

Evaluating Students' Perception of Variables that promote Creative Learning of School Algebra for Economic Development and Sustainability

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Abstract - *The paper sees creativity as a nexus of ideas that if pedagogically developed in students' school algebra, will positively affect the economic development and sustainability of the nation. Based on such conviction, the researchers through a survey study seek the opinion of 155 (96= male and 59= female) Junior Secondary School Two (JSS2) students' perception of variables that make algebraic classroom creative. Two research questions were asked and answered using descriptive statistic of mean and standard deviation. Algebra Creativity Enhancing Teaching/Learning Strategy (ACETS), a 12-item instrument developed by the researchers was validated by three experts in mathematics education and two experts in measurement and evaluation. The reliability of the instrument was established using Cronbach Alpha which gave a reliability index of 0.80. Among the findings are, active participation in algebra class activities (e.g algebra games) give students more understanding and stepwise guides enables students' understanding. Recommendations such as encouraging mathematics teachers to acquire creativity pedagogical knowledge through training and reading, and use same in their lesson plans and class activities among others were made. It was concluded that, the mathematics teacher be encourage to embark on personal capacity development.*

Keywords: Creative learning, School Algebra, Economic Development, Sustainability.

I. INTRODUCTION

With global trends towards sustainable and responsible economic growth and development, policymakers worldwide are now looking to this type of

creativity "epistemological agility", (the capacity to work productively across knowledge domains) as an engine of future productivity and social dynamism. Success in this economic climate, Nigeria needs a skilled, versatile and highly adaptable workforce and the capacity for creativity, innovation and entrepreneurship, which will set the nation's workforce above other nations of the world. But such well-educated, technically proficient workforce in all sectors and for nearly every occupation for economic development and sustainability as a nation depends on the nations' ability to generate new ideas and translate those ideas to concrete innovations. According to U.S president Obama's speech, all students must possess 21st century skills like problem solving, critical thinking, entrepreneurship and creativity (Ruppert, 2010). Among these skills, Ruppert said that creativity is a precursor to innovation, problem solving, and critical thinking. It is the cornerstone of entrepreneurship, it is essential to the design and development of new products, services and processes. Most importantly, creativity requires building upon the capacity of one's imagination to visualize new possibilities for human thought, action and the use of materials.

On this note therefore mathematics as an educational subject taught primarily for the development of thinking skills and reflections on oneself, environmental and societal issues and organizing one's experiences for possible solution(s) to problems (Lapan & Schram, as cited in Ezenweani, 2010) fit in well as a tool for creative empowerment. This is because according to Otunu-Ogbisi (2009), mathematics teaching and learning is the act of imparting and acquiring of skills, knowledge, aptitude,

abilities and attitude capable of making the individual functional and productive for effective all round achievement of a nation's developmental goals. Furthermore, visualizing mathematics as a well fitted tool for human empowerment, Odumosu, Oluwayemi, and Olatunde (2012) described mathematics as the carpenter's hammer, tailor's tape, artist's pencil, barber's clipper, hair dresser's comb, journalist's pen, broadcaster's microphone, doctor's stethoscope and lawyer's wig. They further qualified mathematics as an essential ingredient in manufacturing industries and essential tool in economic activities, bride of sciences, chief bride's maid of social sciences, ladies in waiting for engineering, cosmetology of arts and unavoidable servant of management sciences. This reveals that the main objectives of teaching and learning mathematics is to prepare students with appropriate skills that will enable them contribute towards economic development and sustainability of the society. Hence, Osborn (2003) asserted that career depends largely upon creativity.

Creativity in mathematics according to Haylock (1987) is the ability to see new relationships between techniques and areas of application, and to make associations between possibly unrelated ideas. Sriraman(2004) also described creativity as the process that results in unusual and insightful solutions to a given problem, irrespective of the level of complexity. However, an observable trend among researchers is that there are four dimensions of mathematical creativity (Neetu, 2012) that need to be developed in the students. These include fluency: the number of responses given to any mathematical question (ii) flexibility, the shift in categories or methods in the responses to a given mathematics task (iii) originality, when responses are novel compared to others to the same mathematical task and (iv) elaboration, the ability of a learner to extend, improve or give constructive criticism to standard known methods of solving a mathematical problem (Imai, 2000). According to Tatlal, Aslam, Ali and Iqbal (2012), creativity and emotional intelligence are better predictors of success than generic skills of intelligence.

