Activity-Based, Students' Centered, Experiment and Improvisation (ASEI): For Strengthening Mathematics and Science Education (SMASE) In North Eastern Nigeria

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Abstract
This paper was designed to investigate Activity – Based, Students' Centered, Experiment and Improvisation through Plan, Do, See and Improve (PDSI) as a panacea to Strengthening Mathematics and Science Education (SMASE) in Upper Basic Schools of north eastern Nigeria. The study adopted Ex Post Facto research design which was conducted the entire North – Eastern States in Nigeria. A total of 993 mathematics and science teachers was considered as the population of the study. The study further employed a non-probability purposive sampling where the researchers select 103 mathematics and science teachers who have attended the SMASE training only. The study was guided by two (2) research questions and one (1) null hypothesis where questionnaire served as an instrument for data collection. The result revealed that when teachers go through the SMASE training there would be a gradual change and finally will lead to appreciating the role of SMASE training, thereby leading to a significant improvement in their teaching and learning process which have been seen not only their students' participation in class but also on their performance especially at the JSCE examinations. It therefore recommended that teachers should be encouraged to adopt ASEI/PDSI as an approach to SMASE, school based training (SBT) should be encourage and to become a routine in every school so that ASEI/PDSI principles will be easily assimilated, Government and school authorities should device a means of compulsory adoption and implementation of ASEI/PDSI principles and its principles in all teaching and learning.

Key Words: *SMASE, ASEI, PDSI, SBT.*

Introduction

Mathematics being a tool, its knowledge and skills are the bedrock of all societal transformation and transfer of ideas into reality (Otunu-Ogbisi 2009, Kojigili 2013). According to (Ogwuegbu 2017, Obodo 2001) mathematics is a key component of human activities, it can be inferred that mathematics plays its role in national development. Also Otonu-Ogbisi & Ukpebor (2009), Ugwu (2013) opined that mathematics has been seen as a pivot which many other subjects revolve around it especially science subject. Salman and Adeniyi (2012) further added that lack of knowledge in mathematics can have negative effect on achievement in the sciences.

Shuaibu (2016) in his paper mentioned that the education system in Nigeria, especially at the basic education level, 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 pupils. Musa and Agwagah (2006), Udele (2002), Zolghadr, Reza, Hamzeh (2015), Gazali, Abdullahi, Tela, and Abubakar (2017) confirmed that teaching of mathematics requires application of effective methods (use of concrete materials) that will bring active learning, the absence of this will make pupils not to participate actively in mathematics and science class. Eze, (2017), Gotring and Guwan (2017) opined the need to depart from the traditional chalk/talk method of teaching and learning of mathematics/science concepts to a well-tested and result oriented instructional materials that will lessen teaching time and help the students to stick to the concept of the topic will result to higher achievement of students in mathematics and sciences.

Koko (2004), Ebisine (2012) sees teachers as the driving force behind improvements in the education system and they are in the best position to understand and propose solutions to problems faced by students which can be achieved by making the teaching and learning of mathematics and science effective, meaningful, interesting and pleasurable to the leaners. Udele (2006), Gazali et. al (2017) suggest that serving teachers should be refreshed on improvisation through conferences and workshops from time to time. Furthermore Shuaibu (2016) added that effective teaching in primary schools and upper basic is no longer dependent on qualified teachers but on the quality of teachers who ensure learners score excellent grades, sound knowledge and have practical skills at the end of their primary and upper basic school. It is important to note that there has been poor performance in mathematics and science subjects which is a major source of concern to the government, parents and educators in the country.

It was based on the above assertions that the Federal Ministry of Education and Japan International Cooperation Agency (JICA) conducted a baseline survey in 2005 to ascertain the strategies in use, the needs and challenges facing teaching learning of mathematics and science at primary education level. Major findings of the survey presented to stakeholders showed a mirage of difficulties such as poor Teacher-Pupil strategy, perceived difficult concepts, monotonous use of lecture method of teaching and inadequate and poor utilization of available teaching materials. Thus, SMASE Nigeria project through PDSI was packaged to establish a system of re-training teachers in delivery of mathematics and science curricula.

