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Impacts of teacher knowledge and utilization of selected innovative instructional strategies on senior secondary student algebra achievement

Zalmon IG[1], Wonu N[2], Chikwem E[3]
[1-3] Mathematics/Statistics Department, Ignatius Ajuru University of Education, Port Harcourt, Nigeria

Abstract
The study investigated the impacts of teacher knowledge and utilization of selected innovative instructional strategies on the senior secondary student algebra achievement in Rivers State, Nigeria. The study adopted the correlational research design of the survey type. A sample of 398 students and 228 teachers were randomly selected from 76 schools purposively selected for the study. Three research questions and a hypothesis guided the study. Teacher Knowledge and Utilization of Innovative Instructional Strategies (TKUIIS) and Algebra Achievement Test (AAT) were the two instruments used for data collection. Their reliability coefficients are 0.70 and 0.80 respectively. Descriptive statistic was used to answer the research questions while regression analysis was used to test the hypothesis. Findings revealed that Mathematics teachers have knowledge of the innovative instructional strategies particularly mastery learning and team teaching. They also utilized innovative instructional strategies for classroom delivery. Inquiry learning and vee mapping were the innovative instructional strategies mostly utilized by teachers. More findings revealed a joint significant contribution of teacher knowledge and utilization of innovative instructional strategies on senior secondary student achievement in algebra. From the findings, innovative instructional strategies should be utilized by Mathematics teachers for improved teaching and learning of algebra in the secondary schools.

Keywords: teacher, knowledge, utilization, innovative, instructional strategy, achievement, algebra

Introduction
Teacher education is an old discipline in the Nigeria education system. It is the bedrock of our education system since no education system may rise above the quality of its teachers (FRN, 2013) [6]. It becomes imperative that teacher education should be continually given major emphasis in all educational planning and implementation to ensure quality education in the nation. This quality education can be achieved through the use of innovative instructional strategies in classroom delivery. A teaching strategy is a carefully designed classroom interaction that could be meticulously followed to teach a concept, topic or an idea. This brings out the idea of having numerous strategies. Innovative instructional strategy refers to a learning strategy with a new design or purposively reconstructed existing ideas. This explanation means the use of new or reconstructed existing ideas, methods, and equipment or to combine various teaching strategies to develop a new one. Innovation is defined as the implementation of new and improved knowledge, ideas, methods, processes, tools, equipment, and machinery, which leads to new and better products, services and processes (Ajaja, 2007) [2].

The need for innovative strategies in the teaching of Mathematics is borne out of the fact that different situations - teaching topics, learner's cognitive readiness, the concept being taught, skills intended to be developed in learners demands for different teaching strategies. Therefore a teacher who is not aware of a variety of such strategies can either fail to use them in the first place or use them inaccurately. The young minds need to be exposed to critical thinking, analysis and problem-solving strategies in a fast-changing world like ours. The teaching and learning of Science especially Mathematics requires a unified and comprehensive approach relying on teachers that are professionally trained and equipped with requisite knowledge and competencies. The adoption of students – centered instructional strategies which include the inquiry method, discussion, simulations, games, and other similar strategies have been showed to enhance the active participation of students in Mathematics instructional process. Therefore, the study investigates the impacts of teacher knowledge and utilization of selected innovative instructional strategies on senior secondary student algebra achievement in Rivers State.

Statement of the Problem
This study investigates the impacts of teacher knowledge and utilization of selected innovative instructional strategies on senior secondary student algebra achievement. According to Oludipe and Oludipe (2010) [9], if teachers knowledge is inadequately measured, existing educational production function research could be limited in its conclusions not only about the magnitude of effects that teachers knowledge has on student learning but also about the kinds of teacher knowledge that matter most in producing student learning. More so, Students' abysmal performance in Mathematics has been reported by researchers (Zalmon & Wonu, 2017; Charles-Ogan, 2014) [13, 3]. This poor academic achievement in Mathematics could be attributed to many factors among which

are inadequate utilization of instructional material and ineffective instructional strategy. Researchers have blamed this poor achievement in Mathematics on the use of inappropriate instructional strategies which might lead to lack of interest and retention of mathematical concepts (Elvis, 2013; Fauzia & Urusa, 2012) [4, 5]. Current studies on how students learn Science and Mathematics revealed new innovative instructional approaches in the teaching of Mathematics (Agommuoh, 2013) [1]. Ascertaining the impacts of teacher knowledge and utilization of innovative instructional strategies on student achievement in algebra is the gap this study intends to fill.

