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INNOVATION IN METHODS OF TEACHING MATHEMATICS AND REASONS FOR PREFERENCE IN ENUGU SOUTH LOCAL GOVERNMENT AREA OF ENUGU STATE

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Abstract: *In this study, the aim was to investigate on innovation in methods of teaching mathematics and reasons for preference in senior secondary schools in Enugu South local government area Enugu state Nigeria. Two research questions and two research hypotheses guided the study. Qualitative research methods were employed, primarily, 30 teachers were randomly chosen from senior secondary schools and data were gathered via semi-structured interviews on the innovations in methods of teaching mathematics and reasons for preference. A sample size of 300 (male=137 and female=163) teachers in some selected senior secondary school. The research questions were answered with mean score and standard deviation while the hypotheses were tested with F-test statistic at significant interval of 0.05 levels. However, the findings showed that there is significant difference between male and female teachers on innovation in methods of teaching mathematics and reasons for preference. Thereafter, the researcher recommended teachers should periodically undergo formal training and retraining in new pedagogical developments. During the innovation, teachers should be carried along and objectives should be clearly stated and finally, teachers should be allowed to engage in mapping out the scope of the innovation and how to implement it.*

Keywords: *Teaching methods, mathematics and Innovation.*

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Introduction

Changes and adaptations in other disciplines deeply affect the teaching-learning process in mathematics Aydın and Doğan (2012). Most Mathematics teachers use traditional methods when it comes to teaching Mathematics example white/ black and marker/ chalk. Thus, the teacher plays the role of an instructor. The teacher is the one who decides which teaching-learning method will be used. Most often students are regarded as having gaps in knowledge that the teacher must fill with lots of information. Too often, Mathematical education is separate from the students' daily experiences. Thus, the teacher fails to engage the students' interests in the transfer of new knowledge. So, the teacher has to answer questions such as; why do we need it? Why

do we need to learn this? How best do we deliver the content?

However, it is obvious, and research confirms this, that students learn much better when they are encouraged to discover their own knowledge of the surrounding world. It's about the experiential learning. In order to improve students' Mathematics and their literacy ability, Mathematics teachers should have the freedom and ability to develop and apply modern strategies that give pupils the opportunity to discover new knowledge and to develop problem-solving skills from the process of defining and optimizing a solution to a genuine, real-world practice. It is obvious that besides the modern methods that should be used more often than the traditional ones, the use of integrated learning is also useful. The latter will provide opportunities for more relevant and stimulating experiences for students, regardless of their age. Thus, the recommendation of the European Parliament and of the Council 18 December 2006 (2006/962 / EC) is to include Mathematical competences and basic competences in science and technology within the key competences for lifelong learning.

A criterion for classifying the teaching methods can be related to their history in theeducational process Reynolds, (2010) traditional methods, such as didactic exposition, didacticconversation, demonstration, observation, working with the manual, exercise and modernmethods, such as algorithmization, modeling, problematization, programmed instruction, casestudy, simulation methods and discovery learning, Ozofor (2001).

Traditional method is based on the behaviorist learning theory. Behaviorist refers to the learning theories emphasizing on changing behavior which results from learners' associations of stimulus-response. It asserts that learning is a change in behavior due to experience (Ormord, 2010).In a mathematics class using traditional method, the teacher reviews previous material and homework, and then demonstrates low-level problem solving followed by seatwork imitating the teacher's demonstration (Stonewater, 2005). This pedagogical approach of placing the primary focus on the teacher as a transmitter of knowledge is representative of behaviorist theory, Hackman, (2011).The common method of teaching mathematics using traditional method is a teacher-centered and giving lecture is the dominant situation.

