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INVESTIGATION ON THE ADOPTION OF ACTIVITY – BASED STUDENTS' CENTERED, EXPERIMENT AND IMPROVISATION (ASEI/PDSI) AS AN APPROACH FOR STRENGTHENING MATHEMATICS AND SCIENCE EDUCATION (SMASE) IN PRIMARY SCHOOLS OF NORTH-EASTERN NIGERIA

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ABSTRACT

Strengthening of Mathematics and Sciences Education (SMASE) training is an educational innovation and an initiative of the Nigerian government with the support of the Japanese International Cooperation Agency (JICA). It was launched out of the need to improve performance in the crucial Mathematics and science subjects that had been hitherto unimpressive.This study was to find out the level of awareness of ASEI/PDSI as an approach to SMASE among mathematics and science teachers in primary schools of northeastern states and to ascertain the level of attitudinal change among mathematics and science teachers based on ASEI/PDSI principles. The study employed a descriptive survey design, where a questionnaire was used to collect data from the selected 139 mathematics and science subject teachers. The collected data was analyzed using descriptive statistics to determine the mean score and standard deviation to answer the research questions. The result of the study revealed that there is a fair level of awareness of the SMASE programme among the mathematics and science teachers which eventually led to a change in attitude and approach towards teaching mathematics and science. The result also indicated a non-significance difference between the variables tested. Hence the study recommended among others that teachers should be encouraged to adopt ASEI/PDSI as an approach to SMASE.

Keywords: Mathematics, Science, Education, Nigeria

INTRODUCTION

Mathematics, like any other subject, is important to the extent to which it supports and contributes to the purposes of general education (Ugwu, 2013).Mathematics has been a pivot which many other subjects revolve around it especially science subjects. Lack of knowledge in mathematics produces a deficient effect on the student's achievement.The role of mathematics in the life of an individual and the development of a nation is as great as its knowledge is used in diverse fields of science Kojigili (2013). Thus, mathematics is incredibly important in our lives and, without realizing it, we use mathematical concepts, as well as the skills we learn from doing math problems, every day. Early studies by Eze (2006) and Omotayo, (2009) mentioned the problems of teaching and learning mathematics which include; lack of funds, time constraints poor teachers' skill in developing the resources, poor remuneration and inadequate in-service training, which give birth to poor students performance.Among the challenges mentioned, the poor students' performance in science and mathematics has been at the forefront in most of the works of literature (Tsanwani *et al.*, 2014). Although,

numerous solutions have been proposed and few were used. A recent survey Fenyvesi, et al., (2019) indicated that there is still the need for strengthening the teaching of science and mathematics in Nigerian schools.

Lamenting on the need for effective teaching of science and mathematics, Shuaibu (2016) is of the view that, teachers who teach mathematics and science need to be confident with what they are teaching, they need to have appropriate techniques and strategies of motivating the learners, especially at the basic education level. Accordingly, Ebisine (2012) posits that, teachers are the driving force behind improvements in the education system and are in the best position to understand and propose solutions to problems faced by students. Thus, emphasizing the need for teachers to be equipped with adequate pedagogical knowledge and the equipment and resources for effective teaching. A survey by the Federal Ministry of Education and Japan International Cooperation Agency (JICA) (2004) found practical teaching or use of materials or teaching aids as the only way to make the teaching and learning of mathematics effective, meaningful, interesting and pleasurable to the leaners. Yara, (2009)ascertained that by so doing the learners are guided to find out information and understand concepts through appropriate activities and demonstration, to encourage discovering patterns in mathematics leading to rules and formula. Musa and Agwagah (2006) in support of the practical approach opined that practical activities enable learners to acquire the relative experience that links learning to the environment on their own through the process of thinking, thereby causing positive change in their activities.

