20

Teachers' Creativity: An Innovation to Effective Evaluation in Primary School Mathematics

By

DR. KINGSLEY CHIMAH OBI
Department of Primary Education Studies,
Alvan Ikoku Federal College of Education, Owerri,
Imo State.

MATHEW NNANNA
Alvan Ikoku Federal College of Education, Owerri,
Imo State.

And

CHARITY C. OSIGWE
Science and Computer Seminary Ezihe, Isiala Mbano,
Imo State.

Abstract

The paper Teachers' creativity: An innovation in effective evaluation of primary school mathematics. Creativity calls for divergent thinking and redefinition of already existing set of rules. The study was carried out in Isiala Mbano L.G.A of Imo State. It was a quasi experimental study involving two randomized groups. The population was 140 primary 5 pupils and the sample was 90 pupils selected by systematic random sampling, 45 for group A (creative approach group) and 45 for group B (traditional approach group). The test instruments consist of 10 essay type items. The items were validated by experts. The reliability of the instruments was done using K-R formula 21 and the index obtained was 0.70. The two null hypotheses were rejected. The creative approach group performed better than the traditional approach group. The researchers recommend that educational programme planners and evaluators should bring in creativity for improvement in education among others.

Keywords: Creativity, Innovation, Evaluation.

Creativity is the ability which an individual possesses to formulate, originate or discover new ideas or ways of carrying out/performing specific tasks successfully. It is synthetic combinatorial of realistic and imaginative thinking which most of the times result into novel and unusual ways of solving problems. Creativity lends itself to individuals (irrespective of areas of human endeavour) ability to go beyond the normal or conventional rules to find out unique and original solutions to problems at hand, (Ogwudire, 1997). Creativity could see a teacher sharpening and brightening up a pupil who has been labeled "dummy" by every other teacher and fellow pupils. Creativity could also illuminate and ignite a footballer to score an unsuspecting winning goal when all hopes were almost lost. Over the years, scientists (due to creativity) have worked on and invented new devices such as equipment, gadgets, vaccinations, therapies, drugs etc for healthy upkeep and advancement of mankind and the society. According to Ogwudire and Iroegbu (1997) a number of human factors facilitate creative efforts. They include: redefinition, divergent thinking and sensitivity to problems.

Redefinition: The creative individual throws away old existing ideas and develops new ways of looking at the same variables. This is contrary to convergent thinking whereby a person is stagnated to old and already existing ideas.

Divergent Thinking: This gives rise to flexibility of thought, novelty in concepts oratory prowess (fluency in speeches) ideas and collaborations. Divergent thinkers aggregate what seemed to be useless pieces of information into meaningful mental deposits. Their originality and uniqueness are always outstanding.

Sensitivity To Problems: Problems and problem-causing situations are natural phenomenon. A creative individual assesses/evaluates the content of a problem and makes useful inferences that a solution is needed for it and he goes on to develop steps towards the solution. He does this through intelligence and past experiences which may enhance quick and accurate solution.

Teacher Effectiveness and Instructional Delivery of the Teacher

Teacher effectiveness is a quality continuum on which the actions, inactions and interactions of a teacher towards making students achieve set objectives can be placed (Ogomaka, 2012). Teacher effectiveness is the ability of the teacher to make sure he creates, fosters and maintains a good, challenging and favourable classroom environment so as to ensure an effective instruction delivery (teaching and learning). For teachers' objectives and teaching effectiveness to be attained, the teacher must utilize good managerial skill to control his classroom as well as the discipline of his pupils. Teacher effectiveness is a universal entity which incorporates good managerial skills, involves good classroom environment and its preparation. Good preparation of classroom environment is the arrangement of the classroom to enable the teacher oversee every activity going on in the class at all times. For this to be achieved, the teacher positions himself properly in the class with the seating arrangement in the class

well positioned. This entails making sure that adequate space is maintained in the classroom to enable free traffic flow in the classroom. The teacher must also maintain a good teacher-pupil relationship so as to ensure democratic dealing with his pupils. This will bring about cordiality between the teacher and his pupils. To this end he must take cognizance of the fact that individual differences exist among his pupils and also keenly observe the general ability of his class. In his dealings with his pupils, the teacher has his own personal characteristics. These personal characteristics possessed by the teacher must be good and stable which enable the teacher to be reliable, honest, trust-worthy, consistent among others. He must have good knowledge of his subject matter and also carry his pupils along. The needs of the pupils are diverse and include such need for love and security, need for good academic performance etc. must be satisfactorily met. He should be fair in his ruling and not too rigid. (Enukoha (2010).

