

Assessment of Teacher's Utilization of Innovative Teaching Strategies in Enhancing Achievement in Mathematics among Secondary School Students

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Abstract: This study investigated teacher's utilization of innovative teaching strategies in enhancing achievement in mathematics among secondary school students in Enugu State. The study employed the descriptive survey design. The population of the study was 192 (118 males and 74 females) mathematics teachers. Purposive sampling technique was used to select all the mathematics teachers. The instrument for data collection was the structured questionnaire on utilization of innovative teaching strategies in enhancing achievement in mathematics. The reliability index was determined using cronbach alpha and found to be 0.86. One research question and one hypothesis were tested at 0.05 level of significance. The research question was answered using mean while the hypothesis was tested using independent Chi-square statistics. Results showed that mathematics teachers rarely use innovative teaching strategies during their lessons. It was observed that out of the fourteen innovative strategies in mathematics teaching, only four strategies namely: discussion web, manipulative and project-based learning strategies were frequently used by mathematics teachers. It was also revealed that the gender of mathematics teachers does not influence their utilisation of innovative teaching strategies.

Key words: Assessment, teachers, utilization, innovative teaching strategies and mathematics, project-based, problem solving

INTRODUCTION

Mathematics teaching has undergone a paradigm shift from a passive process to an active construction and interpretation of experiences. Mathematics is usually perceived as a difficult subject. This perception could be changed by the method of teaching which mathematics teachers adopt during their lessons. Mathematics is the science that deals with the logic of shape, quantity and arrangement. It is the bedrock on which modern day technological breakthrough is built. The knowledge of mathematics enhances a person's reasoning, problem-solving skills and in general, the ability to think. This is why developing countries like Nigeria are working hard to develop scientifically and technologically, since, the world is a scientific and technological global village where all proper functioning of lives largely depends on science. Mathematics importance to human existence cannot be overemphasized in view of its application to human everyday life activities (Sunday *et al.*, 2014; Adetunde, 2007) noted that mathematics forms the foundation of a solid education and is the corner stone of modern society. Mathematics is therefore, an essential discipline that is recognized as a tool for solving everyday problem faced by individuals.

Nigeria as a nation appreciates the importance of mathematics in its quest to transform its economy successfully. This can be seen in the mission statement of the national policy on science, technology and innovation which seeks to evolve a nation that develops and utilizes mathematical science's technology and innovation to build a large, strong, diversified sustainable and competitive economy that will guarantee a high standard of living and quality of life for all its citizens.

In spite of the importance and usefulness of mathematics, secondary school student's achievement in the subjects is very discouraging. Researchers have shown that secondary school students exhibit dwindling interest in the subjects (Esiobu, 2005). Studies have also revealed that the achievement in mathematics was generally and consistently poor (Agwagah, 2005). Poor academic achievement in mathematics could be attributed to several factors. For instance (Tshabalala and Ncube, 2016) were of the view that inadequate teaching facilities' lack of fund to purchase necessary equipment, poor quality of textbooks, large classes, poorly motivated teacher's lack of laboratories and libraries' poorly coordinated supervisory activities, interference of the school system by the civil service, incessant transfers of teachers and principals, automatic

promotions of pupils the negative role of public examinations on the teaching learning process and inequality in education opportunities all hamper the smooth acquisition of mathematics knowledge, shortage of well trained teacher's appropriate selection of teaching methods and strategies.

In addition to the above causes of poor achievement in mathematics (Ojimba, 2011) was of the view that prominent causes of poor achievement in mathematics are: acute shortage of qualified professional mathematics teachers, exhibition of poor knowledge of mathematics content by many mathematics teacher's overcrowded mathematics classrooms, students negative attitude toward mathematics undue emphasis on the coverage of mathematics syllabus at the expense of meaningful learning of mathematics concepts, inadequate facilities and mathematics laboratories, teacher's teaching strategies in mathematics lessons. Several researchers have blamed this poor achievement in mathematics on the use of inappropriate teaching strategies which might lead to lack of interest and retention of mathematical concepts (Agommuoh, 2004; Agwagah, 2005; Ifeanacho, 2012; Iji and Harbour-Peters, 2005; Kurumeh, 2004; Ogbonna, 2007). According to Sreedevi and Sudlir (2011) innovative strategies for effective. Mathematics teaching are characterized by the following.

Orientation: The teacher introduces the topic in clear terms. Elicitation of ideas which involves opportunities provided for the students to explore and explain their ideas.

