present results:

A teacher is expected to compare and contrast previous with present results in order to check the level of performance and find out whether or not there is significant difference as a result of remedial instructions received. (Yusha'u, 2006)

Application of Yugal Model

Step 1. Identification of problems through diagnosis:

Students were identified to have had difficulty with learning quadratic equation with a typical score of 30 – 40 percent.

Step 2. Designing strategies for remedial instruction:

Students' prerequisite skills; is knowledge of algebraic equation. The teacher is expected to confirm the prerequisite skills through a brief revision of algebraic expression.
Example: Expand and simplify

$-2(a - b + 4) - 2b + 8$

Solution:

Multiply -2 by (a – b + 4) and add -2b + 8

$= -2a + 2b - 8 - 2b + 8$

Collect like terms together and simplify

$= -2a + 2b - 2b + 8 - 8$

$= -2a + \cancel{2b} - \cancel{2b} + \cancel{8} - \cancel{8}$

$= -2a.$

Key concepts:
Meaning of quadratic equation
How to identify quadratic equation
How to obtain quadratic equation
The process of multiplying the binomial
Expansion of algebraic factors to obtained quadratic equation.
Selection of teaching methods:
The teaching methods to be used in teaching quadratic equation are;
Demonstration method
Carefully guided learning method
Grouping method

Step 3. Planning of remedial instructions:

Objectives: At the end of the lesson students are expected to achieved up to 75th percentile of the key concepts of step 2 mentioned above.
Standards: This include content and developmental standard of the lesson.(See table 2)

Table 2: Quadratic Equation

S/No	PROBLEMS	SOLUTION
1.	What is quadratic equation?	An equation of the form $ax^2 + bx + c$ is called a quadratic equation or quadratic expression. (Where a, b and c are integers or constant) $a \neq 0$.
2.	How would you identify quadratic expression?	A quadratic expression has second degree in x or a or b or q or p as in the given example: $x^2 + 5x + 6$ $a^2 + 5a + 6$ $b^2 + 5b + 6$

		$q^2 + 5q + 6$ $p^2 + 5p + 6$
3.	How do we obtain quadratic expression?	A quadratic equation is obtained by multiplying the binomials i.e. $(x+2)(x+3)$
4.	What is the name given to the process of multiplying the binomials	Expansion; for example expand $(x+2)(x+3)$ *Solution;* $x(x+3) + 2(x+3)$ $= x^2 + 3x + 2x + 6$ $= x^2 + 5x + 6$ Note that the above expression is as follows $(x+2)(x+3)$ $x(x+3) + 2(x+3)$
5.	Which of the following is NOT a quadratic expression? $x^2 + 3x + 2$ $x^3 - 2x^2 + 3$ $3x^2 - 2$ $4x^2 + x - 3$	b. $x^3 - 2x^2 + 3$
6.	Expand the following: $(x+5)(x+7)$	$x(x+7) + 5(x+7)$ $= x^2 + 7x + 5x + 35$ $= x^2 + 12x + 35$

Procedures: The teacher will orderly and sequentially follow his/her plan as presented above.

Assessment: The teacher will assess his/her students through class work and assignments.

Example: (Class work)

Expand the following:

$(2a+3)(a-4)$

$(3x-7)^2$

Solutions:

$2a(a-4) + 3(a-4)$

$= 2a^2 - 8a + 3a - 12$

$= 2a^2 - 5a - 12$

$(3x-7)(3x-7)$

$= 3x(3x-7) - 7(3x-7)$

$= 9x^2 - 21x - 21x + 49$

$= 9x^2 - 42x + 49$

Assignment:

Solve the followings:

$(a+b)(a-b)$

$(2y-2)(y+4)$.

Solutions

$a(a-b) + b(a-b)$

$= a^2 - ab + ab - b^2$

$= a^2 - b^2$

$2y(y+4) - 2(y+4)$.

$= 2y^2 + 8y - 2y - 8$

$= 2y^2 + 6y - 8$.

Step 4. Selection of instructional materials:

Textbooks

Cardboard sheets

Flash cards
Scissors
Markers

Step 5. Presentation:

The lesson will be presented inductively i.e. from simple concept to complex concept i.e. the meaning of algebraic equation to quadratic equation ($a + b$ to $a^2 + 2ab + b^2$).

Step 6. Test and evaluations:
The students are to be evaluated through;
Class work
Assignment
Objective and essay questions formatively and summatively.

Step 7. Comparison of past and present results.

The teacher is expected to compare the students' results before the lesson and after the lesson to see if the objectives have been achieved. If the objectives have not been achieved the lesson should be repeated to the affected students only until they attained at least 75 percent score.

Recommendations

1. Teachers should use YUGAL Model appropriately when teaching slow learners
2. Slow learners should be encouraged by teachers to use text books
3. Teachers should always provide motivation through unitary or homogenous drive;

   Cognitive drive (task oriented)
   Ego-enhancing (non-task oriented)
   Affliative (neither task oriented nor primarily ego enhancing). (Ausubel, 1968)
4. In addition to the above, teachers should strictly observed the four phases of learning as postulated by Gagne (1970), these are:

The apprehending phase
The acquisition phase
The storage phase
The retrieval phase

Conclusion

As part of expectation and teachers responsibilities is to bridge the gap that always exit between the gifted, average and slow learners in every mathematics classroom. To achieve this noble objective the paper searched and found suitability in YUGAL to serve as an alternative method that could best address the problems of slow learning in mathematics classrooms.

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