

Comparative Analysis of SMASSE (ASEI- PDSI) and Heuristic Methods of Teaching Mathematics at Secondary School Level in Gombe State

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Abstract

*The study compared the mean performance of secondary school students taught using SMASSE (ASEI-PDSI) method and students taught using Heuristic method in Vocational Training Colleges (VTC) in Gombe state. The design of the study was quasi experimental, and Mathematics Achievement Test (MAT) was the instrument for data collection. The population of the study consisted of all JSS II students in Vocational Training Colleges in Gombe state. Three of these schools were sampled for the study using simple random sampling technique. They are VTC Deba, VTC Kamara, and VTC Tula. A total of 150 students participated in the study, these comprised 60 each from Deba and Kamara who were drawn using simple random sampling, and all the 30 students from Tula were used. However, a total of 140 students attempted the MAT. Descriptive statistic was used to answer the research questions, while *t*-test was used to test the formulated null hypotheses at 0.05 level of significance. The findings of the study showed that there is no significant difference in the mean performance between students taught using SMASSE (ASEI-PDSI) method and students taught using heuristic method. Also that there is no significant difference in the mean performance of male and female students taught using SMASSE (ASEI-PDSI) method. The study recommended massive step-down training for SMASSE (ASEI-PDSI) across the country.*

Introduction

Specialists in the field of Mathematics Education in Nigeria in 2015 had come up with different approaches to the teaching and learning of Mathematics each acclaimed that his method outweighs the conventional methods used in our secondary schools. Here we have picked five of such assertions:

Musa and Bolaji (2015) in their study of “effect of laboratory method of teaching on students achievement in Mathematics” revealed that laboratory approach enhanced achievement in Mathematics and is independent of gender; Usman and Musa (2015) also in a similar study but using inquiry method of teaching indicated that the post test of the inquiry method was higher than the conventional method in students achievement in Algebra; Sam-kayode and Salman (2015), in their study in ludo games method of teaching probability revealed a significant difference compared to those by the lecture method; Bot and Iliya (2015) revealed that programmed instruction improved SSII students’ achievement in trigonometry better than the use of traditional expository teaching method. The mean student score is statistically significant in favour of students in the experimental group; Salman, Akinjola and Akula (2015) findings in the study of concept mapping method on students achievement in Mathematics revealed a significant difference when taught ratio and proportion using concept-mapping than using the lecture method.

The problem is all the above researches are in favour of laboratory, inquiry, programmed instruction, concept mapping. Heuristic method seemed to have combined most of these

methods earlier used in Nigeria; hence the need to compare it with newly introduced SMASSE (ASEI-PDSI) approach. This will give teachers a clear view as to continue with the former approaches or adopt the new approach.

Statement of the problem

Despite the significance attached to mathematics, poor performance in the subject has been a perennial problem. The poor performance has been attributed to so many factors among which are teacher-centered teaching methodology which both heuristic and SMASSE (ASEI-PDSI) seek to address. To upgrade the quality of mathematics and science education in secondary schools and address the problem of poor performance, the Ministry of Education Science and Technology (MoEST) in collaboration with the Japanese International Cooperation Agency (JICA) initiated the SMASSE INSET project in 2013 on a pilot basis in the pilot states of Kaduna, Niger, and Plateau, and there is an attempt to make it a nationwide programme. Not much is known about the ASEI-PDSI approach in mathematics lessons when compared to heuristic approach in Gombe state. One will hence ask the question: Should ASEI-PDSI approach be adopted in place of heuristic approach? It was in view of this that this study sought to compare the two approaches in mathematics lessons in Vocational secondary schools of Gombe state, with the purpose of making suggestions that will help bring about government's furtherance of advocating to adopt ASEI-PDSI approach.

Purpose of the study

The main purpose of the study is to compare the effect using SMASSE (ASEI-PDSI) method of teaching in teaching mathematics against the Heuristic method on students' performance in Junior Secondary Schools in Gombe.

Research questions

The following research questions guided this study:-

- (1) What is the performance of students taught using SMASSE (ASEI-PDSI) method and students taught using Heuristic method.
- (2) What is the performance of male and female students taught using SMASSE (ASEI-PDSI).
- (3) What is the performance of male and female students taught using both Heuristic and SMASSE (ASEI-PDSI) methods.
- (4) What is the performance of students taught using Heuristic method and SMASSE (ASEI-PDSI) methods for each of the selected schools.