The low achievement of students in external examinations like West African Examination Council (WAEC) could be attributed to lack of creative classroom activities that may promote the development of creativity. Suggestion for a way forward, Myron and Keith (2007) assert that teachers may be more successful in their lesson delivery if they are more conscious of the different learning styles of their students and attempt to use different teaching methods for different types of students. This is especially important when teachers are teaching abstract topics

like algebra. Contributing, Vijayakumari & Kavithamole (2014) assert that, the use of creative techniques in teaching can be a very effective way for students to develop a passion for learning mathematics. Such creative strategies give the students the needed variations that might enhance creativity of the students and deepen their understanding of mathematical concepts. These creative strategies Vijayakumari & Kavithamole (2014) classified into overlapping categories as appreciation, animation, association, alteration and abdication. They further identifies the categories to include brainstorming, sensory awareness attribute listing, modeling, making connections between given situation, systematic change of parts or situations of problems etc. Thus, this study examines Junior Secondary two (JS2) students' perception of creative classroom activities that promote their interest in learning mathematics especially algebra.

Algebra, the language of symbols and relations (Odili, 2006; Kieran & Yerushalmy, 2004) is characterized as generalized arithmetic and the backbone of school mathematics (Kulbir, 2002). According to National Council of Teachers of Mathematics (NCTM, 1989),

Algebra is the language through which most of mathematics is communicated. It also provides a means of operating with concepts at an abstract level and then applying them, a process that often fosters generalizations and insights beyond the original context.

Moses and Cobb (2001) assert that algebra is the new civil right, and the key to the future of disenfranchised communities. In support, Erbas (2004) wrote that the value of algebra goes beyond academic study; algebraic literacy is also a medium for social justice, jobs and later opportunities. Today's technological society seems to have become so demanding and fast changing that there is need for more and more people who have problem-solving capacities to solve the non-routine problems that occur as a result of these societal changes. This is why algebra is one of the six themes of mathematics curriculum scheduled at junior and senior secondary school levels.

Algebra plays a unique and formidable gatekeeper role for later mathematics courses (Cooney & Bottoms, 2002). Elsewhere the Education Alliance (2006) has observed that, regardless of mathematics skills before high school, taking algebra in the middle school is strongly related to achievement gains in high school mathematics. The implication is that, algebraic symbols

are used for generalizing the arithmetic values, and as a mathematics language these symbols have different meanings (semantic) and interpretations in different mathematical situations (syntax).

The centrality of creativity in child development is rooted in Vygotsky's (1930/1984) argument that creativity ('imagination' in Vygotsky's terms) is one of the basic mechanisms that allow development of new knowledge. A child activates imagination when connecting new and previously known concepts, elaborating the known constructs, or developing abstract ideas. Imagination (or creativity) is a basic component of knowledge construction. Since creative thinking is a predictor of teachers' effectiveness, student's creative abilities can only be developed in an atmosphere in which the teacher's creative abilities are properly engaged as teachers extend their creative pedagogical repertoire beyond conveying knowledge which is the focus of this study.

Samira and Mohammad (2013) investigated into the relationship between teachers' creativity and students' academic achievement. They found the mean difference between average group and weak group was 14.33 (sig=.044) and between above average group and weak level was 17.66 (sig=.018). Based on such findings they supported the positive effect of teachers' creativity on students' achievement.

Davidovitch and Milgram (2006) investigated creative thinking as a predictor of teacher effectiveness in 58 college-level instructors. The correlation between creative thinking and teacher effectiveness defined as real-life problem solving was $r = .64, p < .0001$. The absence of a relation between creative thinking and student evaluations was attributed to the fact that student evaluations did not include their opinion of their teachers' creativity. Their findings suggested the potential benefit in sponsoring pre-service and in-service workshops to enhance teachers' creative thinking ability and including creativity in the evaluations of faculty.

Hosseinee (2008) investigated the impact of the creativity teaching program on teachers' knowledge, attitude and skills. The experimental group was involved in "Teaching of creativity" program. Then the impact of the program and training model on instructors' knowledge, attitude and skill were assessed. The results showed that there was a significant difference between the two groups – The experimental group and the control group. The results stated the positive impact of the training period. On gender differences Sak and Maker (2006) and Pooja (2012) found existing gender difference in flexibility

dimension favoring girls while the boys surpass the girls on the other three dimensions of mathematical creativity.

II. STATEMENT OF THE PROBLEM

Creativity is considered a great asset for national development and sustainability. This is because a society endowed with creative citizens is bound to succeed and proffer solutions to challenging issues. Mathematics is identified as one of those key school subjects that promote creativity.

However, students' achievement in mathematics has not been encouraging as reported by examination bodies like WAEC. It is alleged that most students skip problems solving questions which will demonstrate their creative abilities. Thus, this study sorts to examine students' perception of activities that should be encouraged in classroom instructions in mathematics lessons that will promote their creativity. Also the report in mathematics creativity shows that there is gender difference in students' achievement. This study will also find out if there is difference between male and female students' perception in activities that promote students' creativity.

