INTEGRATING ETHNOMATHEMATICS INTO SECONDARY SCHOOL MATHEMATICS CURRICULUM FOR EFFECTIVE ARTISAN CREATIVE SKILL DEVELOPMENT

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Abstract

This study employed a quasi experimental research design to investigate the effects of integrating ethnomathematics into secondary school mathematics curriculum for effective artisan creative skill development in Abia State, Nigeria. This study presented two experimental groups and one control group. Experimental group 1 was taught (raffia weaving) and experimental group 2 (pottery) by integrating ethnomathematics teaching approach into the conventional teaching approach via demonstration and discussion respectively. The control group was taught (traditional building) without integrating ethnomathematics teaching approach. Two research questions and two hypotheses guided the study. The population for this study was 407 Junior Secondary two students in all the public junior secondary schools in Isiala Ngwa North Local Government Area of Abia State. A simple random sampling technique was used to select 117 JS2 students. The instrument used for data collection was Artisan Skill Creativity Ability Test (ASCAT). The instrument was validated and the reliability index for ASCAT was 0.81. Mean, Standard Deviation and Mean Gain were used to answer the research questions while the Analysis of Covariance was used to test the hypotheses at .05 alpha level. The findings revealed that students taught by integrating ethnomathematics instructional approach via practical had the greatest mean gain in the acquisition of creative skills. There was a significant difference in the creative skills acquired by students for artisan skills development when taught using EIA and CIA. It was recommended among others that mathematics teachers should practically integrate ethnomathematics instructional approach to develop artisan creative skill in students.

Keywords: Ethnomathematics, Artisan, Creative Skill, Mathematics Curriculum

Introduction

Mathematics is a school subject that has been accorded a central position in the development of man and society. (Ezeilo,1975; Jegede, 1984) in Odili (2006) posited that mathematics is one of the school subjects that any nation needs for industrial and technological advancement. Mathematics as a utility subject has been viewed from different perspectives by different experts. Sidhu (2006) in his own view opined that mathematics is a very useful subject for most vocations and higher specialized courses of learning. One interesting thing about the various views is that they all converge on the point that mathematics is the key subject to individual and national development. The Nigerian junior secondary school mathematics curriculum has spelt out the goals, content, instructional and evaluative strategies of mathematics education at this level. One of the instructional strategies is that the teaching of mathematics be carried out by using local aids and examples in the immediate environment of the learner for the concretization of mathematics concepts. Gbamanja (2001) posited that a good curriculum must be based on a good theory which reflects the values of the society for which the curriculum is designed.

There exists in the immediate environment of the students, local aids and examples that teachers can fall back on in order to make the teaching and learning of mathematics meaningful to students. The teaching of mathematics according to Ogunkunle (2007) has taken a standpoint of talk and chalk at the secondary school level. This instructional approach does not establish the link between mathematics concepts learnt in the classroom and their applicability to real life situation. Students are not taught mathematics concepts to solve problems in their cultural background. Sidhu (2006) opines that this makes it difficult for meaningful learning to take place in mathematics. Shirley (1995) posited that in many parts of the world, mathematics instruction was based entirely on European model of content structure and algorithm. The implication of this was that western education as introduced in the colonized countries did not reflect the cultures, worldviews and environment of the people. There was a euro-centric bias in the methodology of their curricula. This led to the erroneous impression that mathematics was not indigenous to non-western cultures. This culture-based mathematics is what mathematics historians and educators are interested in researching, in an attempt to see how it can be inculcated into school mathematics curriculum which is often seen as alien and unrelated to the child's culture. This suggests why D'Ambrosio (1977) in Okpobiri (2005) propounded the concept of ethnomathematics and how the integration can be used to improve the academic achievement of students in mathematics.

The integration of Ethnomathematics into the present mathematics curriculum focuses on the curricular that have the potential for facilitating self employment or good skills in the new Nigerian society. A mathematics curriculum that is aimed at providing unemployed Nigerian youths with the basic skills needed for both higher learning and vocation. In this present Nigerian setting where unemployment is a major prevalence, there is an urgent need to integrate ethnomathematical programme/approach into the existing mathematics curriculum to cater for the needs of students who will forge ahead with their education and those who will go into vocations/crafts. Sequel to this, Nigerian curriculum planners have introduced entrepreneurship education in the Nigerian educational system. One of the millennium goals is the reduction of poverty and acceleration of economic growth and development. It is the development of the right entrepreneurial skills in individuals that forms the springboard for economic growth. To this end, Schumpeter (1969) argued that entrepreneurship is the nucleus to national development. One of the standpoints maintained by many educators is that it is important to acknowledge the cultural context of mathematics for students by teaching culturally based mathematics that students can always relate to.