Research hypotheses

The following null hypotheses were tested at 0.05 level of significance:

HO₁ There is no significant difference in the mean performance between students taught using SMASSE (ASEI-PDSI) method and students taught using Heuristic method.

HO₂ There is no significant difference in the mean performance between male and female students taught using SMASSE (ASEI-PDSI) method.

HO₃ There is no significance difference in the mean performance between male and female students taught using both SMASSE (ASEI-PDSI) method and Heuristic method.

HO₄ There is no significance difference in the mean performance between students taught using Heuristic and SMASSE (ASEI-PDSI) methods from each of the selected schools.

Literature Review

Strengthening of Mathematics and Science Education (SMASE) is a joint venture between the Government of Nigeria, through the Ministry of Education, Science and

Technology (MoEST), and the Government of Japan, through the Japanese International Cooperation Agency (JICA).

Strengthening of Mathematics and Science in Secondary Education

In his study in Kenya Onchong'a (2013) stated:

“Strengthening of Mathematics and Science in Secondary Education programme came into being when the consistently poor performance in mathematics and science became a matter of serious concern (Njuguna, 1999). The programme involves equipping teachers with new skills for teaching mathematics and sciences and assisting them to develop improvised teaching and learning materials, with all these geared toward improving performance and giving learners a positive attitude to the subjects (SMASSE, <http://www.SMASSE.org/E/index.html>). It is also worth noting that the Government of Kenya considers mathematics and science education as a key factor to industrialization.

According to the Republic of Kenya (2002), Kenya aims at industrialization by the year 2020. One of the means and ways of achieving this is by putting emphasis on the strengthening of mathematics and science education as a key factor to industrialization. Equally, the Japanese Government puts high priority on mathematics and science education in its aid policy for the Republic of Kenya. According to JICA (<http://www.jica.go.jp>), the birth of SMASSE is also envisioned in the Master Plan on Education and Training (MPET, 1997-2010), Poverty Reduction Strategy Paper (PRSP), and the Medium Term Expenditure Framework (MTEF, 2000-2003) as part of human resource development.”pg.7

Onchong'a in his findings reported that mathematics teachers have a high understanding of the ASEI-PDSI approach; the teachers' use of the ASEI-PDSI approach in their lessons is inadequate.

Research design

The research design used for the study is Quasi experimental design. According to Osuala (1982), an experimental research basically involves a process which requires an active manipulation of one or more independent variables. Osuala further describes that an experimental design are plans which are strategically made to collect data and test hypothesis. The design can be divided on the basis of two important factors. The factors include the control group and experimental group, the research design involve the use of Mathematics Achievement Test (MAT) on both groups.

The participants of the study were divided into two group's i.e experimental and control. The experimental group is subjected to the SMASSE (ASEI-PDSI) method while the control group are taught using heuristic method.

The study was delimited to only two topics i.e. Linear graphs and Approximation/Estimation under Algebraic Processes and was carried out in Gombe state.

The instrument used for data collection was a 20 item multiple choice test which covered the topics taught each item contains four options from which the students chose the correct option. One mark was awarded for correct answer and zero for an incorrect answer.

The students in the Experimental group were taught the topics by SMASSE (ASEI-PDSI) method for three weeks by the researchers and also that of the control group were taught by heuristic method for the same period by the researchers. At the end of the three weeks, Mathematics Achievement Test (MAT) based on the topics taught was conducted by the researchers to the participants in each of the schools.

For the analysis of data, the statistical techniques used include mean, standard deviation and t-test using SPSS statistics (version 16). The decision rule used is that when p value is greater than $\alpha = 0.05$, the null hypothesis is accepted, otherwise rejected.

Population and Sample of the study

The population of the study comprised of all Junior Secondary School (JSS) II students in Vocational training Colleges in Gombe state.

For the purpose of this study three out of eleven Vocational Training Colleges (VTCs) were randomly selected. The selected are: VTC Tula in Kaltungo Local Government, VTC Deba in Yamaltu/Deba Local Government, and VTC Kamara in Gombe Local Government.

In each of VTC Deba and VTC Kamara, 60 students of JSS II were randomly selected, while all the 30 students of JSS II in VTC Tula were used for the study. Therefore a total of 150 students formed the sample used.

However, for VTC Deba and Kamara, 30 students each were randomly selected to represent the experimental and control groups, while in VTC Tula 15 students were randomly selected for the groups.

Results and Discussion

The research questions raised were answered using descriptive statistics and the formulated null hypotheses for the study were tested at 0.05 level of significance.

