STUDENTS' PERCEPTION OF MEASURES FOR ENHANCING CREATIVITY IN MATHEMATICS FOR EFFECTIVE LEARNING DURING PANDEMIC

By

Golly Sammy Gwandum & Bitrus Guwam

College of Education Billiri, Gombe State, Doctoral Student, Department of Science and Technology Education, University of Jos, Nigeria sammygolly@gmail.com
guwambitrus67@gmail.com

ABSTRACT

Mathematics taught at the secondary school level of education is designed to enlighten and enhance one's thinking ability to face challenges. What are then the measures students should take to enhance their creativity in Mathematics? This study was undertaken to answer the question. Two research questions were raised and one hypothesis which was tested at 0.05 level of significance. A descriptive survey design was adopted for the study. The population was 860 students (four students from each school; two from Junior Secondary School and two from Senior Secondary School). A sample of 120 students participated in the study. An instrument titled Students' Perception of Measures for Creativity in Mathematics (SPMCM) with reliability of 0.71 based on Cronbach's Alpha was used to collect data. It contained twelve items sourced from literature, divided into two sections. Mean, standard deviation and Z-test were used to analysed data collected. The findings showed that use of different textbooks, enough time for assignment, learning thinking skills, solving many exercises, planning strategy for solving problem, participating in doing class activities, interacting freely with other students, making trial and error, putting detail of how to solve a problem, studying other attempt, a competitive classroom environment, and family background that encourages excellence are measures for enhancing Mathematics creativity in secondary school. Thus it was recommended that for effective learning of Mathematics, students should take measures for enhancing creativity in the subject.

Key Words: *Mathematics, Students, Creativity, Pandemic*

INTRODUCTION

One's survival on earth is dependent on the ability to be creative in the face of numerous challenges confronting humanity as COVID-19. According to Perdana (2019), creative thinking skills are an essential attribute for success. Creativity is the ability of one to make something relatively new or to do something differently. It is an inherent trait or an acquired trait (Sharma, 2017). One could become creative by inheriting creative traits or through learning creative skills. There is no doubt that one must think critically in order to come up with a new term, expression, concept or idea that will benefit the society especially during pandemic. Subjects taught at the secondary level of education are designed to enlighten and enhance students' thinking ability to face challenges such as COVID-19. Mathematics as a subject taught at this level requires the students to be creative to better understand concepts.

Mathematics creativity means the ability of students to come up with their thinking about a term, an expression or an equation, thereby initiating different plan, approach or pattern of solving a problem. According to Kim, Bae, Choi, Kim and Lim (2019), Mathematics creativity is the ability which involved concept-developing and problem-solving process in the subject.

Mathematics as a product of creativity requires students to think creatively to solve problems. Creativity in Mathematics does not mean that a student should create new concept in Mathematics out of no concepts, rather it means a student should use existing concepts or ideas as a building block to generate something interesting, captivating or relatively new. For students to be mathematically creative, they need to be sound in mathematical processes, such as sorting, identifying, connecting, relating, solving, arranging and identifying patterns (Akinoso, 2014). Without developing a creative mind, students will hardly abstract mathematical concepts and use axioms to understand theorems in the subject. In the course of learning Mathematics, students thought processes are refined and developed as they engage in minds-on and hands-on activities like asking questions, responding to questions, discussions and demonstrations (Agwagah, 2013; Tella, 2013). These provide students with the opportunity to develop their thinking ability. In fact, the environment, minds-on and hands-on activities play a critical role in learning Mathematics, as effective learning of the subject relies on Mathematics creativity.

According to Olaleye (2017), Mathematics education is concerned with the practice of teaching and learning Mathematics within and outside the classroom. Through the process of learning the subject, the ability to identify and analysed patterns, logical and critical thinking skills, ability to see relationship, and problem solving skills are developed (Esangbedo, 2014). When presented with a mathematical problem, students must read carefully, to understand what the problem is all about. They must reflect on what they already learnt. If they have forgotten ideas relevant in solving the problem or what they learnt has not become a concrete experience for reflection, they must go back and learn again. In fact, learning is a cycle that begins with experience, continues with reflection, and later leads to action which itself becomes a concrete experience for reflection (Chesimet, Githau & Ng'eno, 2016). Once students can think creatively and constructively when learning Mathematics, learning becomes a concrete experience for reflection. According to Bot and Timku (2017) creativity is fundamental in fostering critical thinking skills which enable students to create and utilise new ideas. Thus teachers are to encourage students to be creative when learning Mathematics otherwise the subject will be reduced to a set of skills to master and rules to memorise.

Teachers have a critical role to play in ensuring that students are creative in Mathematics. Kim, Bae, Choi, Kim and Lim (2019) findings suggested that a Mathematics teacher education curriculum integrating mathematical creativity has the potential to prepare future educators to implement pedagogy that bridges between process and content in school Mathematics. Teachers focus on creativity in the classroom, have students work on reach problems, allow students to make conjecture, ask sub-problems and analyse problems to enhance creativity in classroom (Sinay & Nahornick, 2016). According to Yumusak (2016), observation, comparison, classification, inferring, forecasting, communication and quantification are the core science skills. Kirimi and Njagi (2016) noted that when the students are exposed to science process skills, their scientific creativity skills in Mathematics improve.