The On-line Cambridge Dictionary (2014) defines an artisan as a worker who practices a trade /handicraft or one that produces something in a traditional way with hands. Artisans are known to possess the characteristic for creative expression of original and new ideas. In today's world, an artisan is one who makes attractive and creative work with hands. It is therefore pertinent for artisans to possess the skill of creativity. It is the extent to which creativity is expressed in their products that determines the extent of value attached to the products. Words synonymous to artisan are artificer, craftsman or journeyman. Every student has creative skill abilities but what matters is the kind of training programme that the student is engaged in to obtain a greater potential for creative output. Creativity is defined as the tendency to generate or recognize new ideas, alternatives or possibilities that may be useful in solving problems (Franken, 2002). When unknown patterns are established and solutions are generated by making connections between phenomena that are not related, problem solving and creative skills becomes the major tool for such activity. Wilson (2013) posits that creativity is the main element of anyone who engages in vocational activity. In a similar manner, Fogarty (2009) advocates that the creative skill of students should be developed since creativity is the essential skill needed in the 21st century.

For one to become an artisan, one will need a strong background in basic mathematics such as quantification, relations, geometrical shapes and measurements. Artisans need basic mathematical knowledge to develop the artisan creative skills. This basic mathematical knowledge is to be taught in the classroom with respect to application and practice. Sequel to this, Scott, Leritz & Mumford (2004) assert that creative skills of students can be developed by learning and applying creative thinking skills. The need for the development of qualified artisans to support the economy remains a high priority. This is especially so in the light of the government's intention to strengthen self- reliance and gainful employment in order to eradicate unemployment and poverty in Nigeria. Artisans may be considered to be involved in art given the beauty and intricate work they do. Therefore, they need quantification, mathematical and creative skills that will make them more efficient in their artisan practices. A better application of the basic mathematical skills to crafts in the students' cultural background will make for better efficiency, more productivity and by implication, better citizenship and nation building.

It is worthwhile to note that a close look at the way mathematical concepts of the present Nigerian junior secondary school mathematics curriculum are presented may not be related to the students' cultural mathematics. Bekalevu (1998) supports this assertion by hypothesizing that lack of cultural consonance in the mathematics curriculum of third world countries could be the reason for the continuous low performance of students in mathematics. The research evidence of Zaslavsky (1991) shows that including the cultural aspects of students in the mathematics curriculum will deepen students understanding of mathematics, boost their recognition of mathematics as part of everyday life and enhance their ability to make meaningful connections between mathematics and cultural practices. To D'Ambrosio (2001), it is a practical approach of teaching and learning mathematics which builds on the students' previous knowledge, background, the role his environment plays in terms of content and method, and his past and present experiences of his immediate environment. Pink (2005) opines that we are living in the era of creativity and this makes it imperative for students to be trained to be creators by developing the creative skills of students. It is on this basis that this study investigates the effects of integrating ethnomathematics into the present mathematics curriculum by employing its practical and culture-based attributes for the development of artisan creative skill.

Statement of the Problem

The objectives of secondary school education as stated in (FRN, 2004:18) maintain that this level of education prepares the student for useful living within the society and higher education. Hence, education practiced in Nigeria is expected to cater for the needs and interests of students who are opportune to further their education and those that truncate it due to one reason or the other. This means that at any point where a child's education terminates, the child should be equipped with the basic mathematical knowledge that will be sufficient to successfully engage in the development of artisan creative skills. There appears to be a disconnection between that which is being taught in the classroom and the real world applications of these skills. Many mathematics teachers carry out mathematics classroom instruction in disconnection to application in the students' cultural background or immediate environment. Mathematics teachers do not consider students' cultural backgrounds in designing and selecting classroom mathematical tasks. This therefore brings a gap between what students learn and its relevance to artisan practices. This study sought to fill this gap.

Purpose of the Study

The objectives of this study are to:

1. outline the effect of the use of Ethnomathematics Instructional Approach (EIA) on the mean score creative skill acquired by students for artisan skills development.
2. analyse the effect of gender on the mean score creative skill acquired by students for artisan skills development.

Research Questions

This study endeavoured to provide answers to the following research questions.

1. To what extent can we describe the mean score difference in the creative skill acquired by students for artisan skills development when taught using EIA and Conventional Instructional Approach (CIA)?
2. What is the difference in the mean score creative skill acquired by the male and the female students for artisan skills development when taught using EIA and CIA?

Hypotheses

Two null hypotheses were tested at .05 alpha level in this study.

Ho_1: There is no significant difference in the mean score creative skill acquired by students for artisan skills development when taught using EIA and CIA?

Ho_2: There is no significant difference in the mean score creative skill acquired by the male and the female students for artisan skills development when taught using EIA and CIA.