This study therefore sees Activity-Based, Students' Centred, Experiment and Improvisation (ASEI) through PDSI approach as a Panacea to Strengthening Mathematics and Science Education in Upper Basic School in North Eastern Nigeria.

The study have strived to answer the following **research questions**.

i. To what extent does ASEI/PDSI influence the attitude of the teachers towards teaching mathematics and science subjects
ii. To what extent does the actualization of PDSI in training is leading to significant improvement in teaching and learning

Research Hypothesis

i. H_o: there is no significant difference in students' performance between Pre – ASEI/PDSI and the ASEI/PDI condition

ii. H_1: there is significant difference in students' performance between Pre – ASEI/PDSI and the ASEI/PDSI condition

Res**earch Design**

The study adopted Ex Post Facto research design. This was compelled by the fact that groups used were intact and the treatment was not manipulated. The intention of the study was to obtain a snapshot of the condition situation of mathematics and science in the schools since the teachers have been in-serviced through SMASE.

Area of the Study

The study was conducted in the entire North – Eastern States in Nigeria. The states comprise of Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe States.

Population of the Study

Mathematics and science teachers were considered as the study population because they were the ones who implemented the ASEI-PDSI approach in the classrooms after undergoing the SMASE training. There are 8,182 (Eight thousand one hundred and eighty-two) primary schools in the whole North east teachers. Gombe state 1091, Yobe state 1033, Adamawa 1890, Bauchi 2601, Taraba State 1514, while Borno state has 53 mega schools. According to the data available at the various States Ministry of Education by January 2020.

Sample and Sampling Techniques

Due to the prevalent case of insecurity that is affecting the North East region, the study delimited the population to cover only upper basic schools located in the municipal capitals of Adamawa, Bauchi and Gombe states, where considerable peace and normalcy exist. The study further employed a non-probability purposive sampling where the researchers select the individuals who have attended the SMASE training only.

Table 1: described the sampled size for the study.

School category	Population	Sample*
Gombe municipal	113	46
Bauchi municipal	109	28
Adamawa municipal	101	29
Total	**933**	**103**

*The sample size is based on the list of teachers that attended the SMASE training

Instrument for Data Collection

A validated 4 – point Likert scale questionnaire was developed for the study for the teachers responses. Junior secondary certificate examination (JSCE) results for the set of students taught by these teachers were also used to determine the effect on learners.

Data Analysis

The collected data was analyzed using descriptive statistics to determine the mean score and standard deviation to answer the research questions. A t-test Analysis was used to test the hypotheses at 0.05 confidence level of significance using Statistical Package for Social Sciences Sciences-23 (SPSS-23).

Results Presentation

Influence of ASEI/PDSI principles on the attitude of teachers towards teaching mathematics and science subjects

Objective one sought to find out the extent to which ASEI/PDSI influence the attitude of the teachers towards teaching mathematics and science subjects in upper basic schools of north eastern states. Table 1 reveals the findings obtained.

Table 2: Mean scores of the extent to which ASEI/PDSI influence the attitude of teachers in upper basic schools of north eastern states.

SN	Statement	Mean	Remark
ATT1	ASEI/PDSI create joyful atmosphere of mathematics / science teaching/learning hence making it interesting	2.6007	Accepted
ATT2	ASEI/PDSI emphasis equal treatment in classroom and this convey the value of social justice	2.5078	Accepted
ATT3	ASEI/PDSI promote the value of friendship by sharing mathematic/science knowledge among the students	2.5945	Accepted
ATT4	ASEI/PDSI establishes good relationship between teachers and their students hence reduces forbear	2.5639	Accepted
ATT5	ASEI/PDSI enable mathematic/science discussions be more interesting and even extend beyond the class time	2.7978	Accepted
ATT6	ASEI/PDSI advocated for activities during mathematics / science lesson using the locally available materials	3.4218	Accepted
ATT7	ASEI/PDSI has make assignment less stressful	3.0615	Accepted
ATT8	ASEI/PDSI has make students to take a future career in mathematics / science related courses	3.2884	Accepted
ATT9	ASEI/PDSI has reduce the popular slogan of "Sir I did not understand"	3.0309	Accepted
	TOTAL		

In general, the result obtained revealed that when teachers go through the SMASE training there would be a paradigm shift from chalk/talk to activity based approach which will lead to

appreciating the role of SMASE training as depicted by the respondents who attended all the cycles of the training. According to Newstrom and Davis (2002), a study on quality and teacher training and student achievement indicated that trained teachers do make a difference and in particular teacher qualification, experience and amount of education and knowledge were positively related to student achievement.

