

## **Efficacy of ICT in Enhancing Mathematics Creative Thinking (MCT) Of Exceptional Children in Selected Primary Schools in Calabar, Nigeria**

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**Abstract:** *The study investigated the efficacy of using information and communication technology (ICT) in enhancing Mathematics Creative Thinking (MCT) of exceptional children in selected primary schools in Calabar. The study was a pre-test, posttest quasi experimental research design. Three null hypotheses guided the study. The researchers developed a validated ICT instructional package for enhancing (MCT) on three mathematical concepts including figural transpose, sum in matrix and geometrical problems which was used in the experimental and control group for 6 weeks. A twenty (20) item of mathematics creative thinking test (MCTT) was pre-tested and post-tested on seventy (70) exceptional ability pupils purposively selected through a multi-stage screening using nomination, intelligence testing and academic record. The data collected were statistically analyzed using ANCOVA at 0.05 level of significance. The result showed that there were significant main effects of Treatment and Gender on MCT of the participants at  $F= 435.288, p<0.05$  and  $F= 108.01, p<0.05$  respectively. There was also significant interaction effect of Treatment and Gender on MCT of exceptional children at  $F= 102.01, p<0.05$ . It was recommended among others that teachers should be trained on the use of ICT skills and techniques so as to optimize mathematics potentials of all children and particularly the exceptional or gifted child.*

**Keywords:** *Exceptional Pupils, ICT Utilization, Mathematics Creative Thinking.*

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### **1. INTRODUCTION**

Creativity is globally recognized as ingenuity tool for quality life of a society, particularly Mathematics Creative thinking which has been described as the bedrock of economic, political, social and technological advancement of any nation (Dada & Dada, 2014). The prime objective of the education of children with exceptional gift, talent or high ability in Nigeria, was to provide for the intellectual/ creative needs of the children at their own pace and ability in the interest of the nation's economic and technological advancement (FGN, 2014). This objective is the reason why governments, schools and parents around the world have been collaborating to evolve effective and efficient strategies to develop the potential of all children with much emphasis on the gifted and talented children who are with high intellectual and creative abilities.

Mathematics Creative Thinking is a construct of intellectual functioning proposed by Dada & Dada (2014) from the concept of Guilford (1950) as one's ability to be quantitatively creative and the ability to produce accurate calculation results. Guilford found that the traits characteristic of creative people are related to their personality and such dependent factors as motivation and serene environment which ICT provides. Children exhibiting traits which mark them as mathematically creative may engage in such behaviors as composing, designing, planning, constructing and inventing. This is as a result of the interaction of the components in the Guilford's structure of intellect.

Most researches in creativity are derived from Guilford's (1950) philosophy. Guilford sought a deeper understanding of the ability to be creative and developed tests to measure it. In Guilford's significant body of work, he broke down into specific aspects of creativity and various influences of creativity in an effort to make creativity more measurable. While accepting the opinion that everybody has some

ability to be creative, Guilford's focused on creativity at the level where it is acknowledged or noteworthy. Guilford's hypothesis that everyone is capable of creative abilities and activities raises the question of why so few people are notably creative. Noteworthy are the types and levels of creativity that are very infrequent and are genetically random. Very creative youngsters can be produced by average parents.

Mathematics creative thinking (MCT) is a type of certainty that was defined as the ability to manipulate, analyze and interpret figures, signs and based on appropriate processing and interaction of the related constructs of the intellect to produce meaningful and useful result or product (Dada & Dada, 2014). The subjective nature of creativity has led to multiple measures to determine diverse creative potentials one of which MCT is one.

Many constructs of the Guilford's structure of intellect interplay to produce MCT. These MCT requires a measure of drive and resources in the right capacity to synthesize the intellect construct into inclusive patterns. For example, reorganization and redefinition can be effective tools in resolving a new problem from an existing model. Dada and Dada (2014) noted that not all individuals have the ability to manipulate multiple interrelated ideas, which was refers to as complexity. Again, Mathematics thinking or analyzing is the ability to observe and operate a given mathematics model of symbolic or figural content structures to build new ones.

Therefore MCT is an evaluative learning behavior that is needed to arrive at potential solutions to mathematical problem in degree of excellence. It is important for exceptional children to learn in a challenging atmosphere and under-realistic atmosphere to optimize their creative instinct. Consequently, there are two different trends that can be distinguished in the research on creativity; these have been called "big C, and 'little c' creativity (Craft, 2005). The big C creativity (or BCC), refers to the creativity of the genius, seen in people such as Mozart, Picasso, and Einstein. Their creative achievements including MCT are exemplary and comprise novelty and excellent in their domain, as well as social recognition and valuation.