Purpose of the Study

The main purpose of the study was to investigate the impacts of teacher knowledge and utilization of selected innovative instructional strategies on the senior secondary student achievement in Algebra. Specifically, the study shall determine:

1. The extent of the Mathematics teachers' knowledge of selected innovative instructional strategies.
2. The level of utilization of selected innovative instructional strategies by Mathematics teachers.
3. The joint contribution of teacher knowledge and utilization of selected innovative instructional strategies to senior secondary student algebra achievement.

Research Questions

This study will seek answers to the following questions:

1. What is the extent of the Mathematics teachers' knowledge of selected innovative instructional strategies?
2. What is the level of utilization of selected innovative instructional strategies by Mathematics teachers for lesson delivery?
3. What is the joint contribution of teacher knowledge and utilization of selected innovative instructional strategies on senior secondary student algebra achievement?

Research Hypothesis

To achieve the objective of the study, the following null hypothesis was tested at 0.05 level of significance:

$H0_1$: There is no significant joint contribution of teacher knowledge and utilization of selected innovative instructional strategies on senior secondary student algebra achievement.

Methods and Materials

Design: The study adopted the correlational research design of the survey type. Teacher knowledge and utilization of the selected innovative instructional materials formed the predictor variables whereas the response variable is the algebra achievement of senior secondary students in Rivers State, Nigeria.

Participants: The target population for the study comprised all the 529 Mathematics teachers in Government senior secondary schools in Rivers State and 68,493 students from all the 247 public senior secondary schools in Rivers State (RSSSB, 2017). A total of 398 and 228 samples of students and teachers respectively obtained from the population by Taro Yamane formula were selected by simple random sampling technique while purposive sampling was used to select a sample of 76 schools for the study.

Instruments for data collection: The research instruments used for data collection were structured questionnaire designed by the researchers known as Teachers' Knowledge and Utilization of Innovative Instructional Strategies (TKUIIS) and Algebra Achievement Test (AAT). TKUIIS was used to collect data on teacher knowledge and utilization of innovative and conventional instructional strategies while AAT was used to collect data on the academic achievement of students in algebra. TKUIIS consists of three sections: A, B, and C. Section A collected the demographic data of the teachers, section B was used to collect data to measure teachers' knowledge of innovative and conventional instructional strategies and patterned after the 5-point Likert scale of Excellent Knowledge (EK), Very Good Knowledge (VGK), Good Knowledge (EK), Fair Knowledge (FK) and No Knowledge (NK). Section C was designed to collect data on the level of utilization of the innovative and conventional instructional strategies by Mathematics teachers. This section was patterned after 4-point Likert scale of Frequently Utilization (FU), Seldom Utilized (SU), Utilized (U) and Not Utilized (NU). The AAT consist of section A and B. Section A was used to collect the demographic data of the students while section B contained 20 items multiple choice algebra achievement test, with options A-D. Each correct option was scored 5 marks with a score of zero for the wrong option.

The validity of Instruments: The instruments were subjected to both content and face validity.

Three specialists in mathematics education validated the instruments. Their correction and inputs were effected accordingly.

Reliability of Instruments: The reliability coefficients of the instruments were determined using the test-retest method. Teacher Knowledge and Utilization of Innovative Instructional Strategies (TKUIIS) and Algebra Achievement Test (AAT) were administered to 20 mathematics teachers and 40 students who were not part of the study samples respectively. After two weeks, the two instruments were re-administered to the same teachers and students. These scores were correlated and 0.70 and 0.80 correlation coefficients were respectively obtained for TKUIIS and AAT.