The respondents rated the statement that said ASEI/PDSI advocated for activities during mathematics / science lesson using the locally available materials very high extent, with the mean score of 3.42. This signifies that the mathematics and science teacher's attitude towards improvisation of instructional aids has been positively influenced by the lessons learned on the principles of ASEI/PDSI during the SMASE training. Exactly as the disciples of constructivism emphasized (Barkin, 2003; Kim, 2001), the respondents agreed that ASEI/PDSI creates joyful atmosphere of mathematics / science teaching and learning hence making it interesting for both the teacher and the students to participate actively. This finding further supported by the report of (Okori & Jerry, 2017) where the authors mentioned that improvisational instruction develop the learner's skills, abilities and crafting strategy by enabling the learners to interpret and appreciate their environment.

It can be deduced from the study that ASEI/PDSI promote the value of friendship by sharing mathematic/science knowledge amongst the students. This according to Jones & Brader-Araje, (2002) is the most effective means of instilling and promoting leadership within the student; and assist in appreciating teamwork within the learners. Based on the result presented in Table 2, it is obvious that the respondents agreed that the SMASE training and the application of ASEI/PDSI principles has greatly influenced the attitude of the teachers towards teaching mathematics and science subjects in upper basic schools of North-Eastern states.

Improvement in teaching and learning mathematics and science teachers based on ASEI/PDSI principles

The study sought to establish whether actualization of ASEI/PDSI in training is leading to significant improvement in teaching and learning of mathematics and science in northeast upper basic schools. The results from teacher's questionnaire were as presented in Table 3.

Table 3: Mean scores of the extent to which actualization of ASEI/PDSI in training is leading to significant improvement in teaching and learning of mathematics and science.

SN	Statement	Mean	Remark
MAA 1	My students became curious in learning mathematics / science as a result of ASEI/PDSI approach	2.5901	Accepted
MAA 2	My students appreciate the value of self-management through the use of ASEI/PDSI approach	2.5045	Accepted
MAA 3	My students cultivated the value of interest in learning mathematics and science via ASEI/PDSI approach	2.7845	Accepted

MAA 4	My Students appreciate the value of social interaction through ASEI/PDSI approach	2.5041	Accepted
MAA 5	My students develop the habit of self confidence in mathematics / science as a result of ASEI/PDSI approach	2.5943	Accepted
MAA 6	ASEI/PDSI approach convey the value of accuracy in my students	3.0321	Accepted
MAA 7	My student appreciates the value of self-discovery as a result of ASEI/PDSI	3.1322	Accepted
MAA 8	I have adopted ASEI/PDSI approach as a better method in strengthening Mathematics and Science Education	2.4378	Rejected
	TOTAL		

At the end of the SMASE training it is expected that teachers will undergo a gradual change that will lead them to appreciate the role of SMASE training. More so, it is expected that the respondents who attended all the cycles of the training shall be able to covey such skills, attitudes and techniques acquired to his/her colleague and students (Mwangi & Mugambi, 2013).

Accordingly, the respondents agreed that due to the accomplishment of the SMASE training, there is a significant improvement in their teaching and learning process. Evidently, Table 3 reveals that the respondents agreed to the statement that student appreciates the value of self-discovery as a result of ASEI/PDSI. This finding is synonymous to Shuaibu, (2016) where the authors upheld that when students are led through a well-organized lesson with a set of structured activities, the leaner will have a quick and rooted understanding of the taught concept. The authors added that discovery learning will be the most loved and the suitable for such a situation.