Little c creativity (LCC), on the other hand, is not for the exceptional, gifted or talented and does not apply to creative and innovative outputs that have a strong impact on society. LCC could be seen as behavior and mental attitude, or as the ability to find new and effective solutions to everyday problems. LCC is not for an extraordinary few. A similar distinction can be found in Sheinderman (2000), who differentiates between revolutionary creativity, imputable to Nobel laureates and geniuses, and evolutionary acts of creativity, which can include doctors making a diagnosis or an editor drafting a magazine.

It can therefore be inferred that LCC seems particularly suitable for the educational sector, where a priority is to encourage all students and pupil's, who have not yet reached their intellectual peak, but who shows an over-abundance of original desire, to achieve their full potential. This study thus adopted the LCC. Creative potential may be found in every child (Runco, 2003); it can be encouraged or inhibited (Sharp, 2004); and its development depends on the kind of training received (Esquivel, 1995). A critical step towards the development of MCT potential of children with high ability is perceived in the use of ICT because of its global notable advantages which include intellectual stimulation, drill and practice, goal accuracy, free from bias and psychological distractions and well friendly environment. This is the concept that informed investigating the efficacy of utilization of ICT in enhancing mathematics creative thinking.

Information and communication technologies (ICT) have become commonplace entities in all aspects of life. Over the past twenty years the use of ICT has fundamentally changed the practices and procedures of nearly all forms of endeavour within business and governance and more importantly education. However, there appears to be a misconception that ICTs generally refers to computers and computing related activities'. This is not the case, although computers and their application play a significant role in modern information management and education, other technologies and/or systems also comprise of the phenomenon that is commonly regarded as ICTs.

Pelgrum and Law (2003) state that near the end of the 1980s, the term computers was replaced by IT (information technology) signifying a shift of focus from computing technology to the capacity to store and retrieve information. This was followed by the introduction of the term ICT (information and communication technology) around 1992, when e-mail started to become available to the general public. According to a United Nations report (1999) ICTs cover Internet service provision,

telecommunications equipment and services, information technology equipment and services, media and broadcasting, libraries and documentation centres, commercial information providers, network-based information services, and other related information and communication activities. According to UNESCO (2002) information and communication technology (ICT) may be regarded as the combination of Informatics technology with other related technology, specifically communication technology. The various kinds of ICT products available and having relevance to education, such as teleconferencing, email, audio conferencing, television lessons, radio broadcasts, interactive radio counseling, interactive voice response system, audiocassettes and CD ROMs etc have been used in education for different purposes (Sharma, 2003; Sanya, 2001; Bhattacharya and Sharma, 2007).

Ogunlaja (2013) defined ICT as an acronymic term that denotes Information and Communication Technology. He further made a critical analysis on the element that has given rise to this term ICT. The first element which is information, in computing is described as already processed data that is accurate and timely, which has a very high capacity of influencing behaviours, decisions, and outcomes of events; while, literally according to Oxford dictionary (2005), it is defined as what is being conveyed or represented by a particular sequence of symbols, figures or any other impulses. The second element: Communication is seen as the means of sending or receiving information, by the use of letters, symbols, and codes, etc. through the use several media such as telephone lines, signalling devices and computers. Finally, Technology is seen as the application of scientific knowledge (the branch of knowledge concerned with applied sciences) for practical purposes, and the use of machinery and equipment based on such knowledge.

Hence, from the critical breakdown of these elements that makes up ICT, it can be said that Information and Communication Technology is the application of the branch of knowledge concerned with applied sciences for the practical purpose of processing data or raw facts accurately and timely into a particular sequence of symbols, letters, codes and signals to influence behaviours, decisions, and outcomes of events, and the sending and receiving of this through the use several media or computer related facilities and gadgets in a timely, efficient and effective manner. Owing to the great advantages the use of ICT offer particularly to educating children, this paper sought to examine the efficacy of ICT in enhancing MCT of exceptional children. The ICT provision in this study is the audio visual interactive learning programme through the use of computer.

## **2. STATEMENT OF THE PROBLEM**

Technology and particularly ICT is increasing in importance in people's lives and it is expected that this trend will continue, to the extent that technological literacy will become a functional requirement for people's work, social, and personal lives. The use of ICT in education has the capacity to increase the quality of the pupils' achievement by enhancing thinking and learning particularly in mathematics. Meanwhile, MCT has been reported to be faced with challenges that are rooted in teaching pedagogy and most importantly unchallenging, non-stimulating, unreceptive and unfriendly learning environment that are not required by children with exceptional ability to optimize their Mathematics potential. The problem of this study is therefore conceptualized as; would ICT enhance MCT of male and female children with exceptional ability?