Based on the achievement test, the results of 140 participants were collated. The results of the study are presented as below;

Research Question One

What is the performance of students taught using SMASSE (ASEI-PDSI) method and students taught using Heuristic method.

Table 1

Descriptive Statistics of students for Control and Experimental groups

Groups	N	Mean	SD
Control	70	7.6429	3.03619
Experimental	70	6.9286	2.56126

The result in Table 1 shows that the students in the experimental group who were taught using SMASSE had a mean of 6.9286 with standard deviation of 2.56126, while students in the control group taught using heuristic had a mean of 7.6429 with standard deviation of 3.03619.

Research Question Two

What is the performance of male and female students taught using SMASSE (ASEI-PDSI).

Table 2

Descriptive Statistics of male and female students taught using SMASSE (ASEI-PDSI).

Groups	N	Mean	SD
Male	39	6.5641	2.45801
Female	31	7.3871	2.65427

Table 2 indicates that the male students in the experimental group who were taught using SMASSE had a mean of 6.5641 with standard deviation of 2.45801, while their female students' counterparts had a mean of 7.3871 with standard deviation of 2.65427.

Research Question Three.

What is the performance of male and female students taught using both Heuristic and SMASSE (ASEI-PDSI) methods.

Table 3

Descriptive Statistics of male and female students taught using both methods

Groups	N	Mean	SD
Male	80	7.2500	3.02102
Female	60	7.3333	2.55560

The result in Table 3 shows that the male students in the two groups had a mean of 7.2500 with standard deviation of 3.02102, while female students in the two groups had a mean of 7.3333 with standard deviation of 2.55560.

Research Question Four

What is the performance of students taught using Heuristic and SMASSE (ASEI-PDSI) methods from each of the selected schools.

Table 4

Descriptive Statistics of students' performance in Control and Experimental groups in Deba.

Groups	N	Mean	SD
Control	30	6.7333	2.76597
Experimental	30	5.9000	2.46842

The result in Table 4 shows that the students in Deba that are in the experimental group who were taught using SMASSE had a mean of 5.9000 with standard deviation of 2.46842, while their counterparts in the control group taught using heuristic had a mean of 6.7333 with standard deviation of 2.76597.

Table 5

Descriptive Statistics of students' performance in Control and Experimental groups in Kamara.

Groups	N	Mean	SD
Control	25	8.6800	3.57911
Experimental	25	7.7200	2.65393

The result in Table 5 shows that the students in Kamara that are in the experimental group who were taught using SMASSE had a mean of 7.7200 with standard deviation of 2.65393, while their counterparts in the control group taught using heuristic had a mean of 8.6800 with standard deviation of 3.57911.

Table 6

Descriptive Statistics of students' performance in the Control and Experimental groups in Tula.

Groups	N	Mean	SD
Control	15	7.7333	1.98086
Experimental	15	7.6667	1.91485

The result in Table 6 shows that the students in Tula that are in the experimental group who were taught using SMASSE had a mean of 7.6667 with standard deviation of 1.91485, while their counterparts in the control group taught using heuristic had a mean of 7.7333 with standard deviation of 1.98086.

Hypothesis One

There is no significant difference in the mean performance between students taught using SMASSE (ASEI-PDSI) method and students taught using Heuristic method.

Table 7

T-test analysis of the difference between the mean performance of students in the Control and Experimental groups.

Groups	N	Mean	SD	t-cal	Df	p-value	Decision
Control							
Experimental	70	7.6429	3.03619	1.504	138	.135	Accepted
	70	6.9286	2.56126				

Table 7 revealed that $t = 1.504$, $p = .135$, $df = 138$ at $\alpha = 0.05$. Since $p > 0.05$, the null hypothesis is accepted and therefore, concluded that there was no significant difference in the mean performance of students taught using heuristic method and those taught using SMASSE (ASEI-PDSI) method.

Hypothesis Two

There is no significant difference in the mean performance between male and female students taught using SMASSE (ASEI-PDSI) method.

Table 8

T-test analysis of the difference between the mean performance of male and female students in the Experimental group.

Groups	N	Mean	SD	t-cal	Df	p-value	Decision
Male	39	6.5641					
Female	31	7.3871	2.45801	1.343	68	.184	Accepted
			2.65427				

Table 8 revealed that $t = 1.343$, $p = .184$, $df = 68$ at $\alpha = 0.05$. Since $p > 0.05$, the null hypothesis is accepted and therefore, concluded that there was no significant difference in the mean performance of male students and female students taught using SMASSE (ASEI-PDSI) method.