Method of data collection: The instruments were administered to the mathematics teachers and students by the researchers after due orientation and retrieved the same day they were administered.

Method of Data Analysis: The data collected from the respondents for this study were analyzed using SPSS (version 21) software. The research questions were analyzed using mean and standard deviation while the hypothesis was tested using regression analysis.

Results

Research Question 1: What is the extent of the Mathematics

teachers' knowledge of selected innovative instructional strategies?

Table 1: Mean and standard deviation on the extent of Mathematics teachers' knowledge of selected innovative instructional strategies (N=228)

S/N	Knowledge of Innovative Instructional strategies	EK	VGK	GK	FK	NK	Mean	SD
1	Brainstorming	51	79	56	30	12	3.56	1.13
2	Simulation Based Learning	49	62	66	36	15	3.41	1.18
3	Peer Tutoring	39	73	33	46	37	3.14	1.36
4	Cooperative Learning	31	90	42	34	31	3.25	1.26
5	Group Learning	34	84	48	28	34	3.25	1.28
6	Experiential Learning	53	106	35	17	17	3.71	1.13
7	Cognitive Apprenticeship	49	101	42	21	15	3.65	1.11
8	Guided Learning	49	100	37	30	12	3.63	1.12
9	Inquiry Learning	69	108	27	18	6	3.95	0.99
10	Role Play	61	75	41	36	15	3.57	1.22
11	Active Learning	84	46	55	26	17	3.68	1.28
12	Game-Based Learning	57	79	54	27	11	3.63	1.12
13	Interdisciplinary Teaching	74	57	36	37	24	3.53	1.36
14	Technology Based Learning	67	82	62	10	7	3.84	1.00
15	Mastery Learning Strategy	80	111	29	4	4	4.14	0.83
16	Learning Trajectory	21	64	73	33	37	3.00	1.20
17	Collaborative Learning	19	46	97	49	17	3.00	1.03
18	Laboratory Based learning	33	72	68	28	27	3.25	1.20
19	Problem Based Learning	14	81	73	33	27	3.10	1.10
20	Concept Mapping	12	54	96	39	27	2.93	1.05
21	Laboratory Demonstration based Learning	25	55	102	21	25	3.15	1.09
22	Activity Based Learning	17	56	112	19	24	3.10	1.02
23	Tutorial Based Learning	16	61	52	53	46	2.77	1.24
24	Ethnomathematics Learning Approach	37	75	55	30	31	3.25	1.26
25	Integrated learning system	22	69	90	31	16	3.22	1.03
26	Computer assisted instructions	52	77	53	35	11	3.54	1.14
27	Learning management systems	30	71	79	34	14	3.30	1.07
28	Field Trip systems	12	53	38	57	68	2.49	1.28
29	Design Based learning	33	81	45	37	32	3.20	1.27
30	Learning while doing	76	64	39	27	22	3.64	1.31
31	Metacognitive Learning	51	79	56	30	12	3.56	1.13
32	Constructivist Learning Model	49	62	66	36	15	3.41	1.18
33	Constructionist Learning Model	39	73	33	46	37	3.14	1.36
34	Vee Mapping	31	90	42	34	31	3.25	1.26
35	Teaching for Understanding	34	84	48	28	34	3.25	1.28
36	Project Based learning	53	106	35	17	17	3.71	1.13
37	Acronym Memory	49	101	42	21	15	3.65	1.11
38	Mind Map	49	100	37	30	12	3.63	1.12
39	Just-In Time Teaching	69	108	27	18	6	3.95	0.97
40	ICT based learning	61	75	41	36	15	3.57	1.22
41	Model-Lead Test Learning	84	46	55	26	17	3.68	1.28
42	Target-Task Learning	57	79	54	27	11	3.63	1.12
43	Integrated Curriculum Delivery	74	57	36	37	24	3.53	1.32
44	Diagnostic and remedial instruction	67	82	62	10	7	3.84	1.00
45	Team Teaching	80	111	29	4	4	4.14	0.81
46	Think-Pair-Share	51	79	56	30	12	3.56	1.13
47	Discovery Learning	49	62	66	36	15	3.41	1.18
48	Laboratory Activity based Learning Strategy	39	73	33	46	37	3.14	1.36
49	Flipped Classroom	31	90	42	34	31	3.25	1.26
	Grand mean						3.66	0.54