According to Abramovich, Grinshpan and Milligan (2019), students require both cognition and practical experiences throughout the continuation of their Mathematics education. On creativity in Mathematics, Sinay and Nahornick (2016) observed that most students have little opportunity to be creative. Boaler, Dieckmann, Nunez, Sun and Williams (2018) noted that some students have damaging fixed mind sets, believing that their intelligence is unchangeable. This will make them not to take measures that would enhance their creativity in Mathematics. Egbo and Nwafor (2013) suggested that teacher should use different strategies in teaching as "mere telling

is not teaching and simply listening is not learning (p.184)". Therefore, students should be given the opportunity to demonstrate what they have learnt in Mathematics through classwork, question and interaction, while the teacher serve as a facilitator in the classroom.

Mathematics provides an effective way of building mental discipline and encourages logical reasoning and mental rigor (Nwigboji & Olo, 2017). Nigeria as a nation needs creative minds that will read between the lines, think out of the box, to come up with ideas that would leverage the nation out its myriad problems as pandemic. Unfortunately, a good number of students that finished secondary school obtain goods grades in Mathematics without really acquiring the knowledge. In fact, when it comes to Mathematics, everybody ones to get A, B, or C, and many students engage in examination malpractice. So they pass the subject with incomplete mastery of numbers, facts, computational weakness, difficulty transforming knowledge, making connection, incomplete understanding of the language of Mathematics, difficulty comprehending the visual and spatial aspects (Akinoso, 2014). Students focus on good grades in Mathematics is detrimental to the overall development of creativity in the subject. A student should set target, but the drive towards that target should not impair positive efforts towards the realisation of the target. Thus there is need for measures that will enhance creativity in Mathematics for better understanding of concepts to minimise malpractice in the subject, and ensure the application of its concepts during pandemic.

Research Questions

The following research questions are raised to guide the study:

1. What are the measures that students need to enhance creativity in Mathematics?
2. Do students' perception of measures of enhancing creativity in Mathematics dependent on school-type?

Hypothesis

1. There is no significant difference between the perception of public and private school students on measures of enhancing creativity in Mathematics.

METHODOLOGY

A descriptive survey design was adopted for the study because it was meant to find out appropriate measures that teachers should take to enhance students' creativity in Mathematics. The population was 860 students (four students from each school; two from Junior Secondary School and two from Senior Secondary School). The 215 secondary schools comprised 98 public schools and 117 private schools, in the Southern Educational Zone of Plateau State. This comprised Qua'anpan, Mikang, Shendam, Langtang North, Langtang South and Wase Local Government Areas of the State. A sample of 120 students participated in the study. Those students that formed the sample were purposively selected to represent their schools. They were administered the questionnaire on 8th June, 2019, during the Mathematics Olympiad Organised by the Mathematical Association of Nigeria Plateau State Chapter in conjunction with the Plateau State Ministry of Education, at two centres, namely Government Girls' Secondary School Shendam and Federal Government Girls' College Langtang. An instrument titled Students' Perception of Measures for Creative in Mathematics (SPMCM) with reliability of 0.71 based on Cronbach's Alpha. It contained twelve items sourced from literature, divided into two sections. Section A asked of information on Biodata and section B was structured using five-point rating scales of Strongly Agree(SA), Agree(A), Undecided(UD), Disagree(D) and Strongly Disagree(SD). These ratings were weighted 5, 4, 3, 2, and 1 respectively. SPMCM was face and content validated by three experts in the field of Mathematics education and their suggestions were used. Mean was used to answer research

questions. Mean score of 3.00 and above were considered as high extent while mean score of 2.99 and below were considered as low extent. Finally, Z-test was used to test the hypothesis at 0.05 significance level.

RESULTS

Research Question One

What are the measures that students need to enhance creativity in Mathematics?

Table 1: **Measures for enhancing Students' Creativity in Mathematics**

S/N	Statement	SD	D	UD	A	SA	Mean	SD
1	Use of different textbooks	1	4	1	34	76	4.55	0.76
2	Have enough time to do assignment	1	0	0	33	82	4.68	0.57
3	Learn skills that enhance thinking	0	1	3	53	59	4.47	0.60
4	Solve many exercises from textbooks	1	0	8	39	68	4.49	0.70
5	Plan strategy for solving a problem	0	0	7	51	58	4.44	0.61
6	Participate in doing class activities	0	4	1	28	83	4.64	0.68
7	Interact freely with other students	3	8	9	40	56	4.19	1.02
8	Keep making trial and error	16	15	16	38	31	3.46	1.37
9	Keep details of how a problem is solved	2	1	7	54	52	4.32	0.78
10	Study other attempts towards solving a problem	1	1	2	53	59	4.44	0.66
11	A competitive classroom environment	2	1	3	51	59	4.41	0.75
12	Family background that encourages excellence	2	0	5	32	77	4.57	0.74

Table 1 shows that the mean values of measures ranged from 3.46 to 4.68, and are greater than 3.00. These imply that the students agreed that all the measures can be taken to enhance students' creativity in Mathematics.