## **3. PURPOSE OF THE STUDY**

The purpose of the study is to find out if utilizing ICT would enhance mathematics creative thinking of exceptional ability children. The specific purpose include to:

- Determine if ICT would enhance MCT of exceptional children
- Examine the effect of gender in MCT of exceptional children
- Investigate the interaction effect of ICT and gender in enhancing MCT of exceptional children.

## **4. HYPOTHESES**

- Utilization of ICT does not significantly enhance mathematics creative thinking of exceptional children.
- Gender does not significantly affect mathematics creative thinking of exceptional children.
- There is no significant interaction effect of ICT utilization and gender in enhancing mathematics creative thinking of exceptional children.

## 5. SIGNIFICANCE OF THE STUDY

The Pupils of primary school will find the result of this study very useful as it will enhance their MCT and new knowledge and skill with the application of ICT. Parents of these pupils will equally find the result of this study beneficial because they will understand and acknowledge the importance of exploring the ICT for their children and make conscious efforts towards improving the MCT. The study will also be relevant to policy makers, educational planners and administrators as a baseline survey that is required to formulate policies that would identify pupils who are mathematically creative, full of new innovations and ideas like the exceptional children, harness these creative ideas and give them all the necessary support and encouragement to see that such ideas and creativity are developed and brought to real application.

The finding of this study will also be useful to teachers to willingly accept or adapt to the new trends of teaching, and to get themselves acquainted with ICT innovations, skills, techniques and information in order to fully harness and enhance creativity of these children. The result of this study will also be significant to other researchers wishing to carry out a similar study on other areas or on a broader scope. It will serve as a relevant reference material. Other interested persons/ individual and groups working on improving creativity will also see the finding of this study resourceful.

## 6. METHODOLOGY

This study used a pre-test, posttest, control group, experimental research design. The design adopted is summarized below:

Treatment (E<sub>1</sub>): 0<sub>1</sub> X<sub>1</sub> 0<sub>3</sub>

Control (E<sub>2</sub>): 0<sub>2</sub> 0<sub>4</sub>

Where 0<sub>1</sub>, 0<sub>2</sub> denote pre-test observation for treatment group and the control group respectively while 0<sub>3</sub> and 0<sub>4</sub> denote post- test observation for treatment group and control group respectively. X<sub>1</sub> represent treatment programme: Utilizing ICT teaching-learning strategy. The sample (participants) for the study was 70 exceptional pupils purposively selected through multi-stage screening using nomination checklists, school academic record and slosson intelligence test (reliability of 0.93). The participants are from six primary schools in Calabar, Nigeria. The researcher used primary five pupils in the schools. There are 37 participants from three schools in the treatment group and 33 participants from three schools in the control group. The choice of three schools for the experimental and control was to control for intervening variables. Computers with a quantitative reasoning interactive software and audio peripheral are provided for teaching-learning process including assessment of the participants in the treatment group for a period of six weeks. The treatment was given for two hours a week (40 minutes per periods and for three periods per week). No ICT facility was provided for the control group but teaching-learning process was done conventionally also for six weeks. A 20 items multiple choice questions on quantitative reasoning test (QRT) with reliability of 0.91 obtained from Kuder-Richardson 20 formula was used to measure the MCT. The participants were trained for 6 weeks on three major areas of mathematics creativity namely figural transpose, sum in matrix and geometrical problem. The pre-treatment and post-treatment assessment was conducted and the scores obtained were analyzed using ANCOVA.

## 7. RESULTS AND DISCUSSION

**Table1.** Posttest means scores in MCT of participants by treatment and Gender

Treatment	Gender	Mean	N
Utilization of ICT in treatment group	Male	17.64	18
	Female	18.38	19
	Total	18.05	37
Control group	Male	11.60	16
	Female	12.24	17
	Total	11.93	33

The descriptive statistics for the post test score in the utilization of ICT for MCT of primary five pupils shown in table 1 below. The table revealed that the post test score is higher in the treatment group with a mean value of 18.05, while that of the control group is 11.93. By gender consideration, the female exceptional pupils had a higher post test score of 15.31 while the males have 14.62. In the treatment group, females had 18.37 while males have 17.64, whereas, in the control group males have 11.60 and females have 12.24.