The teacher in his effectiveness should prepare his lessons and at the same time use variety of teaching methods. He should provide learning experiences appropriate to various levels of development of the child, thus minimizing classroom problems. The subject matter must be meaningful and challenging and should be within reach or level of his pupils, ensuring they are adequately provided for and highly motivated.

The teacher must possess certain good skills belonging to the three domains of educational objectives so as to make him effective. These skills are;

a. Cognitive Skills

i. Knowledge of the learner
ii. Knowledge of the subject matter
iii. Knowledge of teaching skills
iv. Knowledge of psychology of learning

b. Affective Skills

i. Show interest in the learner
ii. Create a democratic classroom climate, show love, understand every individual learner, be accepting kind and humorous

c. Psychomotor Skills

This is the ability to write legibly within a specific time, organize, draw correctly, construct correctly, demonstrate adequately, experiment, prepare improvised teaching aids etc. The instructional delivery of the teacher must include the role or part he plays in his teaching to ensure realization of specific objectives and behavioural change of his pupils in the discharge of his duties. This will ensure the production of skilled, informed healthy and productive citizens. The teacher gives instruction to his pupils, directs, plans, organizes and supervises the learning activities of his pupils. He also provides required opportunities for the pupils to learn by finding appropriate learning materials for the pupils to learn according to their individual abilities and potentials. The teacher experiments the classroom environment to bring out the best of the needed attributes in his pupils. He uses direct observation to determine to what

extent the pupils are responding to the learning content he is providing. He provides tasks which have different task numbers or levels (Ogomaka, 2011) and determines the easiness or difficulty of such tasks and the rate at which the pupils respond to them. The teacher in his role and responsibility through good classroom management prevents and controls problem behaviours of his pupils. He provides incentives and motivational techniques to encourage pupils and also organizes learning activities that are challenging.

The teacher provides help and ideas to his pupils in relationship to interaction with learning materials. He uses a democratic principle to approach his pupils, passes on positive expectations, encourages his pupils as well as allowing them to express their own opinions and initiatives. He can also suggest new concepts and how they were arrived at to develop along that line of reasoning.

Teacher effectiveness when fully exhibited and demonstrated, helps pupils manifest self esteem, he cannot do this if he does not understand the overall needs of his pupils very well. This gives the child sense of belonging. The teacher must introduce variety during lesson delivery, such as creating an atmosphere of laughter or play activities in between lessons. He must make sure he challenges fast learners very well and at the same time tolerate the slow learners by giving more attention to them.
Assessment techniques as used by the teacher must be of various forms aimed at proper evaluation. To ensure the realization of this, the teacher adopts child -centered methods of teaching and at other times may also use teacher-centered methods. In carrying out his task using child-centered methods, the teacher uses project method, experimentation, discussion method, discovery method, problem-solution method, individualized instruction method and insightful method. In his teacher-centered method, the teacher uses demonstration and lecture methods, (Nwana, 2007).

The teacher must have the proper understanding that his good relationship with his pupils must affect them positively in their attitude towards learning. He must therefore encourage and tolerate them to reasonable extent (Ogwudire and Iroegbu 1997). Teacher effectiveness is a quality continuum and must incorporate the following attributes:

a. Subject Matter Mastery (SMM) or mastery of subject matter (MSM).
b. Classroom Management (CRM)
c. Teacher knowledge of Students (TKS).
d. Teacher Personality and Presence (TPP).
e. Teaching Principle and Methods (TPM) (Ogomaka 2011).