Purpose of the study

The main purpose of this study was to assert how creative teaching and learning would help knowledge acquisition in algebraic classroom among JSS2 students. Specifically the study was to:

- i. Identify activities perceived by students that enhance creativity in algebra classroom
- ii. Find out which of the gender is most likely to embrace more the classroom activities identified in one.

Research questions

The following research questions were asked to guide the study

- i. What are the activities that enhance creativity in algebraic classroom among JSS2 students?
- ii. Which gender is most affected by the activities that enhance creativity in algebraic classroom among JSS2 students?

III. METHODS

The design of this study was a simple survey research design. This is because the study sought the subject's opinion on the issue under discussion. The target population for this study was all the JSS2 afternoon session students in Walomayo council ward of Makurdi metropolis. One stream was found from Bright Hope secondary school, while two streams were

found in Walomayo secondary school. The total of these three streams gives the sample size of 155 (96 male and 59 female) students that were used in the study.

The instrument used for this study was called Algebra Creativity Enhancing Teaching/Learning Strategy (ACETS). It was a four point scale calibrated in the form of strongly agree (SA), agree (A), disagree (D) and strongly disagree (SD) weighted 4, 3, 2 and 1 accordingly. It is a 12-item instrument that was validated by three experts in mathematics education and two experts in measurement and evaluation. A reliability index of .80 was obtained using Cronbach Alpha formula.

The researchers personally went to the two institutions, seek permission and administered their

instrument which was fill and returned within thirty minutes. The data collected and collated was analyzed using the descriptive statistic of mean and standard deviation. To arrive at a decision, items that were positively skewed which had a mean score of 2.5 and above were accepted, while any item with a mean score less than 2.5 were rejected. For the negatively skewed items, the revise was the case.

IV. RESULTS

The result of this study is presented according to the research questions asked. This is based on the data collected and collated.

Research Question 1: What are those variables that will enhance creative acquisition of knowledge in algebraic classroom among JSS2 students?

Table 1: Variables that enhances acquisition of creative knowledge in algebra classroom among JSS2 students.

S/No	Items	\bar{x}	S.dev	Remarks
1	Algebra lessons presented alongside symbols, cartoons and comics are more enjoyable and understanding.	2.86	1.01	Retain
2	In most algebra lessons, activities that enable students to work on their own and in groups with well planned activities are more beneficial.	2.79	1.02	Retain
3	Taking some algebra lessons outside the class reduce language difficulties by physically seeing, handling and observing objects then representing them with alphabets.	2.89	0.99	Retain
4	I enjoy and understand algebra lessons that am given opportunity to work with colorful concrete objects (manipulatives) or drawings.	3.12	0.88	Retain
5	Playing algebraic games made me to understand linear equations and their graphs.	3.10	0.90	Retain
6	Marking and awarding marks promptly for students' class activities encourages their participations in algebra lessons.	3.40	0.59	Retain
7	In algebra lessons all students should have the chance to ask questions for clarification.	3.05	0.97	Retain
8	My teachers marking not only answers encourage me in learning algebra class activities.	3.14	0.94	Retain
9	Algebra class activities that fully engaged and appropriately challenged students with widely differing abilities and interests are enjoyable.	2.88	1.07	Retain
10	In any algebra class, teachers with excellent skills in questioning the students foster better, the spirit of enquiry and creative thinking in the students.	2.80	1.03	Retain
11	Algebra lessons are enjoyable when planned in clear and well-supported links with real life events.	3.12	0.88	Retain
12	The instruction approach should allow students to reflect critically on their ideas, actions and outcomes.	3.52	0.51	Retain

Table 1 indicates that the mean response of the respondents in the items of the questionnaire ranged from 2.79 to 3.52 with item 12 having the highest mean while item 2 has the lowest mean. The corresponding standard deviation of the items ranged from 0.51 to

1.07. This implies that the subjects of the study have closer opinion of issues under discussion. Again, they all agree on the twelve items as been variables that enhances creative acquisition of knowledge in algebra classroom.

Research Question 2: Which gender is most affected acquisition in algebraic classroom among JSS2 by the variables that will enhance creative knowledge students?

Table 2: Gender disparity on variables that enhances creative knowledge acquisition among JSS2 students.