The SMASE Nigeria project was packaged to establish a system of re-training teachers in the delivery of mathematics and science curricula. With the aims of shifting the teaching paradigm from "banking style/chalk and talk" to "ASEI and PDSI approach". ASEI and PDSI approach is the effective approach for ensuring the quality of mathematics and science lessons and their steady improvement. ASEI, which is an acronym for Activities, Students, Experiments, and Improvisation is a key=p;.l;word in the SMASE project for lesson innovation. ASEI lesson is made possible through PDSI practice (Plan, Do, See, and Improve) (SMASE Newsletter). Azare (2018), by this approach, students' interest in the subject will be stimulated and sustained throughout their lessons to nurture the much-needed young scientist and technologies for the nation's socio-economic and industrial revolution. He further added that this approach has caused, attitudinal change, improvisation, planning a better lessons using the PDSI approach. This study, therefore, investigates an effort towards the actualization of ASEI/PDSI as an approach for strengthening mathematics and science education (SMASE) in primary schools of north-eastern Nigeria. The study sought a deeper understanding of the Attitudinal Change among Mathematics and Science teachers of the SMASE Programme. To achieve that, the study is set to answer the following research questions:

1. What is the level of awareness of ASEI/PDSI as an approach to SMASE among mathematics and science teachers in primary schools of northeastern states?
2. What is the level of attitudinal change among mathematics and science teachers based on ASEI/PDSI principles?

MATERIALS AND METHODS

Design and Area of the Study

The study employed a descriptive survey research designs because it is concerned with describing the population under study without influencing it in anyway. This design is suitable for this study since it allows for the collection, organization, analyzation, and presentation of data in a meaningful way.Not all targeted population have undertaken the SMASE training; thus, the major objectives or activities of this design is to collect, organize and present the description of some characteristics of the group as it existsby interviewing or administering a questionnaire to a sample of science and mathematics teachers.The geographical area of the study covered the entire North – Eastern States in Nigeria. The states comprise of Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe States, as shown in Figure 1. Thus, the study involved all the primary schools in the North East.

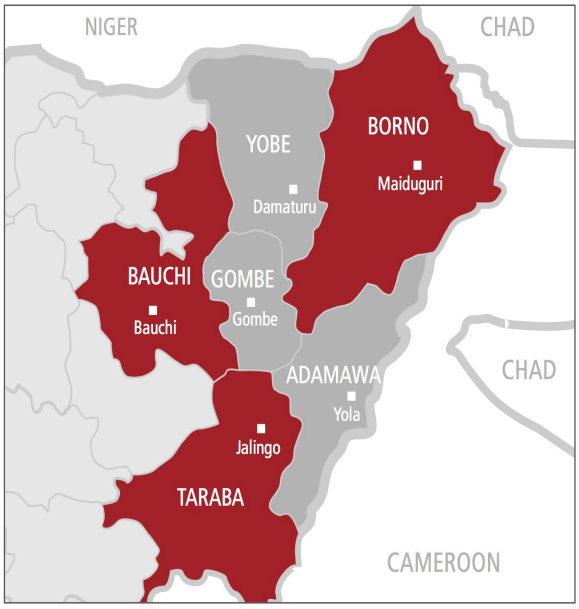

Figure 1: Map of North-east geopolitical regions covered by the study. (Google Maps, 2017)

Population and Sampling

The population of the study comprised all primary school teachers in the Northeastern part of Nigeria.However, due to the prevalent case of insecurity that is affecting the North East region, the study delimited the population to cover only primary schools located in the state capitals of three states (Adamawa, Bauchi, and Gombe) where considerable peace and normalcy exist. The study further employed a stratified random sampling method to obtain the representative sample. The sample comprised of 139 teachers of mathematics and science subjects drawn from the study area according to the recommendations by (Kathuriand Pals, 1993; Mugenda and Mugenda, 2003).Prior to the administration of the questionnaire, five research specialists from the school of science federal college of education (Technical) Gombe validated the instrument. The collected data was analyzed using descriptive statistics.