The primary school teacher in his effectiveness and instructional delivery in primary school mathematics must demonstrate good subject matter mastery (SMM) and convince his pupils properly that mathematics is not a difficult subject but for interesting and hardworking pupils. He does so by using variety of approaches to problem solving in the classroom setting. Severally, the teacher solves given examples

on mathematics topics through conventional (traditional) methods and other new approaches not very familiar with his pupils so as to promote and foster proper learning of the subject with every ease. He is a good manager in his class, sees properly to adequate provision and arrangement of seats and tables for easy passage through the different corners of the class and at the same time have proper knowledge of his pupils, their cognitive abilities, family and socio-economic backgrounds, religious affiliations, names of the pupils and know that his personality which comprises composure, dressing and movement in the class has much influence on his pupils. He must also ensure that he utilizes good teaching principles and methods which include questioning skills, chalkboard management, legibility and voice or vocal sound. His mastery of content in his instructional delivery of any topic on mathematics must have required method and principle. In the delivery of his lessons, his voice must be distinct and audible for easy communication and transform of knowledge of mathematics. Instructions on how to solve every problem must be clearly stated and every approach to problem solving properly explained. He must introduce the newly discovered task number as proposed by Ogomaka (2002) in his problem solving. Task number is a newly conceived psychometric property by Ogomaka (2011) and has not been given much consideration (Ogomaka 1990). Task numbers are steps to mental operations which are undertaken to successfully or accurately arrive to a solution to a given problem or task without reckoning/counting again any step that has already been undertaken Ogomaka, (2004).

Primary School Mathematics and Instructional Delivery of the Teacher

The teacher in his instructional delivery in primary school mathematics must ensure that he realized the objectives set out for the course content. The objectives include:

1. The teacher demonstrates skills in teaching primary mathematics curriculum using child centered strategies.

2. The teacher designs, produces and utilizes relevant instructional material (including locally sourced) for effective teaching of the primary school mathematics curriculum.

3. He must develop scheme of work and lesson plans in accordance with National Primary School Mathematics Curriculum (NPSMC). The teacher must use child-centered strategies for teaching which include:

i. Number stories
ii. Word problems
iii. Mathematics games
iv. Use of graphic organizers

According to Ilori, Okunmuyide, Mohammed and Okechukwu (2010). A good combination of one or more of these strategies together with appropriate instructional

materials based on specific objectives will ensure proper instructional delivery. These strategies and their usefulness are briefly explained as follows:

- **Number Stories**

Number stories are highlights on how stories and mathematics can be used in conjunction to each other to aid in the mathematical development of a child and provide the child with certain benefits, Adegbeyiene, Ezeriuku and Ajugu (2004). Stories make anything seem possible with just a little imagination. Number stories make a good way to help the children to develop mathematical ideas which will further help the children to see the relevance of mathematics in their own lives. Stories can feature as strongly in promoting children's mathematical development as the other activities used for this purpose, such as physical activities (e.g. following directions, counting skills or jumps), stories can show children how numbers, measuring and shapes help us with everyday tasks. Number stories give children a good foundation for the understanding of abstract concepts which later stages of their development will require of them. The pictures in a story book can offer many opportunities for the development of mathematical discussion as the story progresses. Stories can help visual learners, as well as auditory learners, to remember and understand mathematical ideas.

Development of vocabulary is an essential part of learning. Mathematics has words that are unique to the subject. Words as minus, add, square, and symmetry are rarely used in children's everyday life. However, if these words are gently introduced through stories, children will have a picture of what we use them to represent. This will help children to be more comfortable with them when they meet them again later in life Adeniran, Agboulabor and Olatokun (2009).

- **Strategies of Teaching Number Stories**

One of the strategies of teaching number stories is by encouraging numeral recognition and formation. This will be done by encouraging the children to say the name of each number and to show the appropriate number of fingers. Children can as well be asked to carry out a number of actions such as clapping, nodding, leg tapping etc. trace the numerals with a finger, draw their attention to the spot which indicates the starting point and the arrow which shows direction and also encourage them to trace over the numeral with a finger. The children are required to make a small collection of objects and also count them. They should be told that the best way of counting is to place the fore finger of both hands on the starting number. The left hand finger stays in position while that of the right hand counts the jumps to the right. This will help the children to remember their starting point (Chanon, Smith and Head, 2004).

- **Word Problems**

In mathematics education, the term word problem is often used to refer to any mathematics exercise where significant background information on the problem is presented as text rather than in mathematical notation. They often involve a narrative of some sort, they are occasionally also referred to as story problems and may vary in the

amount of language used. The contents of word problems are example, structure, common types, purpose and use, history and culture, references and external links.