S/N	Items	Male		Female		Mean Diff.
		\bar{x}	S.dev	\bar{x}	S.dev	
1	Algebra lessons presented alongside symbols, cartoons and comics are more enjoyable and understanding.	2.97	0.92	2.68	1.12	M>0.29
2	In most algebra lessons, activities that enable students to work on their own and in groups with well planned activities are more beneficial.	3.22	0.62	3.51	0.50	F>0.29
3	Taking some algebra lessons outside the class reduce language difficulties by physically seeing, handling and observing objects then representing them with alphabets.	2.98	0.94	2.75	1.06	M>0.23
4	I enjoy and understand algebra lessons that am given opportunity to work with colorful concrete objects (manipulatives) or drawings.	3.00	0.95	3.19	0.82	F>0.19
5	Playing algebraic games made me to understand linear equations and their graphs.	3.22	0.81	2.90	0.99	M>0.32
6	Marking and awarding marks promptly for students' class activities encourages their participation and understanding in algebra lessons.	2.96	0.97	2.53	1.06	M>0.43
7	In algebra lessons all students should have the chance to ask questions for clarification and critique for developing their understanding.	2.97	0.91	3.10	0.85	F>0.13
8	My teachers marking not only answer encourage me in learning algebra class activities.	2.85	0.87	3.25	0.73	F>0.40
9	Algebra class activities that fully engaged and appropriately challenged students with widely differing abilities and interests are enjoyable.	3.24	0.63	3.20	0.64	M>0.04
10	In any algebra class, teachers with excellent skills in questioning the students foster better, the spirit of enquiry and creative thinking in the students.	3.25	0.70	3.24	0.63	M>0.01
11	Algebra lessons are enjoyable when planned in clear and well-supported links with real life events.	3.34	0.54	3.36	0.52	F>0.02
12	The instruction approach should allow students to reflect critically on their ideas, actions and outcomes.	3.41	0.50	3.41	0.50	Both

From Table 2, the mean response of the male students ranged from 2.85 to 3.41 with standard deviation ranging from 0.50 to 0.97. The female mean response ranged from 2.53 to 3.41 while their standard deviation ranged from 0.50 to 1.12. A close look at the means and standard deviations of male and female students in Table 2 shows that even though the respondents all agree with the items, some observable differences exist. The implication is that, male agreed in stronger terms that, playing algebraic games made them understand linear equations and their graphs better. Also, marking and awarding marks promptly for

students' class activities encourages their participation and understanding in algebra lessons. Whereas their female counterparts agreed in stronger terms saying, teachers that mark stepwise and not just answers in their work, gives them much encouragement. Whereas item 12 showed that both male and female tied in their degree of responses.

This shows that, male students understand linear equations and their graphs better when given access to algebraic games. The male are also more encouraged when their mathematics teachers mark and record their activities promptly. The female students on their part

showed better understanding when their teachers mark not only answers in any given algebra class activities.

Summary of Major findings

Promoting creative learning of school algebra is largely dependent on students-activity centered strategies as supported by Baran, Erdogan and Çakmak (2011) that, creativity is not a special gift that very few people possess by chance, but an ability and type of behavior that can be developed through practice.

Teachers may be more successful in their lesson delivery if they are more conscious of the different learning styles of their students and attempt to use different teaching methods for different types of students (Myron & Keith, 2007).

In most algebra lessons, activities should be well planned such that students should be allowed to work on their own and in groups.

V. DISCUSSION

The result of the study is an indication that there exists closeness of expressions from respondents on variables that promote creative learning of school algebra among JSS2 students. Means obtained on various items were above the cut-off point of 2.5 while their various standard deviations were less than 1 with only few slightly above 1. The implication of this is that the respondents' opinions with regard to variables that promote creative learning of school algebra do not differ much. Such responses are in support of NCTM's (2000) position on algebra as an essential component of contemporary mathematics whose set of concepts and techniques teaches the representation of quantitative relations and mathematical thinking for formalizing patterns, functions, and generalizations.

Again the result of individual item analysis is a strong indication that the JSS2 students are yearning for teaching that will provide them with opportunities that promote their creative learning in algebra. Such yearning is in support with Mann's (2005) and Ruppert's (2010) call for inclusion of creativity education in school curriculum of the 21st century. This also support Vygotsky's (1930/1984) argument that creativity as one of the basic mechanisms help the development of new knowledge in children by connecting new and previously known concepts, elaborating the known constructs, and developing abstract ideas.

The entire results attest to the fact that, the manner in which teachers put together their creative pedagogical repertoire and present creative class activities are

important indices of creative knowledge acquisition in the students.

VI. CONCLUSION

It is evident that creativity can be promoted in algebraic classroom through teaching and learning. However, the mathematics teacher must have the creativity repertoire before he/she could be able to develop the learner. This could be achieved through reading other peoples works, applying same with his/her students and improving upon their works by embarking on personal capacity development.

VII. RECOMMENDATIONS

Mathematics teachers should be encouraged to acquire creativity pedagogical knowledge through training and reading, and use same in their lesson plans and class activities. Stakeholders in mathematics education should encourage mathematics teachers to make annual publication of their action-research in the classroom as this will help them know and adopt methods which will foster complementary values to creativity-friendly society. School authorities should manage their teachers and students in such a way that encourages creativity teaching and learning spirit.

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