PROMOTING EFFECTIVE CREATIVITY IN MATHEMATICS THROUGH INNOVATIVE METHODS AMONG PRIMARY SCHOOL PUPILS IN BATAGARAWA LOCAL GOVERNMENT AREA OF KATSINA STATE

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Abstract

This study focused on promoting effective creativity in mathematics through innovative methods among primary school pupils in Batagarawa Local Government area of Katsina state.The study was a randomized experimental survey type. 12mathematics teachers and 120 primary four pupils were randomly selected from 4 out of the 66 primary schools in Batagarawa.4 groups(3 Experimental and 1 Control) were formed. Data was collected through self-devised teachers' questionnaire and pupils' achievement test. The t-test analysis of difference between means was used to test each hypothesis at the 0.05 level of probability.Results show that the three innovative methods (play-way, pictures and diagrams and manipulatives) has effect on developing pupils' creativity, and pupils taught mathematics using the methods performed better than those taught using traditional method. Thus, the use of innovative methods in teaching mathematics is highly recommended to develop creativity, enhance better understanding and performance of pupils in mathematics and government should encourage teachers in this respect.

Keywords: Play-way, Manipulatives, Pictures, Diagrams Achievement.

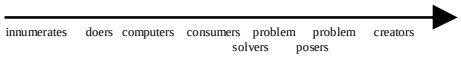
Misfeldt (2015) stated that creativity and innovation are important 21st-century skills, and mathematicseducation contributes to the development of these skills. Thus, the need for creative, innovative individuals with a strong foundation in mathematics is overwhelming. In today's world, it is not enough to be proficient at computation or at memorizing rote procedures to solve routine problems. These skills are important, but even more important are the abilities to recognize and define problems, generate multiple solutions or paths toward solution, reason, justify conclusions, and communicate results. These are not simply abilities that one is born with and they do not generally develop on their own. For students to become creative mathematicians, these talents must be cultivated and nurtured. (Sheffield, 2008).

This study therefore aimed at finding better ways to promote creativity in mathematics through the use of innovative methods in teaching and learning mathematics at primary school level.

Creativity and Innovation in the Mathematics Classroom

Enhancing students' creativity and innovation is an important educational goal within and across specific school topics. Enhanced creativity and innovation supposedly empower students to cope with their lives, increase their potential value in the labor market, and allow them to participate in aesthetic and joyful experiences (Loveless,2002).

Sheffield (2008) also proposed that one way to think of the development of mathematical creativity is to imagine pupils moving along the following continuum where students are thought as moving from being virtually innumerate, lacking basic concepts and skills to being able to do some basic mathematics and to compute proficiently:



(Sheffield, 2003)

Teachers play a critical role in the development of students' mathematical creativity. In some cases, education does more to destroy creativity than to enhance it, but the promotion of creativity and innovation are increasingly important to the future of the world. Mathematics helps children to explore mathematical concepts as they sort, classify, compare quantities, and find patterns (Ankita, 2013). The environment plays a critical role in the need for as well as the nurturing of mathematical creativity. (Sheffield, 2008)

Tan (1998) observed that Teaching mathematics creatively is essential. Creative teaching that is interesting and challenging can motivate pupils' learning. It is indispensable to arouse pupils' interests in mathematics at their young age.

Using Drawings, Diagrams and Pictures to Teach Mathematics

The idea that a picture is worth a thousand words is so true. Pictures and photography can tell a story or share ideas or even teach mathematics concepts. More recently there have been a few studies published promoting the ideas of teaching mathematical ideas using photography.(Munakata and Vaidya, 2012; Braggs and Nicol, 2010; Northcote, 2011; Anderson, 2007)

Braggs and Nicol (2010) found success with using photography in the teaching of mathematics particularly, using photographs that enhance the problem solving activities. Munakata and Vaidya (2012) found in their research that teachers need to encouragestudents to seek connections between the math and sciences and everyday life throughphotography. Northcote (2011) believes that teachers need to use photography in the classroom to point out the math in real-life experiences. Anderson (2007) found that by placing a digital camera in the hands of students enablesthem to explore their own conceptual learning.

According to Larson (1985) a first step in understanding a problem is to draw and label a figure, diagram or a graph. Children have been found to perform better in mathematical problem solving situations when diagrams are used by teachers to elicit appropriate mental images. (Yancey, 1989).

Using Manipulatives in Teaching Mathematics

Van de Walle, Karp & Bay-Williams (2012) stated that manipulatives are physical objects that students and teachers can use to illustrate and discover mathematical concepts, whether made specifically for mathematics (e.g., connecting cubes) or for other purposes (e.g., buttons). Manipulatives can be extremely helpful to young children, but they must be used correctly. Children must understand the mathematical concept being taught rather than simply moving the manipulative around.