- **Strategies for Teaching Word Problems**

The rationale and reasons for teaching number stories and word problems are:

1. To stimulate in the children the interest and joy in mathematics.
2. To train children in accuracy.
3. To inculcate in the children the skills to manipulate numbers.
4. To help them to develop a healthy attitude towards learning.
5. To help them to understand mathematics
6. To train their mind in the habit of accurate reasoning.

- **Mathematical Games**

A mathematical game is a multiplayer game whose rules, strategies, and outcomes can be studied and explained by mathematics. Examples of such games are Tic-tac-toe and Dot and boxes. On the surface a game need not seem mathematical or complicated to still be a mathematical game. For example, even though the rules are straight forward. Mathematicians analyze the game using combinational game theory. Mathematical games differ from mathematical puzzles in that all mathematical puzzles require mathematics to solve them whereas mathematical games may not require a knowledge of mathematics to play them or even to win them. Thus, the actual mathematics of mathematical games may not be apparent to the average player. Some mathematical games are topics of interest in recreational mathematics. When studying the mathematics of games, the mathematical analysis of the game is more important than actually playing the game. To analyze a game mathematically, the mathematician studies the rules of the game in order to understand the inner-workings of the game possibly to determine if a game has a solution (Adeniran 2009).

- **Graphic Organizer**

A graphic organizer is a visual and graphic display that depicts terms, and or ideas within a learning task. Graphic organizers are also sometimes referred to as knowledge maps, concept maps, story maps, cognitive organizers, advance organizers, or concept diagrams. One way to make a curriculum more supportive of students and teachers is to incorporate graphic organizers. Graphic organizers come in many varieties and have been widely researched for their effectiveness in improving learning out comes for various students, (Adeniran 2009).

There are different types of graphic organizers, they are

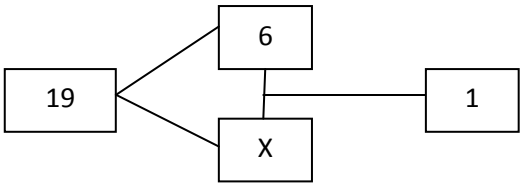
i. Descriptive or thematic map
ii. Network trace
iii. Spider map
iv. Problem, and solution map
v. Problem-solution outline
vi. Fishbone map

vii. Comparative and contrastive map
viii. Compare and contrastive matrix
ix. Continuum scale
x. Series of event chain
xi. Cycle interaction outline
xii. Human interaction outline

When the teacher utilizes these strategies very well in his primary school mathematics instructional delivery, combined with maximum effectiveness, he provides a basic frame work for a good educational achievement of the pupil at the adolescent stage. Solve for missing values in the figures below;

1. $+ 47\frac{3}{4} = 76$

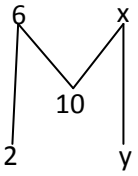
2.



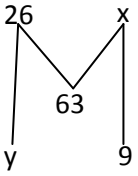
3.

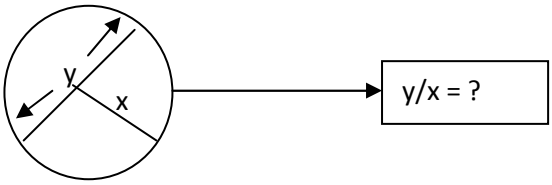
2	a	2/3
b	$1^2/_3$	c
d	e	$1^1/_3$

4.

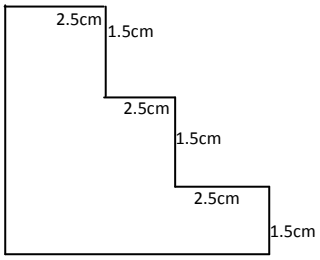


5.



6. 

7. Find the perimeter of the figure below



Statement of Problem: The determination of creativity estimate θ, using logistic curve of item response theory IRT is highly demanding. For an achievement test mean for a group of testees less than 1000 or even 2000, it is a waste of time to and also not in conformity with the use of logistic curves. To determine the properties of the test following the classical test theory (CTT), would imply the use of a set of testees who are not members of 1000 or 2000. Yet the determination of item properties through CTT approach is faulted since such properties are said to be group dependent.
Could the utility and utilization of creativity in problem solving and evaluation in primary school Mathematics offer better articulation among pupils and teachers?