RESULTS AND DISCUSSION

Characteristics of the Respondents

Distribution of respondent by Gender

Among the Mathematics teachers that participated in this study, 36% representing 48 respondents were female while 64% were male as indicated in Figure 2. Researches by USAID (2008) and UNESCO (2007) indicate that there are poor participation and performance in science and Mathematics by females. This has been attributed to a lack of role models in science and Mathematics because there are few female teachers in mathematics and science subjects. These subjects have been traditionally perceived to be too hard for girls. The Nigerian Federal Ministry of Education through the Gender Policy of 2008 (Okonkwo, 2013),is committed to improving gender participation

and performance in science by increasing participation of women in these subjects and all sectors of education.

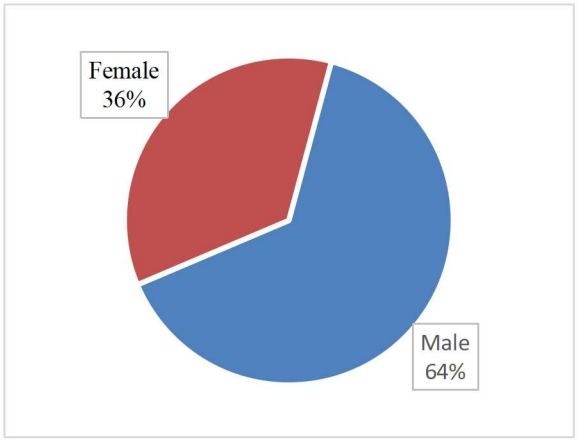

Figure 2: Gender distribution of the mathematics teachers

Distribution of Respondents by Age

Table 1 presents the distribution of the mathematics teachers respondents' age.From the results, fifty-nine of the Mathematics teachers, 44.0%,were aged between 25– 29 years. Findings also indicated that 30.0% were aged between 30 – 39 years, 13.0% were aged between 40 – 49 years while 13.0%were above 50 years.

Table 1: Distribution of respondents' age.

Year	Frequency	Percent
25 – 29 years	59.4	44.0
30 – 39 years	40.5	30.0
40 – 49 years	17.55	13.0
Above 50 years	17.55	13.0
Total	**135**	**100.0**

It can be deduced that young persons are becoming more engaged in science and mathematics, with about 60% of the respondent within the youthful age. Thus, it can also predict that there will be a high level of acceptance of new strategies and approaches among the younger teachers, in accordance with Garrison and Walter (2000), who opined that persons within the youthful age of 20 -40 are more receptive to changes.

Professional Qualification of the Teachers

Figure 3 presents the teachers' professional qualifications. The majority (52%) of the science and mathematics teachers had a Nigerian Certificate in Education (NCE), this certificate (NCE) is the minimum qualification required for admittance into a teaching jobs at the primary level.

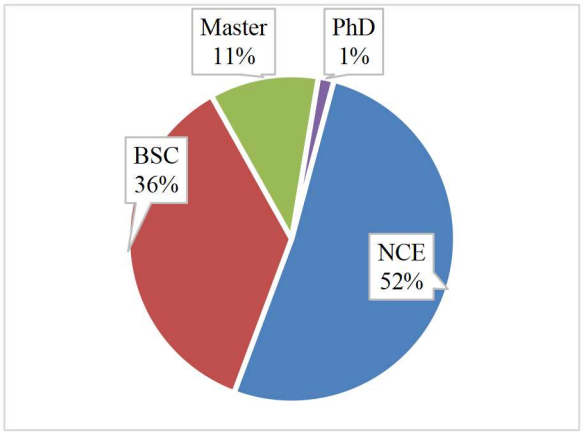

Figure 3: Professional Qualification distribution of the respondents

Forty-seven (47) of the respondents, representing 36% of the science and mathematics teachers had a Bachelor of Education. The remaining 11% held master's in education, with only 1 Ph.D. holder as a supervisor. Since the quality of teaching is at the mercy of the professional qualification of the teachers, it is, therefore, necessary to emphasize the engagement of the most qualified and enthusiastic graduate teachers for effective teaching and learning to take place. The results of this study show that the teachers are well qualified. However, in addition to a professional qualification, year of experience plays a significant influence on the quality of teaching. Figure 4 captured the teaching experience of the respondents.