The respondents agreed that by following the ASEI/PDSI approach, students cultivated the value of interest in learning mathematics and science. In addition, the respondents answer to item number 4 revealed that the student's interest to learning of science and mathematics came as they appreciate the value of social interaction through ASEI/PDSI principles of teaching. It is therefore important to note that, the actualization of ASEI/PDSI approach can lead to a remarkable improvement in teaching and learning of mathematics and science, especially when it is followed judiciously.

Regrettably, not all the respondents agreed to have adopted the ASEI/PDSI approach as a better method for strengthening Mathematics and Science Education in the upper basic. This finding calls for the need to examine whether there are challenges that is beyond the teachers to manage, which is hindering the wide adoption of the ASEI/PDSI approach. Although (Mwangi & Mugambi, 2013) have identified that in Kenya, there is lack of proper understanding of the ASEI/PDSI principle by the teachers. Thus, leading to poor adoption of the ASEI/PDSI approach to teaching of science and mathematics. Similarly, Shuaibu, (2016) cautioned that, staff is not always ready to pledge their support to what they do not fully understand. Advisably, involving the teacher when planning for the training makes them more participatory. Participatory

approach leads to owning up of the project hence ensuring maximization of the output, which is the goal of any innovation.

The Influence of SMASE on Students' Performance in Mathematics / Science

In order to assess the influence ASEI/PDSI principles of SMASE teacher training on student's performance and to generate answers to the research hypothesis, the JSCE results from 2014 to 2018 were analyzed. Mean scores for before SMASE and after SMASE were calculated to provide two set of scores shown in Table 4..

Table 4: Difference in mean score of JSCE for before SMASE and after SMASE

VARIABLES	N	σ	S D	SD ERROR
Before SMASE	24	4.17	13.201	2.141
After SMASE	24	4.63	8.167	1.444

Table 4 shows the result obtained through a paired sample t- test between before SMASE and after SMASE score of JSCE. Therefore p-value is less than the confidence level ($p< 0.05$). This indicates that the difference between before SMASE and after SMASE score of JSCE is significant, therefore, the null hypothesis H_0 was rejected and the H_1 accepted.

Table 5: Difference in mean score of JSCE for before SMASE and after SMASE

VARIABLES	N	X	SD	df	t-cal	P	Remark
Before ASEI/PDSI	24	4.17	2.132	23	5.053	0.012	H_0 Rejected
After ASEI/PDSI	24	4.63	2.756				

This finding corroborates the position of Newstrom and Davis (2002), in a study on the quality of teacher training and student achievement. The authors indicated that trained teachers do make a difference and in particular, teacher qualification, experience and amount of education and knowledge were positively related to students' achievement. It will be correct to mention that when mathematics and science teachers are given the required suitable training in a conducive teaching and learning environment where the principles of ASEI/PDSI can be practiced, improvement in the student's performance can be assured.

Conclusion

This study was generally designed to investigate on ASEI/PDSI as a panacea to SMASE in Upper Basic Schools of north eastern Nigeria. This study was guided by two (2) research questions and one (1) null hypothesis. Objective one examined the extent to which ASEI/PDSI influence the attitude of the teachers towards teaching mathematics and science. The result revealed that when teachers go through the SMASE training there would be a gradual change and finally will lead to appreciating the role of SMASE training as depicted by the respondents who attended all the cycles of the training. Objective two sought to establish whether actualization of ASEI/PDSI in training is leading to significant improvement in teaching and learning of mathematics and science in northeast upper basic schools. The result indicated that

the respondent agreed that due to the accomplishment of SMASE training, there is a significant improvement in their teaching and learning process. This study reveals the influence of ASEI/PDSI principles of SMASE on student's performance by analyzing JSCE results.

Recommendation

1. Teachers should be encouraged to adopt ASEI/PDSI as an approach to SMASE
2. School Based Training (SBT) should be encourage and to become a routine in every school so that ASEI/PDSI principles will be easily assimilated.
3. Government and school authorities should device a means of compulsory adoption and implementation of ASEI/PDSI principles and its principles in all teaching and learning
4. Government, school authorities and PTA should device means of monitoring and rewarding best forming teachers who adopts and implement ASEI/PDSI principles
5. Gender sensitivity during the activities should be encouraged
6. Seminar, workshops and conference on ASEI/PDSI should be promoted by both the government and the school authority.

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