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The finding of inferential analysis is presented in table 2. The table shows the result of the ANCOVA tested at 0.05 level of significance. The three hypotheses are tested in the analysis.

**Table2.** ANCOVA of pretest and posttest Achievement in MCT

Performance in MCT	Type III sum square	Df	Mean score	F	Sig.
Intercept post test	63.08	1	63.08	5.53	.15
Pre-test	40.58	1	40.58	13.01	.01
Main Effects					
Treatment	227.00	1	227.00	435.28	.00
Gender	3.44	1	3.44	108.01	.00
interaction effect Treatment + Gender	3.21	1	3.21	102.017	.03
Error	77.99	68	3.120 <sup>b</sup>		

**Hypothesis 1:** Utilization of ICT does not significantly enhance mathematics creative thinking of exceptional children.

Table 2 indicates that the result of the analysis relative to hypothesis 1 is 435.28 at  $df = 1$  and 68 and  $p < 0.05$ . This result shows that the null hypothesis stated is rejected. This implies that the use of ICT in the treatment group has significant effect in enhancing mathematics creative thinking.

**Hypothesis 2**

Gender does not significantly affect mathematics creative thinking of exceptional children.

The result in table 2 with respect to the effect of gender in MCT shows that  $f = 108.01$  at  $df = 1$  and 68,  $p < 0.05$ . The implication is that the null hypothesis is rejected hence gender has significant effect on creativity of exceptional children in primary schools with more females discovered as being more mathematically creative than male pupils.

**Hypothesis 3**

There is no significant interaction effect of ICT utilization and gender in enhancing mathematics creative thinking of exceptional children.

The result in table 4, shows that  $f = 102.017$ , at  $df = 1$  and 68 and  $p < 0.05$ . This implies that the null hypothesis 3 is rejected. In the words the interaction of gender and the use of ICT have significant effect in enhancing creativity of exceptional children in primary schools.

**8. DISCUSSION OF FINDINGS**

The result from the test of null hypothesis 1 showed that utilizing ICT contributed significantly in enhancing mathematics creative thinking of exceptional children. The result showed that utilizing ICT play a vital role in enhancing pupils’ mathematics creative thinking. The features of ICT have been described as provisional, interactive, capacity building, wide coverage, speed gaining and automatic responses (Dada & Dada, 2014). Using ICT enables exceptional pupils to communicate, share and work collaboratively anywhere, anytime they have needs to analyze problems and explore ideas as well as develop concepts in mathematics. Loveless (2008) stated that interactions with ICT provides pupils new ways of doing things, extended it to enhancing ability, novel ways of dealing with a quantitative task which might change the nature of the activity itself, or provide limitation and structure which influence the nature and boundaries of the activity. Hence, ICT is an effective intervention and remediation tool for enhancing mathematics creative thinking.

The result from testing the null hypothesis 2 showed a significant contribution of gender influence in enhancing mathematics creative thinking. The evidence does not clearly support gender differences in creativity based on test result; however, to the extent that a case for such gender differences can be made, the available evidence suggests that girls scored higher on mathematics creative thinking tests than men and boys (Baer & Kaufman, 2008). The question of gender differences in creativity is a complex, controversial and contentious topic. Conclusions have been inconsistency from the empirical evidence on gender difference in creativity test scores; there are studies that report that girls and women score higher than boys and men, and there are studies that report the opposite. The study has however found girls better in mathematics creative thinking than boys. The result obtained from analyzing null hypothesis 3 showed that there is significant effect of the interaction effect of ICT utilization and gender in enhancing mathematics creative thinking of the participants.

## 9. CONCLUSION

Based on the findings in the study, it can be concluded that ICT contributes significantly to enhancing creativity of exceptional children; gender also has significantly influence in enhancing mathematics creative thinking of exceptional children. Interaction of ICT and gender do not contribute significantly in enhancing mathematics creative thinking of exceptional children.

## 10. RECOMMENDATIONS

In view of the findings of the study, the following recommendations are made:

- Teachers should be encouraged to accept and utilize ICT facilities, skills and techniques to maximize learning for all children and particularly the gifted children.
- The mathematics curriculum should be reviewed to accommodate utilization of ICT skills for the purpose of exposing pupils to a wide variety of stimulation, providing them opportunities to optimize their mathematical potentials.
- Government should make provisions for mathematics teachers to attend workshop, seminars, and conferences on ICT as well as providing adequate learning materials and resources in schools.

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