Scope Of The Study: The areas of Mathematics in which 10 essay type quantitative reasoning (Etqr) are set are arithmetic and geometry of senior primary school (basic) Mathematics.

Purpose Of The Study: Generally, this study aims at ascertaining which of the traditional or creative approaches in Mathematics will produce better results as regards cognitive performances in arithmetic and geometry.
Specifically the researchers
i) Ascertained the mean cognitive performance scores in primary school arithmetic and geometry of two groups of pupils.
ii) Tested if the mean scores (x) of the two groups of pupils differ significantly.
iii) Ascertained the variance of cognitive performance scores in primary school arithmetic and geometry of the two groups of pupils.

iv) Tested if the variances of the scores of the two groups of pupils differ significantly.

Research Questions

The researchers formulated the following research questions to guide the study:

1) What are the Mean Cognitive Performance, scores (X) of the two groups of pupils evaluated based on traditional approach and creativity approach of solving primary school mathematics?

2) What are the variances of the cognitive performance scores of the two groups of pupils evaluated based on traditional approach and creativity approach of solving primary school mathematics?

Hypotheses: The researchers formulated the following hypotheses to guide the study:

HO_1: The mean cognitive performance scores (x) of the two groups of pupils do not differ significantly at α - level of 0.05.

HO_2: The variances of the cognitive performance scores of the two groups of pupils do not differ significantly at α - level of 0.05.

Significance of the study:

The study is considered significant because: the result of the study will add to the existing body of knowledge on the need and importance of creativity to problem solving in the evaluation of primary school mathematics. The study highlights the main effects of creativity in the evaluation of primary school mathematics. The study would help evaluators give required consideration to creativity during school and programme evaluation.

Education authorities such as school supervisors will realize the importance of creativity in teaching and learning.

Mathematics teachers will see the need to bring in creativity in teaching and learning to enhance better understanding.

The study will help evaluators give consideration to creativity during school and programme evaluation.

Design: The study is a quasi experiment. It involves manipulation of independent variable and watching its effect on the dependent variable, without controlling all the intervening variables of the randomized groups.

R_1 X O

R_2 X O

Where R = Random group

X = Treatment

O = Post test

The independent variable is the teaching procedure while the dependent variable is the learning outcome. The two groups were randomized through reshuffling

Population: The population was made up of 140 primary 5 pupils in Isiala Mbano in Imo State, Nigeria.

Sample and Sampling Technique: The sample selected was 90 pupils, 45 for group A and 45 for group B. The sampling technique was systematic random sampling.

Instrument for Data Collection: Essay type test items ($Etti_s$) were used. There were two sections, sections 1 and 2. There were 10 items in all.

Validation of Instrument: The items were validated by five experts of educational Mathematics, Measurement and Evaluation. The experts read through the items to ensure the correctness of expressions, the appropriateness of tasks/exercises and the correctness of the solutions. A test blue print was developed to ensure content validity. The scores were based on percentages.

Reliability of the Instrument: The reliability of the instrument was carry using Kudder-Richardson (K-R) formula 21 and the index obtained was 0.70. This was to ensure that they exhibit the degree of consistency they are expected to.

		Total	**Mean $\bar{x}$**
Random Group A	62, 82, 75, 69, 91, 53, 50, 94, 80, 64, 60, 84, 63, 81, 61, 83, 61, 79, 65, 74, 70, 60, 84, 90, 54, 85, 59, 94, 50, 89, 53, 49, 95, 96, 48, 77, 67, 68, 76, 51, 91, 57, 87, 88, 56	3240	72
Random Group B	40, 82, 32, 90, 72, 50, 60, 62, 48, 74, 81, 33, 89, 70, 82, 55, 67, 64, 58, 69, 53, 51, 71, 39, 83, 51, 71, 33, 47, 75, 50, 72, 49, 73, 30, 92, 40, 82, 83, 39, 43, 79, 81, 41, 61,	2745	61

Test Scores

Mean Score $\bar{x}$ for group A $= \frac{3240}{45} = 72$

Mean score $\bar{x}$ for groups B $= \frac{2745}{45} = 61$

$S^2_A = 152$, $S^2_B = 65$, $n_A = 45$, $n_B = 45$

$$Zcal = \sqrt{\frac{72 - 61}{\frac{152}{45} + \frac{65}{45}}} = 5.009$$

Results

Table 1: Z-test Statistics Summary Table.