Key: Knowledge $\bar{x} \geq 3.00$, No knowledge; $\bar{x} < 3.00$

Table 1, showed a high extent of Mathematics teachers' knowledge of selected innovative instructional strategies (M=3.66, SD=0.54). It showed that the Mathematics teachers have more knowledge of mastery learning strategy (M=4.14, SD=0.83) and team teaching (M=4.14, SD=0.81). These were followed by inquiry learning (M=3.95, SD=0.99) and just-in-time teaching (M=3.95, SD=0.97). The least was interdisciplinary teaching (M=3.53, SD=1.36)/integrated curriculum delivery (M=3.53, SD=1.32) respectively.

Research Question 2: What is the level of utilization of selected innovative and conventional instructional strategies by Mathematics teachers for lesson delivery?

Table 2: Mean and standard deviation on the level of Mathematics teachers' utilization of selected innovative instructional strategies (N=228)

S/N	Utilization of Innovative Instructional strategies	FU	SU	U	NU	Mean	SD
1	Brainstorming	129	57	30	12	3.33	0.90
2	Simulation Based Learning	81	96	36	15	3.07	0.88
3	Peer Tutoring	59	43	57	69	2.40	1.17
4	Cooperative Learning	96	54	39	39	2.91	1.13
5	Group Learning	95	55	33	45	2.88	1.16
6	Experiential Learning	153	39	18	18	3.43	0.94
7	Cognitive Apprenticeship	150	42	21	15	3.43	0.91
8	Guided Learning	144	39	33	12	3.38	0.92
9	Inquiry Learning	177	27	18	6	3.64	0.74
10	Role Play	112	56	42	18	3.15	0.99
11	Active Learning	76	74	51	27	2.87	1.01
12	Game-Based Learning	102	72	39	15	3.14	0.93
13	Interdisciplinary Teaching	90	57	51	30	2.91	1.07
14	Technology Based Learning	114	84	15	15	3.30	0.86
15	Mastery Learning Strategy	144	54	15	15	3.43	0.88
16	Learning Trajectory	65	88	33	42	2.77	1.06
17	Collaborative Learning	50	109	51	18	2.84	0.86
18	Laboratory Based learning	78	90	33	27	2.96	0.98
19	Problem Based Learning	81	87	33	27	2.97	0.99
20	Concept Mapping	55	107	39	27	2.83	0.93
21	Laboratory Demonstration Learning	63	117	21	27	2.95	0.92
22	Activity Based Learning	56	124	21	27	2.92	0.90
23	Tutorial Based Learning	62	61	57	48	2.60	1.10
24	Ethnomathematics Learning Approach	94	68	33	33	2.98	1.07
25	Integrated learning system	72	105	33	18	3.01	0.88
26	Computer assisted instructions	101	79	36	12	3.18	0.88
27	Learning management systems	81	96	36	15	3.07	0.88
28	Field Trip systems	59	43	57	69	2.40	1.17
29	Design Based learning	96	54	39	39	2.91	1.13
30	Learning while doing	95	55	33	45	2.88	1.16
31	Metacognitive Learning	153	39	18	18	3.43	0.94
32	Constructivist Learning Model	150	42	21	15	3.43	0.91
33	Constructionist Learning Model	144	39	33	12	3.38	0.92
34	Vee Mapping	177	27	18	6	3.64	0.71
35	Teaching for Understanding	112	56	42	18	3.15	0.99
36	Project Based learning	76	74	51	27	2.87	1.01
37	Acronym Memory	102	72	39	15	3.14	0.93
38	Mind Map	90	57	51	30	2.91	1.07
39	Just-In Time Teaching	114	84	15	15	3.30	0.86
40	ICT based learning	144	54	15	15	3.43	0.88
41	Model-Lead Test Learning	65	88	33	42	2.77	1.06
42	Target-Task Learning	50	109	51	18	2.84	0.86
43	Integrated Curriculum Delivery	78	90	33	27	2.96	0.98
44	Diagnostic and remedial instruction	81	87	33	27	2.97	0.99
45	Team Teaching	55	107	39	27	2.83	0.93
46	Think-Pair-Share	63	117	21	27	2.95	0.92
47	Discovery Learning	56	124	21	27	2.92	0.90
48	Laboratory Activity-Based Learning	62	61	57	48	2.60	1.12
49	Flipped Classroom	94	68	33	33	2.98	1.07
	Grand mean					3.04	0.53