Research Design

The research design used for this study was quasi-experimental. This design randomly presented three intact classes (two experimental groups and one control group). Experimental Group 1 got involved in traditional raffia weaving and was treated by integrating ethnomathematics via demonstration; Experimental Group 2 got involved in pottery and was treated by integrating ethnomathematics via discussion while the Control Group got involved in traditional building and was treated by non integration of ethnomathematics.

Area of Study

The area of study was Isiala Ngwa North Local Government Area of Abia State Nigeria.

Population of the Study

The population of the study comprised of all 407 Junior Secondary two (JS2) students in all the public co-educational junior secondary schools in Isiala Ngwa North Local Government Area of Abia State Nigeria.

Sample and Sampling Technique

The sample for this study was 117 JS2 students. Three (3) schools were randomly drawn for this study. A further simple random sampling technique was employed to select one (1) intact class from each of the three sampled schools. The researcher ensured that the sample students have the same psychological factors in common regarding their chronological age, mental development, cultural background and mathematics experience.

Instrumentation

The instrument used for data collection was a researcher made practical ability test tagged Artisan Skill Creativity Ability Test (ASCAT). ASCAT was used to elicit JS 2 students' practical application of mathematics concepts for the development of artisan skills in traditional raffia weaving, pottery and building. The scoring scale of ASCAT was on a 4-point scale of Strongly Present (SP) = 4, Moderately Present (MOP) = 3, Minimally Present (MIP) = 2, Not Present (NP) = 1. The mean criterion for each item in ASCAT was 2.5.

Validation of the Instrument

The validity of ASCAT was determined by two experts in the area of Mathematics Education and Measurement & Evaluation. These experts were given the instrument to check their relevance, the clarity of the language and any contradictions. The corrections made by the experts were effected at the final construction of the instrument before administering them on the sample.

Reliability of Instrument

The Crombach alpha reliability method was used to establish the internal consistency of ASCAT. The subjects' samples used to ascertain the reliability of ASCAT were not part of the study sample. Each copy of ASCAT was administered to the students once. The scores of students were subjected to analysis using Statistical Package for Social Sciences (SPSS) software and a reliability coefficient of 0.81 was obtained.

Method of Data Collection

Lesson plans for teaching the three (3) groups (two experimental and one control) was prepared by the researcher. Three lesson plans on (types of geometric lines, properties of plane shapes and patterns & designs) were prepared for each group. Each topic was prepared for the experimental group 1(raffia weaving) and experimental group 2 (pottery) by integrating ethnomathematics teaching approach into the conventional teaching approach via demonstration and discussion respectively while each topic was also prepared for the control group (traditional building) without integrating ethnomathematics teaching approach into the conventional teaching approach. The researcher considered the age and class of the students, lesson duration of 40 minutes per teaching session, class size, students' previous knowledge, the specific objectives of the lesson topics, instructional materials, the sex and qualification of the intact class teachers. The regular mathematics teachers of the intact classes were used to carry out the teaching. These teachers were trained by the researcher for two (2) days on the integration of ethnomathematics teaching approach via demonstration and discussion on the experimental groups and the non integration of ethnomathematics teaching approach on the control group. The teachers were also closely supervised by the researcher during the teaching session to avoid deviation from the lesson procedure. The major source of guide for teaching both experimental and control group was the lesson plans. The experiment was not disclosed to the students to avoid faking on the part of the students.

A pretest of ASCAT was first administered to all three (3) groups (i.e. experimental groups 1 & 2 and the control group). This was then followed by the teaching of the topics for six weeks. Each group was taught the same content, by same regular mathematics teacher, for the same duration of time, under similar environmental conditions using the same lesson plans. The only difference was the integration of ethnomathematics to the experimental group 1 via demonstration, experimental group 2 via discussion and non integration of ethnomathematics to the control group. After the experiment, a post-test of ASCAT was given to the three groups. The students' scripts for both pretest and posttest were collated and analyzed statistically.

Method of Data Analysis

Mean, standard deviation and mean gain were used to answer the research questions while the Analysis of Covariance (ANCOVA) was used to test the hypotheses at .05 significant level.

Results

Table 1: Mean gain scores in the creative skill of students taught using EIA and CIA

			Pretest		Posttest		Gain	
Skill	**Group**	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
	EG1	38	51.32	8.44	84.08	9.65	32.76	14.92
Creative	**EG2**	40	52.50	13.87	75.75	9.31	23.25	16.51
	CG	39	66.28	10.99	54.36	10.27	11.92	14.85

EG1= Experimental Group 1, EG2=Experimental Group 2, CG= Control Group.