Hypothesis Three

There is no significance difference in the mean performance between male and female students taught using both SMASSE (ASEI-PDSI) method and Heuristic method.

Table 9

T-test analysis of the difference between the mean performance of male and female students.

Groups	N	Mean	SD	t-cal	Df	p-value	Decision
Control	80	7.2500	3.02102				
Experimental	60	7.3333	2.55560	0.172	138	.863	Accepted

Table 9 revealed that $t = 0.172$, $p = .863$, $df = 138$ at $\alpha = 0.05$. Since $p > 0.05$, the null hypothesis is accepted and therefore, concluded that there was no significant difference in the mean performance of male students and female students.

Hypothesis Four

There is no significance difference in the mean performance between control group and experimental group from each of the selected schools.

Table 10

T-test analysis of the difference between the mean performance of students in Control and Experimental groups in Deba.

Groups	N	Mean	SD	t-cal	Df	p-value	Decision
Control	30	6.7333	2.76597				
Experimental	30	5.9000	2.46842	1.231	58	.223	Accepted

Table 10 showed that $t = 1.231$, $p = .223$, $df = 58$ at $\alpha = 0.05$. Since $p > 0.05$, the null hypothesis is accepted and therefore, concluded that there was no significant difference in the mean performance of students taught using heuristic method and students taught using SMASSE (ASEI-PDSI) in Deba.

Table 11

T-test analysis of the difference between the mean performance of students in Control and Experimental groups in Kamara.

Groups	N	Mean	SD	t-cal	Df	p-value	Decision
Control	25	8.6800	3.57911				
Experimental	25	7.7200	2.65393	1.077	48	.287	Accepted

Table 11 yielded $t = 1.077$, $p = .287$, $df = 48$ at $\alpha = 0.05$. Since $p > 0.05$, the null hypothesis is accepted and therefore, concluded that there was no significant difference in the

mean performance of students taught using heuristic method and students taught using SMASSE (ASEI-PDSI) in Kamara.

Table 12

T-test analysis of the difference between the mean performance of students in Control and Experimental groups in Tula.

Groups	N	Mean	SD	t-cal	Df	p-value	Decision
Control	15	7.7333	1.98086				
Experimental	15	7.6667	1.91485	0.94	28	.926	Accepted

Table 12 indicated that $t = 0.94$, $p = .926$, $df = 28$ at $\alpha = 0.05$. Since $p > 0.05$, the null hypothesis is accepted and therefore, concluded that there was no significant difference in the mean performance of students taught using heuristic method and students taught using SMASSE (ASEI-PDSI) in Tula.

Summary and Conclusion

The study was a comparison between heuristic and SMASSE (ASEI-PDSI) methods of teaching Mathematics at Junior Secondary School level. The study used quasi experimental design, and Mathematics Achievement Test as the instrument for data collection. The population for the study was all JSS II students in Vocational Training Colleges in Gombe state. Three of these schools were randomly selected as a sample for the study; they are VTC Deba, VTC Kamara, and VTC Tula. A total of 150 students participated in the study, while 140 students attempted the Mathematics Achievement Test. Descriptive statistic was used to answer the research questions, while t-test was used to test the formulated null hypotheses at 0.05 level of significance. The result showed that all the four null hypotheses were accepted. The study set out to compare the mean performance between students taught using SMASSE (ASEI-PDSI) method and students taught using Heuristic method. The result shows that the performance of students in both methods is similar which results to non-significant difference between their mean performances as indicated in the tested hypotheses. Also, the mean performance of male students who were taught using SMASSE (ASEI-PDSI) and their female counterparts was similar as no significant difference was reported. It can be concluded that these insignificant differences is due to the fact that their regular teachers are not conversant with the SMASSE (ASEI-PDSI) approach and had never used it in teaching, hence the students tend to shy away from the method.

Recommendations

All the four hypotheses were accepted at 0.05 level of significance, contrary to the researchers' expectations; hence, the following recommendations were made;

- i. The step down training for SMASSE (ASEI-PDSI) had not been effective, therefore more Science and Mathematics teachers need to be trained.
- ii. Adequate admission policies should be put in place to enforce recommended class size for SMASSE (ASEI-PDSI) to be effective.
- iii. Facilities like buildings equipped with tables and seats should be provided by government for effective implementation of SMASSE (ASEI-PDSI).

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