Key: Utilized $\bar{x} \geq 2.50$, Not utilized; $\bar{x} < 2.50$

Table 2, showed a high level of Mathematics teachers' utilization of selected innovative instructional strategies (M=3.04, SD=0.53). It showed that the highest utilized innovative instructional strategies were inquiry learning (M=3.64, SD=0.74) and Vee mapping (M=3.64, SD=0.71). These were followed by experiential learning (M=3.43, SD=0.94), cognitive apprenticeship (M=3.43, SD=0.91), mastery learning strategy (M=3.43, SD=0.88), metacognitive learning (M=3.43, SD=0.94), constructivist learning model (M=3.43, SD=0.91) and ICT based learning (M=3.43, SD=0.88). The least was tutorial-based learning (M=2.60, SD=1.10)/laboratory activity-based learning strategy (M=2.60, SD=1.12).

Research Question 3: What is the joint contribution of teacher knowledge and utilization of selected innovative

instructional strategies on senior secondary student algebra achievement?

H_{01}: There is no significant joint contribution of teacher knowledge and utilization of selected innovative instructional strategies on senior secondary student algebra achievement.

Table 3: Summary of regression analysis on the joint contribution of teacher knowledge and utilization of innovative instructional strategies on student algebra achievement.

A: Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.854[a]	.573	.592	15.53244

a. Predictors: (Constant), Utilization, Knowledge

B: Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std.Error**	**Beta**		
1	(Constant)	26.419	5.040		5.241	.000
	Knowledge	1.617	3.898	.453	4.415	.008
	Utilization	1.045	3.987	.401	5.011	.001

a. Dependent Variable: Achievement

C:ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	274.332	2	137.166	10.569	.000[b]
	Residual	95296.361	395	241.257		
	Total	95570.693	397			

a. Dependent Variable: Achievement

Part B of Table 3 shows that the summary of regression analysis on the relationship between teacher knowledge and utilization of innovative instructional strategies and students algebra achievement might be described as strong (R=.854). The R-square value of .573 in part A showed a 57.3 % joint contribution of teacher knowledge and utilization on students' achievement in algebra. The regression equation $y = 26.419 + 1.617k + 1.045u$ shows that an increase in the teacher knowledge and utilization of innovative instructional strategies might lead to an increase in the students' algebra achievement. The F-statistic shows that there is a joint significant contribution of teacher knowledge and utilization of the innovative instructional strategies on student algebra achievement (F2, 395=10.569, p<.05). The null hypothesis was rejected at .05 alpha level.

Discussion

Teacher knowledge and utilization of innovative instructional strategies

Findings from this study revealed that mathematics teachers have knowledge of innovative (M=3.66, SD=0.54) and conventional (M=3.48, SD=0.47) instructional strategies. The teachers utilize both innovative (M=3.04, SD=0.53) and conventional (M=3.07, SD=0.53) instructional strategies in lesson delivery. This finding differs from that of Ogunkunle (2009) [8] who established that school teachers in Port Harcourt were ineffective in teaching Mathematics because they apply conventional teaching method in almost all the topics they taught. This difference could be due to awareness created over time on the need for teachers to utilize innovative instructional strategies. However, the finding of this study on the extent of teacher knowledge of innovative instructional strategies corroborated with that of Regina, Emmanuel and Josiah (2010) [10] but differ with their finding on the level of utilization. They found out that the level of teacher awareness of innovative instructional strategies was high but that only a few of the strategies were being effectively utilized by the teachers. Gbadamosi (2013) [7] reported that the level of teacher awareness and utilization of innovative instructional strategies was affected by their qualification.