Classification and exchange: Students are given a chance to realize scientific and mathematical ideas in examining their own ideas. Exposures to conflict situation which involves students being provided with situation which will enable them test their ideas and recognize the limitation of these ideas.

Constructions of new ideas: Students are provided with opportunities to restructure (extend, modify or represent their ideas).

Evaluation: Students being provided with opportunities to test the validity of their newly construct ideas.

Applications of ideas: Students are provided opportunities to apply their idea in new situations to reinforce the ideas.

Review change in ideas: Students are given opportunity to refer upon how and why their ideas have changed. These ideas however, could vary between male and female students. Gender is seen as a socio-cultural construct that assigns roles, attitudes and values

considered appropriate for each sex (Ekeh, 2003). The disparity in the view of males and females has been studied over the years (Saunders and Quirke, 2002) stated that males expected innovative strategies to offer to them easy and quick answers and they worked alone or sometimes even in pairs. On the other hand, females were interested in the quality of the product and they preferred interactive group work. It is worth mentioning that females tended to study online more than men as online learning which is an innovative teaching/learning style, may be appropriate for female's lifestyles and they were also more likely to look for further, views of education (Selwyn, 2003). Moreover, Selwyn reported that as the current situation changes, educational technology can be seen as a predominantly feminine activity.

Hence, there is need for the teaching and learning of mathematics in secondary schools to be more involving through interaction between teachers and students. Innovative mathematics teaching strategies has the potential to increase access to and improve the relevance and quality of education in developing countries. Some of these innovative strategies as identified by Oyelekan *et al.* (2018) include, acronym memory, affinity, analogy, choral response, computer assisted instruction, construction spiral, cooperative learning, crawford slip, demo kits, discussion web, field trip, grab bag, graphic organizers, guided discovery, idea spinner, jigsaw, laboratory, listen-think-pair-share, manipulatives, mind maps, peer tutoring, problem solving, project based learning, reciprocal teaching, role playing, socratic method, stir the teams, study aids, twinning, vee mapping.

Secondary school mathematics curriculum is designed to equip students with knowledge and skills that will enable them solve their everyday problems. Therefore, students need knowledge, problem-solving skills, creative and critical thinking for proper adjustment into a fast scientifically and technologically developing society like ours. Students must, therefore, be taught to meet up with the challenges ahead and demand by daily living. This is very imperative, since, lecture based instruction which is teacher-centered has been identified as a major shortcoming in the teaching and learning of mathematics (Bassey, 2005). Bearing in mind the nature of mathematics there is therefore, the need for the teacher to use innovative teaching strategies in the teaching of the subject, so, as to enable the students learn and acquire positive attitudes and values, process skills and problem-solving skills. Hence, the present study is to investigate teacher's utilization of innovative teaching strategies in enhancing mathematics achievement among secondary school students in Enugu state.

Agommuoh (2004) investigated on secondary school student's assessment of innovative teaching strategies in enhancing achievement in physics and mathematics. The study adopted the descriptive survey design. By the use of

purposive sampling 190 out of a population of 394 senior secondary school year one physics and mathematics students from two co-educational senior secondary schools in Umuahia North local government area of Umuahia Education Zone of Abia state was used. The instrument for data collection was the researchers developed structured questionnaire. The data collected was analysed using mean for the research questions and chi square statistics for the hypothesis. Results showed that inquiry method, discovery learning, discussion, role play, simulation, games, team teaching, brainstorming and other similar strategies were adjudged to be innovative teaching strategies that can enhance achievement in physics and mathematics. Another study was conducted by Oyelekan *et al.* (2018) on science teacher's utilisation of innovative strategies for teaching senior school science in Ilorin, Nigeria. The study adopted the descriptive survey. A sample of 200 and 20-60 (256) science teachers were selected from secondary schools in Ilorin East, South and West local government areas using stratified random sampling technique. Data was obtained using a researcher-designed questionnaire called Innovative Teaching Strategies Questionnaire (ITSQ). The descriptive statistics was used to analyse the research questions while the chi-square statistics was used to analyse the hypothesis.