Using manipulatives in teaching mathematics will help students learn to relate real world situations to mathematics symbolism, work together cooperatively in solving problems, discuss mathematical ideas and concepts, verbalize their mathematics thinking, solve problems without teacher direction, and learn that there are many different ways to solve problems. Manipulative use is a fun, easy way to introduce and visualize a concept. (Schweyer, 2000)

Smith (2009) stated that there are probably as many wrong ways to teach with manipulatives as there are to teach without them. The math manipulatives should be appropriate for the students and chosen to meet thespecific goals and objectives of themathematical program. According to Abdussalam(2014),it is also important for teachers to allow their students to have free time to play with the manipulatives. He also stated that

teachers should provide children with opportunities to work with materials with open-ended objectives that have no specific preset goals. These opportunities allow the children the chance to explore their own questions and generate a variety of answers.

Integrating Play-way Method in Mathematics Classrooms

This method consists of the activities that include a sort of fun or play and give joy to the students. Students don't realize that they are learning but in a way they are gaining knowledge through participating in different activities. This method helps to develop interest in mathematics, motivates students to learn more and reduces the abstract nature of the subject to some extent. Integrating playing into mathematics lessons makes learning an interesting endeavour. Mathematics is embedded in children's play, just asit is in many aspects of their lives; children enjoy playing with everyday mathematics; andchildren even spontaneously play with the mathematics taught in school. (Gelman, 2000)

It should therefore come as no surprise that everyday mathematics is a significantaspect of children's play. Children use informal skills and ideas relating to number, shape, andpattern as they play with blocks or read storybooks. Indeed, everyday mathematics provides the cognitive foundation for a good deal of play, as well as for other aspects of the child's life.

Schools that are using play way method believe that learning is best through play activities. It rejuvenates the children in their learning and enhances their learning abilities. Play-way method of teaching give free reign to a child's curiosity and helps a child to grow. A child understands his needs and goals while playing. So play can be an effective way of teaching children. It has been proved (Siegler, 2008) that maximum amount of learning results while playing games. Through play way method teaching of mathematics becomes more lively and interesting. Role plays, projects, theme based learning, field trips, puppetry are a few techniques included in play way method. Through play way method they learn to solve problems, think on abstract ideas, remain focused and work diligently and persistently.

Statement of the Problem

Teaching creatively means teaching with variations and innovations. Teaching mathematics through lectures may be an easy instructional method for teachers. When students are passively listening to teachers, however, their opportunities to understand mathematical concepts and procedures are not maximized. Rather than just listening to teachers talk, students need to be actively involved in mathematics and to do mathematical activities (Brown, 1994).Another problem posed by the new millennium is

the proper use of the ever advancing technology ineducation. (Misfeldt, 2015).

Materials and Methods

The paper focused on promoting effective creativity in mathematics through the use of 3 innovative methods(i.e. play-way, pictures & diagrams and manipulatives) in teaching and learning among primary school pupils' in Batagarawa local government area of Katsina state. The purpose of the research is to find out:

1. How teachers' use of innovative methods (i.e. play-way, pictures & diagrams and manipulatives)in teaching mathematics affects pupils' creativity at primary school level.

2. Whether there is difference in mathematics performance of pupils taught using innovative methods (i.e. play-way, pictures & diagrams and manipulatives) and those taught using traditional method.

Hypotheses

The following null hypotheses are formulated and tested at the 0.05 level of significance to achieve the objectives of the research:

H_{01} Using innovatives in teaching mathematics has no effect on developing pupils' creativity at primary school level.

H_{02} There is no significant difference in mathematics performance pupils taught using innovative methods and those taught using traditional method.

Methodology

The research design was quasi-experimental which considered experimental/treatment and control /untreated groups. The population for the research comprised of 66 primary schools, 102 mathematics teachers and 3,201 pupils in Batagarawa local government of Katsina state. Four schools were randomly selected from which 30 pupils are picked from each amounting to 120 pupils to serve as the sampled data. A total of 12 mathematics teachers were also randomly sampled taking three from each selected school. Three schools from the sample (Experimental groups) were taught basic topics (Number, Numeration and Geometry) using the methods of play-way, pictures &diagrams and manipulative by the researcher. The fourth school (Control group) was taught using the traditional method. Each group was taught using three periods of 40 minutes each (totaling 120 minutes) within a week.