The relationship between teacher knowledge and utilization of innovative instructional strategies and student algebra achievement

According to findings from this study, there is a joint significant relationship between teacher knowledge and utilization of the innovative instructional strategies on student algebra achievement (F2, 395=10.569, p<.05). The null hypothesis was rejected at .05 alpha level. This finding depicts that teacher knowledge of innovative instructional strategies and its effective and efficient utilization will to a very large extent influence the academic performance of students in algebra positively. This view is consistent with that of Sternberg (2006) [12] who opined that using multiple innovative styles of teaching leads to greater retention, deeper comprehension, and higher achievement scores.

Conclusion

Based on the findings of this study, the following conclusion was drawn:

1. Mathematics teachers have knowledge of innovative instructional strategies
2. Teachers utilized the innovative instructional strategies in algebra lesson delivery
3. There is a significant joint contribution of teacher knowledge and utilization of innovative instructional strategies to student algebra achievement

Recommendations

The following recommendations are made based on the findings of this study:

1. Secondary school Mathematics teachers should strive to acquaint themselves with the knowledge of innovative instructional strategies.
2. The use of these innovative instructional strategies should be encouraged in the teaching of secondary school students to enhance their academic performance in Mathematics.
3. Teachers should endeavor to utilize their knowledge of different innovative instructional strategies in teaching Mathematics at secondary school to improve students' performance.

References

1. Agommuoh PC. Secondary school student assessment of innovative teaching strategies in enhancing achievements in physics and mathematics. IOSR Journal of Research and Method in Education (ISOR-JRINE). 2018; 3(5):2320-7388. Retrieved March 19, 2017, from www.josrjournals.org.

2. Ajaja OP. Teaching method across discipline. Agbor. Allwell publication, 2007.
3. Charles-Ogan G. Metacognitive learning strategy and senior secondary school mathematics students' misconceptions in Rivers State, Nigeria. Abacus: The Journal of Mathematical Association of Nigeria (MAN). 2014; 39(1):234-246.
4. Elvis MG. Teaching methods and students' academic performance. International journal of humanities and social science invention ISSN. 2013; 2(9):2319-7722. Retrieved September 2013 from https://www.researchgate.net/publication.
5. Fauzia K, Urusa A. Effects of innovative teaching strategies on students' performance. Global journal of human social science linguistics & education. 2012; 12(10):30-50.
6. Federal Republic of Nigeria. National policy on education (6th Edition) Lagos: Nigerian Educational Research Development Council (NERDC) Press, 2013.
7. Gbadamosi AF. Biology teachers' awareness and utilization of innovative teaching strategies in Oyo South Senatorial District, Nigeria, 2013. https://unilorinsciencedu.files.wordpress.com/
8. Ogunkunle RA. Teachers' effectiveness as emergent issue confronting quality mathematics education in primary schools in Rivers State. African Journal of Historical Sciences in Education. 2009; 5(1&2):73-80.
9. Oludipe B, Oludipe ID. Effects of constructivist-based teaching strategy on academic performance of students in integrated science at the junior secondary school level. Educational Research and Reviews. 2010; 5(7):347-353. Retrieved July 2010 http://www.academicjournal.org/ERR2.
10. Regina M, Emmanuel E, Josiah A. Teachers' awareness and utilization of innovative teaching strategies in secondary school science in Benue State, Nigeria. International Research Journals. 2010; 2(1):032-038, Retrieved March, 2010 from http://www.interesjournals.org/ER.
11. Rivers State Senior Secondary Schools Board. Local Government Area breakdown of students enrolment for 3rd term 2015/2016 session, 2017.
12. Sternberg RJ. Recognizing neglected strengths. Educational Leadership. 2006; 64(1):30-35.
13. Zalmon IG, Wonu N. Comparative analysis of students' mathematics achievement in West African senior secondary certificate examination in Nigeria. European Journal of Research and Reflection in Educational Sciences. 2017; 5(1):24-31.