Results showed that out of the 36 selected innovative teaching strategies, most science teachers frequently used only 2 while the rest were rarely used. For centuries, lectures have been the most frequently used method for delivering knowledge in general academic teaching, especially in mathematics. Mathematics occupies a pivotal position that makes it a tool for the socio-economic development of any nation. For this reason, mathematics was made compulsory at both primary and secondary school levels of education in Nigeria. In spite of this relevance the failure rates of students in the various examinations are always high. The teaching and learning of mathematics in Nigeria can be said to be unsatisfactory and disturbing. This is evident by the declining trend in the mathematics achievement of students in school and public examinations.

The annual releases of West African Senior Secondary Certificate Examination (WASSCE) Mathematics by West African Examination Council (WAEC) indicate the problematic nature and general low achievement of secondary school students in mathematics due to poor foundation in junior secondary school mathematics acquisition. Several factors have been shown to be responsible for this negative trend among which the teacher characteristics such as mastery of subject matter, appropriate use of teaching methods and strategies among others have been a

prevalent factor. It is therefore, imperative to improve the teaching and learning in Nigeria because the poor achievement in mathematics among secondary school students is a clear indication that Nigeria still needs sustainable change in growth and development. Hence, it is imperative to ascertain the extent to which mathematics teachers utilize innovative teaching strategies in enhancing mathematics achievement among secondary school students in Enugu state.

The purpose of this study is to investigate teacher's utilization of innovative teaching strategies in enhancing mathematics achievement among secondary school students in Enugu state. The research question below guided the study. To what extent do mathematics teachers utilize the innovative teaching strategies? The hypothesis below tested at 0.05 significant levels guided the study:

- H_{01} : there is no significant difference in the mean scores of teachers on the utilization of innovative teaching strategies based on gender

MATERIALS AND METHODS

The study employed the descriptive survey design. The population of the study is made up of 192 mathematics teachers in all public secondary schools in Enugu state, Nigeria. The sample of this study consisted of 192 (118 males and 74 females) secondary school mathematics teachers. This number was drawn using purposive sampling technique. The instrument for data collection was a structured questionnaire on utilization of innovative teaching strategies in enhancing achievement in mathematics developed by the researchers. The responses were Frequently Used (FU), Rarely Used (RU) and Never Used (NU). It is a fourteen-item questionnaire that is made up of innovative teaching strategies that can be used in teaching mathematics. The instrument was face validated by three experts (one mathematics education expert and two measurement and evaluation experts).

The reliability of the instrument was determined by administering the instrument to 25 mathematics teachers in Imo state who were not part of the study but share similar characteristics that are necessary for the study. The internal consistency of the instrument was established using Cronbach alpha reliability method and reliability coefficient of 0.86 was obtained. Cronbach alpha was considered appropriate because the items are polytomously scored. The data generated were analysed with descriptive statistical tools. Mean and standard deviation were used to answer research question. A mean value of 2.00 was use as a criterion mean for taking decision. While independent Chi-square statistics was used to test the null hypothesis at 0.05 level of significant.

Table 1: Mean and standard deviation of the extent of mathematics teacher’s utilisation of innovative teaching strategies

Strategies	N	Mean	SD	Decision
Computer Assisted Instruction (CAI)	192	1.7656	0.64090	Disagree
Cooperative learning	192	1.9115	0.77085	Disagree
Field trip	192	1.6510	0.69259	Disagree
Discussion web	192	2.3698	0.65019	Agree
Graphic organizers	192	1.8750	0.76917	Disagree
Guided discovery	192	1.8958	0.70865	Disagree
Listen-think-pair-share	192	1.7708	0.70865	Disagree
Laboratory	192	1.9688	0.69332	Disagree
Manipulative	192	2.0573	0.66463	Agree
Mind maps	192	1.9271	0.70518	Disagree
Problem solving	192	2.3698	0.76146	Agree
Project based learning	192	2.1042	0.71600	Agree
Role playing	192	1.7031	0.63936	Disagree
Peer tutoring	192	1.8542	0.72327	Disagree

Table 2: Chi-square item by item analysis of male and female teacher’s mean responses on the utilization of innovative teaching strategies in enhancing achievement in mathematics