Data Collection

The teachers' questionnaire was divided into 2 sections and contained 10 questions each with 4 options Lickert scale (Strongly agree, Agree, Disagree and Strongly disagree). The first section was on the use of innovative methods (i.e. play-way, pictures & diagrams and

manipulatives) while the other section was on the development of creativity in pupils.

The Primary Mathematics Achievement Test (PMAT) consist of 20 questions on Number, Numeration and Geometry. The instruments were validated by 3 Chief lecturers in Mathematics and the item analysis was conducted alpha reliability test was 0.82.

Statistical Tools

The hypotheses were tested using t-test of significance difference between meansat 0.05 level of significance.

Results

H_{01} Using innovative methods in teaching mathematics has no effect on developing pupils' creativity at primary school level.

Table 1: t – test Results for Teachers Questionnaire

Responses	No of Teachers	Mean	Standard deviation	t-calculated	t-critical
Innovatives in teaching	12	27.25	4.35	4.41	2.09
Pupils' creativity	12	17.75	4.06		

**Significant level = 0.05, degree of freedom = 22*

From table 1, the t-calculated is greater than t-critical (4.41 > 2.09) thus the null hypothesis is rejected. This implies that using innovatives in teaching mathematics affects pupils' creativity.

H_{02} There is no significant difference in mathematics performance pupils taught using innovative methods and those taught using traditional method.

Table 2: t – test Results for PMAT Scores of Students Taught Using Play-way and those taught Using Traditional Method

Methods	No of pupils	Mean	Standard deviation	t-calculated	t-critical
Play-way	30	10.00	1.62	4.29	2.00
Traditional	30	7.80	2.30		

**Significant level = 0.05, degree of freedom = 58*

Table 2 showed that the t-value is greater than the t-critical (4.29 > 2.00) and the mean of those taught using play-way method exceeds the mean of those taught using the traditional method. Thus, the null hypothesis is rejected and there is significant difference in the mathematics achievement of those taught with play-way method compared with those taught with the traditional method.

Table 3: t – test Results for PMAT Scores of Students Taught Using Pictures and Diagrams and Those taught Using Traditional Method

Methods	No of	Mean	Standard deviation	t-	t-critical
Pictures & Diagrams	30	10.70	1.42	5.89	2.00
Traditional	30	7.80	2.30		

**Significant level = 0.05, degree of freedom = 58*

Table 3 revealed that the mean score of pupils taught with pictures and diagrams is greater than the mean of pupils taught with traditional method (10.70 > 7.80). Also, the t-value is greater than the t-critical (5.89 > 2.00). The null hypothesis is rejected and thus there is significant difference in the achievement of those taught with pictures and diagrams over those taught with traditional methods.

Table 4: t – test Results for PMAT Scores of Students Taught Using Manipulative and Those taught Using Traditional Method

Methods	No of	Mean	Standard deviation	t-	t-critical
Manipulatives	30	13.27	1.82	10.23	2.00
Traditional	30	7.80	2.30		

**Significant level = 0.05, degree of freedom = 58*

Table 4 also showed that the mean of pupils taught with manipulatives is greater than the mean of pupils taught with traditional method. The null hypothesis was also rejected since the t-value is far greater than the t-critical. Hence, there is significant difference in performance of pupils taught with manipulatives over pupils taught using traditional method.

Discussion

The results showed that the use of innovatives in teaching mathematics at primary schools leads to promotion of pupils' creativity. Thus the teachers' use of different innovative methods will go a long way to develop pupils' interest, motivation and creativity not only in mathematics but in other science subjects. This finding is in line with the findings of Smith (2009), Abdussalam (2014)on use of manipulatives, Anderson (2007), Northcote (2011) on pictures and diagrams and Gelman (2000), Siegler (2008) on play-way method. Tan (1998) and Sheffield (2008) observed that Teaching mathematics creatively is essential since it yields better performance from pupils and takes care of very large classes. Most innovatives depend solely on local available materials, so the teacher only needs to use his initiatives.

Conclusion

Teaching mathematics to young children can be developmentally appropriate and enjoyable for the child and teacher alike when it is challenging

and playful and produces real learning. Teachers need to get acquainted with the innovative in teaching mathematics to enhance better performance of pupils and promote transfer and application of mathematics in everyday life.

Recommendations

Based on the finding of this study, the following recommendations are made:

1. Primary school teachers need extensive professional development to learn to implement early childhood mathematics education effectively. Drawing diagrams, using manipulatives and play-way methods are important strategies in problem solving but not yet fully exploited in the classroom.

2. The government should assist teachers through provision of instructional resources and training on how to use them effectively in teaching as well as in supervising them.

Mathematics curriculum planners and textbook authors should integrate the use of innovatives in the curriculum and text books for adequate use in schools for instruction.

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