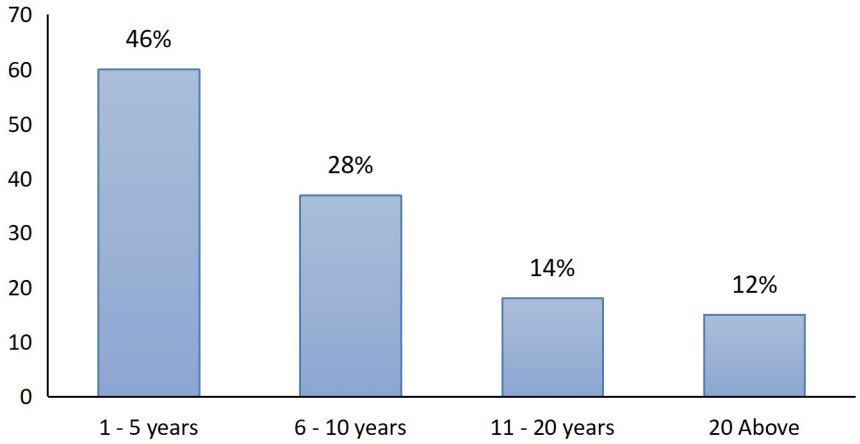

Figure 4: The distribution of respondents teaching experience

The findings shown in Figure 4 reveal that 46% of the science and mathematics teachers have taught for1 – 5 years, while28% had 6 – 10 years of teaching experience. Similarly, only 12% had above 20 years of teaching experience. Teaching experience is an asset; experienced teachers are expected to be competent in their work since in the course of teaching they acquire new knowledge, skills, and abilities. Adeyemi (2008) in a study on teachers' teaching experience and students' learning outcomes in secondary schools concluded that teaching experience is a critical variable.He observed that experienced teachers normally have better strategies and ways of bringing the subject matter being taught to students understanding and they applied it in any given situation.

Respondents awareness of ASEI/PDSI as an approach to SMASE

The research sought to find out the level of awareness among mathematics and science teachers in primary schools of northeastern states on the ASEI/PDSI principles as an approach used for strengthening mathematics and science education. Table 2 revealed the findings obtained.From the table, it can be seen that the mean awareness of the whole group of teachers is 3.5203which is considered a high value (70%) on the Likert type scale and therefore implying that the Level of awareness of ASEI/PDSI as an approach to SMASE among mathematics and science teacher in primary schools of northeastern states had improved with the introduction of SMASE in the teaching and learning of mathematics. This could be attributed to the positive impact of the in-service training for science and mathematics teachers through the SMASE program.

Table 2: Mean scores of Level of awareness of ASEI/PDSI as an approach to SMASE among mathematics and science teachers in primary schools of northeastern states.

SN	Statement	Male (N=87)	Female (N=48)	Total (N=135)
LOA1	Aware of the existence of SMASE Programme	4.0901	3.0901	3.5901
LOA2	Aware of ASEI / PDSI Principles used in the SMASE Programme	2.6745	2.7845	2.7295
LOA3	Aware of the SMASE programme through being a State Trainer	2.7045	2.1745	2.4395
LOA4	Aware of the SMASE programme through being a participants during the state cascading down	3.7063	4.3063	4.0063
LOA5	Aware of the SMASE programme through School Based Training (SBT)	2.4563	2.6863	2.4713
LOA6	Aware of the SMASE Programme during staff briefing	4.4322	4.0322	4.2322
LOA7	Aware of the SMASE programme and its ASEI/PDSI principles during model lesson presentation	3.8863	3.6223	3.7543
LOA8	Aware of the principles of ASEI/PDSI and had plan to embrace it	3.0222	4.4226	3.7224
	MEAN OF MEANS	**3.3716**	**3.3649**	**3.3682**

It can be deduced from the table that the entire item statements influenced the level of awareness of the science and mathematics teachers on the ASEI / PDSI Principles used in the SMASE Programme, except for items 2 and 5. It also revealed that items 6 and 1 have the highest influences on the male teachers while items 4 and 6 had the greatest influence on female science and mathematics teachers. It is important to note that, although there is a high level of awareness of the SMASE Programme among the science and mathematics teachers, the mean score of item 5 revealed that School-Based Training (SBT) is rarely conducted. Another significant finding from table 3 is on item 3. It shows that female science and mathematics teacher are less involved in the SMASE programme at the State Trainer level. This finding corroborates with Okonkwo, (2013) on the failure of the system to equally involve women in the coordination and implementation of science and mathematics projects and training.