Random group	Sample size (n)	Mean (x)	Variance (S^2)	Z_{cal}	Z_{tab}	Decision
Creativity A	45	72	152	5.009	2.02	Significant, HO_1 rejected
Traditional B	45	61	65			

The results of the table show that both groups have sample size of 45 each. The mean score for the creativity group was 72 while its variance was 152. While the mean score for the traditional group was 61 and its variance was 65.

Table 2: F-test for variances Summary table.

	S^2_A	S^2_B	F_{tab}
S^2_A	1.00	2.15 significant HO_2 rejected	1.69
S^2_B	2.15 significant, HO_2 rejected	1.00	1.69

The results of F-test for variances show that the tabulated result was lower than the calculated result, leading to the rejection of null hypothesis. Significant difference existed between the two groups. The creativity group performed better than the traditional group.

Discussion of Result: The creativity approach group performed better than the traditional approach group. This suggests that creativity and innovation should always be brought in the teaching and learning of mathematics.

Implication Of The Study: The result of the finding show that some pupils can perform specific tasks more successfully using creative ideas than when they use the routine (traditional) ways of problem solving in primary school mathematics.

Limitation: The result of this study was limited by some constraints. The researchers were unable to assess pupils in junior primary school and also could not assess pupils in other areas of Mathematics because the scope of this study is based on arithmetic and geometry of senior primary school mathematics.

Conclusion

Much consideration should be given to creativity during instructional delivery and school programmes evaluation to enable pupils do well in primary school mathematics and as a necessary guide for further education. This is so because the results of this study show that the creativity group performed better than the traditional group.

Recommendations: The researchers recommend that this study be carried out in different subject areas at various educational levels and that:

1) Workshops, seminars, conferences and debates on creativity should be organized from time to time by government and other relevant agencies for both teachers and pupils.
2) Pupils who distinguish themselves in creativity in Mathematics should be encouraged using scholarship awards by government and other educational stake holders as well as encouragements using other motivational facilities.
3) Primary school pupils should be encouraged by their Mathematics teachers and other relevant stake holders in education to bring in creativity during problem solving to enhance divergent thinking.
4) Primary school educational evaluators should bring in creativity and innovations during school programme and curriculum evaluations.
5) Programme planners/curriculum experts should endeavour to utilize creativity during programme planning in primary school Mathematics.
6) Primary school Mathematics teachers should facilitate problem solving using creativity.

References

Adegbeyiene, U., Ezeiruku, O. & Ajugu, E (2007). *Essential Computer Studies*, Lagos, Longman Nigeria Plc.

Adeniran, Agbonlahor, R, Olatokun, W. & Olatunde, A, (2009). *Computer Studies for Secondary Schools*, Ibadan, HEBN Publisher Plc.

Channon, B, Smith, A.M. & Head, H.C, (2004). *New General Mathematics for West Africa*, London, Longman Group Limited.

Egbe, E, Odili, G.A and Ugbebor, 0.0, (1999). *Further Mathematics for West Africa*, African - FEP Publishers Limited.

Enukoha, O. (2010 year book number 6) *lesson study Approach for Effective Teaching of Primary Mathematics. Nigerian Academy of Education.* Reforms in Nigerian Education (287-304).

Ilori, S, Okunmuyide, B, Mohammed, W.U, & Okechukwu, S.K. (2010) *Champion primary mathematics* 5, Lagos Macmillan Nigeria publishers Limited.

Ogomaka, P.M.C (1990) *Description Educational Statistics*. Owerri, Totan Publishers Ltd.

Ogomaka, P.M.C (2002) *Towards Uniformity in Research Proposal and Reports.* Owerri, Cape publishers Int'l Ltd.

Ogomaka, P.M.C (2004) *Inferential statistics for Research in Education and social science* Owerri, peacewise systems and prints.