Table 1 showed that the highest mean gain in acquisition of creative skill was obtained by the students in EG1 (MG=32.76, SD=14.92). This was followed by students in EG 2 (MG=23.25, SD=16.51). The least mean gain was obtained by students in the control group (MG=11.92, SD=14.85)

Table 2: Mean gain scores in the creative skill of students based on strategies and gender

				Pretest		Posttest		Gain	
Skill	**Group**	**Gender**	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
	EG1	**Male**	14	47.50	8.03	85.71	9.17	38.21	14.89
		Female	24	53.54	8.01	83.13	9.98	29.59	14.29
Creative	**EG2**	**Male**	17	57.94	16.40	71.47	8.80	13.53	16.93
		Female	23	48.48	10.27	78.91	8.52	30.43	12.15
	CG	**Male**	11	75.45	10.36	54.55	10.36	20.90	14.63
		Female	28	62.68	9.08	54.29	10.43	8.39	13.61

Table 2 revealed that the male students in the experimental group 1 had the highest mean gain in creative skill (MG=38.21, SD=14.89). This was followed by the female students in experimental group 2 (MG=30.43, 12.15). The least mean gain was obtained by the female students in the control group (MG=8.39, SD=13.61).

Table 3: Summary of ANCOVA on the difference in the mean score creative skill acquired by students for artisan skills development based on strategies

Skill	Source of variance	Type III Sum of Squares	Df	Mean Square	F	Sig.
	Corrected Model	18239.145[a]	3	6079.715	63.727	.000
	Intercept	24560.098	1	24560.098	257.436	.000
	Pretest	48.725	1	48.725	.511	.476
Creative	Group	12714.477	2	6357.238	66.636	.000
	Error	10780.513	113	95.403		
	Total	624225.000	117			
	Corrected Total	29019.658	116			

Table 3 showed that there is a significant difference in the creative ($F2, 113=66.636$, $p< .05$) skill acquired by students for artisan skills development when taught using EIA and CIA. From the result of the analysis $H0_1$ was therefore rejected.

Table 3b: Post Hoc test of multiple comparisons on the pair-wise difference between the groups on creative skills

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
EG1	EG2	8.261*	2.215	.000	3.873	12.648
	CG	28.859*	2.532	.000	23.844	33.874
EG2	EG1	-8.261*	2.215	.000	-12.648	-3.873
	CG	20.598*	2.462	.000	15.720	25.476
CG	EG1	-28.859*	2.532	.000	-33.874	-23.844
	EG2	-20.598*	2.462	.000	-25.476	-15.720

Based on estimated marginal means

* The mean difference is significant at the .05 level.

Table 3b showed that the mean difference between EG1 and EG2 was significant (MD=8.261, p<.05) and in favour of EG1. The mean difference between EG1 and the control group was significant (MD=28.859, p<.05) and in favour of EG1. The mean difference between EG2 and the control group was significant (MD=20.598, p<.05) and in favour of EG 2. However, the most significant of the three strategies was Experimental Group 1 (EG1).

Table 4 Summary of ANCOVA on the difference in the mean creative skill acquired by students for artisan skills development based on gender

Skill	Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Creative	Corrected Model	18301.889[a]	4	4575.472	47.813	.000
	Intercept	22069.230	1	22069.230	230.622	.000
	Pretest	25.281	1	25.281	.264	.608
	Group	12587.475	2	6293.737	65.769	.000
	Gender	62.744	1	62.744	.656	.420
	Error	10717.769	112	95.694		
	Total	624225.000	117			
	Corrected Total	29019.658	116			

Table 4 showed that there was no significant difference in the mean creative ($F1, 112=.656$, $p>.05$) skills acquired by the male and the female students for artisan skills development when taught using EIA and CIA. From the result of the analysis Ho_2 was therefore retained.

Discussion of Results

The result revealed that the creative skills of students can actually be developed to meet the 21st century needs of the artisans by integrating ethnomathematics into mathematics curriculum via practical. This is in consonance with Scott, Leritz & Mumford (2004) who asserted that creative skill can be developed. The result also revealed that the acquisition of creative skills by students is tilted towards both the male and female gender. This implies that there are vocations that the male gender excel in and also vocations that the female gender excel in. In this study the male students' creative skill was highly developed in traditional raffia weaving and building than their female counterpart. On the other hand, the female students' creative skill was highly developed in pottery than their male counterpart.

Conclusion

Integrating ethnomathematics Instructional Approach into mathematics curriculum is effective at developing the artisan creative skills of students. However, integrating ethnomathematics instructional approach via practical was found to be most effective than integrating via discussion.

Recommendations

Based on the findings of the study the following recommendations were made:

1. Teachers should practically incorporate ethnomathematics when teaching mathematics to develop students' artisan skill of creativity.

2. Students should be guided to apply the creative skills acquired in mathematics to solve real life problems.
3. Curriculum planners should integrate ethnomathematics into the present mathematics curriculum for entrepreneurship education since it will help develop skills that students need for most vocations.

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