Attitudinal change Among Mathematics and Science Teachers Based on ASEI/PDSI Principles

To answers the research question on attitudinal change, 10 items were used to evaluate the attitudinal change among mathematics and science teachers based on ASEI/PDSI principles. The results were as shown in Table 3.

Table 3: Mean scores of levels of attitudinal change of mathematics and science teachers based on ASEI/PDSI principles.

SN	Statement	Male (N=87)	Female (N=48)	Total (N=135)
AC1	Shift from knowledge / content based approach to Activity – Oriented Teaching and Learning	2.6112	2.5901	2.6007
AC2	Change from Teacher – Centered Teaching to Students – Focused Participatory	2.5111	2.5045	2.5078
AC3	Move from Lecture/Chalk and Talk/ Talk and Talk methods to Experiment / Research Based Approach	2.4045	2.7845	2.5945
AC4	Adoption to Improvisation rather than Recipe Type, Textbook Examples, Teacher Demonstration	2.6236	2.5041	2.5639
AC5	Leading a discussion that will enable my students to have positive feelings about mathematics	3.0012	2.5943	2.7978
AC6	Used to be humble enough to allow my students to present their mathematics/science problems and attending to them	3.0114	3.0321	3.0218
AC7	Cultivate the value of hardworking in my students by rewarding best performance	2.5007	2.4478	3.0615
AC8	Promptly cultivate in my students the value of creativity by allowing them to explore on mathematics/science subjects	2.8541	3.0322	3.2884
AC9	Mostly emphasize on the value of positive belief that mathematics is not difficult subject by giving an example of higher-achieving mathematics students	2.4574	3.6223	3.0309
AC10	Often listen to my students problem and that cultivate in them the value of love	3.0222	3.7226	3.3724
	MEAN OF MEANS	**3.3747**	**3.6043**	**2.8839**

The results indicated a lot of changes in the attitude of teachers towards mathematics after SMASE training. As much as the mean attitude of the whole group of teachers is 2.8839 which is a relatively high value (60%) on the Likert type scale? Item 10 scored the highest mean of 3.3742 and this showed that students were always embraced and listens to. As teachers show empathy and love of his/her student towards learning, it will be a good model for the students to emulate. Similarly, the result for item 8 indicates that teachers allowed the students to explore the teaching and learning process.

CONCLUSION AND RECOMMENDATIONS

The major objective of this study is to establish whether (ASEI/PDSI) as an approach for strengthening mathematics and science education (SMASE) had changed the teachers' attitudes towards mathematics for improving the teaching approaches in northeast primary schools. The result revealed that there is a high level of awareness of the SMASE programme among mathematics and science teachers.However, school-based training (SBT) is rarely conducted. More so, the result indicated that there are a lot of

changes in the attitude of mathematics and science teachers by showing love, empathy, listening to, and embracing their students. However, the findings indicated that the ASEI-PDSI approach was not being practiced by teachers in teaching science and mathematics lessons as expected. The study revealed that mathematics and science teachers have reasonably adopted the ASEI/PDSI principles in their teaching activities, but rarely conduct curriculum analysis according to ASEI/PDSI principles.The positive effort however needs to be enhanced towards instilling attitudinal change in both the teachers and students, for a better strengthening of mathematics and science education in primary schools. The study, therefore, recommended that teachers should be encouraged to adopt ASEI/PDSI as an approach to SMASE, by coordinating routine SBT in every school so that ASEI/PDSI principles will be easily assimilated.Apart from balancing gender inequality, the Government, school authorities and PTA should devise a means of monitoring and rewarding best-performing teachers who adopt and implement ASEI/PDSI principles.

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