Strategies	Gender	NU	RU	FU	Total	df	p-value	Remarks
Computer assisted instruction	M	44(41.1)	62(63.3)	12(13.5)	118	2	0.60	NS
	F	23(25.8)	41(39.7)	10(8.5)	74			
Cooperative learning	M	37(40.6)	49(47.3)	32(30.1)	118	2	0.53	NS
	F	29(25.4)	28(29.7)	17(18.9)	74			
Field trip	M	61(55.9)	45(47.3)	12(14.8)	118	2	0.24	NS
	F	30(35.1)	32(29.7)	12(9.3)	74			
Discussion web	M	15(11.1)	51(52.2)	52(54.7)	118	2	0.13	NS
	F	3(6.9)	34(32.8)	37(34.3)	74			
Graphic organizers	M	41(43.0)	48(46.7)	29(28.3)	118	2	0.82	NS
	F	29(27.0)	28(29.3)	17(17.7)	74			
Guided discovery	M	37(36.3)	58(57.8)	23(22.7)	118	2	0.93	NS
	F	22(22.7)	36(36.2)	16(15.0)	74			
Listen-think-pair-share	M	50(46.1)	52(52.9)	16(19.1)	118	2	0.34	NS
	F	25(28.9)	34(33.1)	15(11.9)	74			
Laboratory	M	28(30.1)	60(61.5)	30(26.4)	118	2	0.42	NS
	F	21(18.9)	40(38.5)	13(16.6)	74			
Manipulative	M	25(22.7)	66(65.8)	27(29.5)	118	2	0.57	NS
	F	12(14.3)	41(41.2)	21(18.5)	74			
Mind maps	M	33(33.8)	61(59.0)	24(25.2)	118	2	0.83	NS
	F	22(21.2)	35(37.0)	17(15.8)	74			
Problem solving	M	21(20.3)	33(33.8)	64(63.9)	118	2	0.94	NS
	F	12(12.7)	22(21.2)	40(40.1)	74			
Project based	M	24(24.6)	55(56.5)	39(36.9)	118	2	0.79	NS
	F	16(15.4)	37(35.5)	21(23.1)	74			
Role playing	M	44(46.7)	61(59.6)	13(59.6)	118	2	0.64	NS
	F	32(29.3)	36(37.4)	6(7.3)	74			
Peer tutoring	M	35(40.6)	56(54.1)	27(23.4)	118	2	0.16	NS
	F	31(25.4)	32(33.9)	11(14.6)	74			

NS: Not Significant, S: Significant, M: Male, Female, NU: Never Used, RU: Rarely Used, FU: Frequently Used

RESULTS AND DISCUSSION

Analysis of data in Table 1 shows the extent of mathematics teacher’s utilisation of innovative teaching strategies. It shows that most of the mathematics teachers agree to discussion web, manipulative, problem solving and project based learning strategies, since, their mean responses to the items are more than 2.0 bench mark mean. It can also be seen from Table 1 that mathematics teachers disagree to Computer Assisted Instruction (CAI), cooperative learning, field trip, graphic organizers, guided discovery, listen-think-pair-share, laboratory, mind maps, role playing and peer tutoring.

Table 2 above shows the chi-square item by item analysis of male and female mathematics teacher’s

utilization of innovative teaching strategies used in teaching mathematics. The results show that there was no significant difference between male and female teachers for strategies 1-14 with p-value 0.60, 0.53, 0.24, 0.13, 0.82, 0.93, 0.34, 0.42, 0.57, 0.83, 0.94, 0.79, 0.64, 0.16, respectively which were >0.05 level of significance with 2 degrees of freedom. Hence, the null hypothesis which states that there was no statistically significant difference between male and female mathematics teacher’s utilization of innovative teaching strategies used in teaching mathematics is retained.

The innovative strategies that were utilised by mathematics teachers have been revealed in this study. This study revealed that the gender of mathematics teachers does not affect their utilisation of innovative

teaching strategies. Hence, the null hypothesis tested in this study was not rejected. The results of this study revealed that out of the fourteen selected innovative teaching strategies, only 4 were utilised by most of the mathematics teachers. The remaining 10 strategies were not frequently utilised, since, their mean responses were <2.0 bench mark mean. This agrees with the submission of (Oyelekan *et al.*, 2018) who stated that various teaching strategies exist yet poor teaching and learning of mathematics seems to continue unabated.

CONCLUSION

Findings of this study indicated that all the innovative teaching strategies were used by the mathematics teachers, however, only 4 of these 14 strategies were frequently used by most of the mathematics teachers. The teachers do not frequently use the rest of the strategies. This implies that mathematics teachers barely utilize innovative teaching strategies in their lessons. The Chi-square analysis showed that no significant differences existed between male and female mathematics teachers in the utilization of innovative teaching strategies. Hence, the null hypothesis which states that there is no significant difference between male and female mathematics teachers in the utilization of innovative teaching strategies was not rejected.

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