Research Question Two

Do students' perception of measures of enhancing creativity in Mathematics dependent on school-type?

Table 2: **Measures of enhancing Creativity in Mathematics based on School-Type**

S/N	Statement	Public		Private	
		Mean	SD	Mean	SD

1	Use of different textbooks	4.47	0.82	4.72	0.60
2	Have enough time to do assignment	4.74	0.44	4.56	0.75
3	Learn skills that enhance thinking	4.51	0.55	4.38	0.67
4	Solve many exercises from textbooks	4.58	0.55	4.31	0.92
5	Plan strategy for solving a problem	4.44	0.62	4.44	0.60
6	Participate in doing class activities	4.65	0.68	4.62	0.67
7	Interact freely with other students	4.08	1.12	4.41	0.75
8	Keep making trial and error	3.43	1.43	3.51	1.27
9	Keep details of how a problem is solved	4.26	0.82	4.44	0.68
10	Study other attempts towards solving a problem	4.39	0.59	4.56	0.79
11	A competitive classroom environment	4.39	0.61	4.46	0.97
12	Family background that encourages excellence	4.52	0.77	4.67	0.66
		4.47	0.82	4.72	0.60

Table 2 shows that the mean values of measures for enhancing creativity in Mathematics of public school ranged from 3.43 to 4.74 and are greater than 3.00. The mean values of measures for enhancing creativity in Mathematics of private school ranged from 3.51 to 4.72, and are greater than 3.00. These imply that measures of enhancing creativity in Mathematics are the same in both public and private schools.

Hypothesis

There is no significant difference between the perception of public and private school students on measures of enhancing creativity in Mathematics.

Table 3: **Z-Test Analysis of Responses based on School-Type**

School-Type	**N**	**Mean**	**Std. dev**	**df**	**Z-tab**	**Z-cal**
Public	77	4.47	0.82			
				114	1.96	1.68
Private	39	4.71	0.60			

Table 3 reveals that the calculated value of 1.686 is less than the table value of 1.96 at 0.05 levels of significance, and the degree of freedom was 114. This implies that there was no significant

difference between the mean scores of private and public school students on the measures of enhancing creativity in Mathematics.

DISCUSSION

The study on secondary school students' perception of how to enhance creativity in Mathematics reveals that use of different textbooks, enough time for assignment, learning thinking skills, solving many exercises, planning strategy for solving problem, participating in doing class activities, interacting freely with other students, making trial and error, putting detail of how to solve a problem, studying other attempt, a competitive classroom environment, and family background that encourages excellence are measures for enhancing Mathematics creativity in secondary school (Table 1). These findings concur with the views of Sinay and Nahornick (2016) who suggested that teachers should have students work on reach problems, allow students to make conjecture, ask sub-problems and analyse problems to enhance creativity in classroom. Also the study shows that those measures for enhancing Mathematics creativity in the secondary school are not dependent on school-type (Tables 2 &3).

CONCLUSION

Learning Mathematics creatively is critical for understanding mathematical concepts. The study revealed that there are measures that should be taken to enhance creativity in Mathematics as seen in figure 1. Those measures are essential if students are to learn Mathematics effectively for application of its knowledge during pandemic.

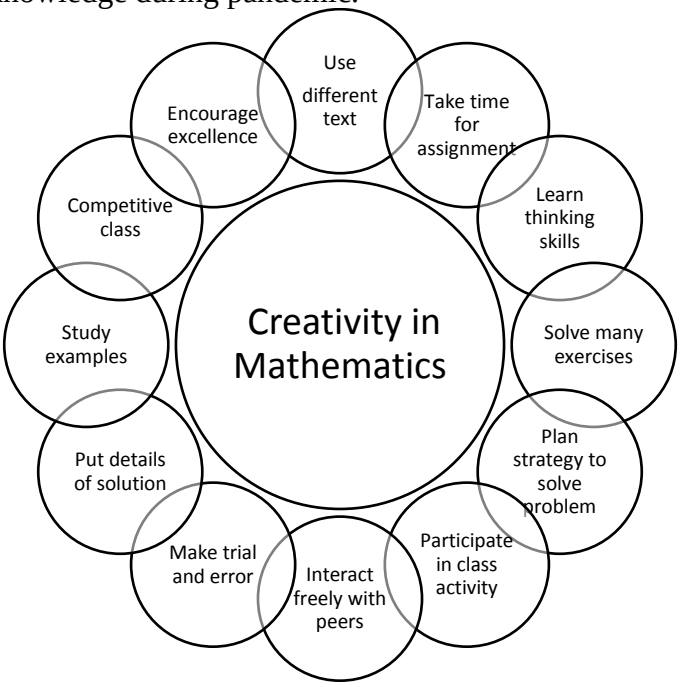

Figure 1: Measures for Enhancing Creativity in Mathematics

RECOMMENDATIONS

Based on the findings of this study, the following are recommended:

1. For effective learning of Mathematics, students should take measures for enhancing creativity in the subject.
2. Teachers are to encourage students to take measures for enhancing creativity in Mathematics.

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