Some problems arises using traditional methods such as follows:

In taking notes instead of understanding and engrossing new ideas and understudies' powerlessness to handle key thoughts and ideas; Since an instructor needs to convey a fixed number of ideas inside a restricted time, most classroom exercises are gotten the job done to the introduction arrange as it were. The practice is left for the understudy to do as homework; only one out of every odd understudy has a similar pace of learning. While a few understudies can pursue the educator's address with accommodation, the vast majority of the others expect time to choke on the data that they are getting. Additionally, every understudy has an alternate learning style. There was no anticipation that a sensation student should ace an idea by simply tuning in to an address. In the event that a visual student deteriorates grades than a sound-related student, it does not imply that the previous is moderate or dull; it may basically imply that the classroom techniques were intended for the sound-related student as it were.

The word "innovation" is derived from the Latin verb "innovare," which means "to renew." Innovation is the practical implementation of ideas that result in the introduction of new goods or services or improvement in offering goods or services. *It is also a process by which a domain, a product, or a service is renewed and brought up to date by applying new processes, introducing new techniques, or establishing successful ideas to create new value*. According toAgwagah (2021), innovation could be seen as a deliberate change geared towards achieving a desired goal. Innovation in education thus, is similarly focused on making positive changes, but in this case, specific changes that will directly benefit a classroom, school, district, university, or even an organization's training and learning practices. Educators and administrators take a variety of both large- and small-scale approaches to this process. For instance, innovation in education according to Lianghuo (2017) might include: An educator recognizing a need for ideas to be better shared among other teachers in their district and developing processes that more easily facilitate; a practitioner identifying a gap in understanding among the students in their classroom and brainstorming new, creative ways to approach that topic and An administrator identifying the need for better communication between teachers and parents, and working to create an online system that allows

for more transparency into their student's progress. While each of these forms of innovation is very different, each involves an educator following the innovation activities in an effort to improve the ways in which the education system functions.

However, Innovation in education encourages teachers and students to explore research and use all the tools to uncover new frontiers and generate ideas. It involves a different way of looking at problems and solving them. The thinking process that goes into it will help students develop their creativity and their problem-solving skills.

Thus, Innovation is a vital component of progress across industries, and education is no different.Baş (2015) believes that the process of innovation in education includes three key steps: Examine the current situation.This should include an examination of teachers experience followed by a mental exploration of how that experience could be improved upon. Secondly, Make Small-Scale Changes**.** Once teachers have explored the above examination of current situation are formalized, then try to make that change on a small-scale within their own environment. Finally, broaden the approach and accept to Feedback. Analyze the outcomes of that experiment and identify what further support might be needed to either hone the idea or restructure it all together.

Some innovations in methods of teaching mathematics are as follows;

Inductive method is to move from specific examples to generalization. Mathematics in the making is experimental and inductive. Induction is that form of reasoning in which a general law is derived from a study of particular objects or specific processes.

Deductive method the teacher moves from general to specific. Deductive method, the teacher gives a rule and asks the students to verify its application to several concrete examples and this method is short and time-saving. The solution of the problems by pre-established formulas takes little time.

Lecture method the teacher speaks all through the lesson and the students listen attentively and silently. The teacher may not even use the blackboard or any other teaching aid. Lecturer does not allow students to raise their doubts or ask any question seeking clarification for any of the points mentioned during the lecture. Students take down notes for the important ideas and later memorize them. Lecture method is useful in introducing new topics.

With the advent of Laboratory Method, many of the colleges are well equipped with computer laboratories. The availability of computing software can be utilized in complementing classroom mathematics teaching to promote students´ active engaging and learning; to exchange long and difficult numerical and algebraic manipulations by communication of supporting reasoning when answering mathematics questions; to make experimental activities easier to handle; to develop problem resolution skills dealing with more interesting and difficult problems in so far as numerical, algebraic graphical and programming resources are available; to encourage discussion of different solutions or strategies as one works with multiple representations of the same mathematics object or process; to motivate the development of paired notions like discrete/continuous and finite/infinite. The pedagogical work needed to construct and implement learning situations to actualize these potentialities constitutes a major challenge to teachers; and oral presentations in mathematics service units as students' educational needs are diverse. Reaching parts of the brain that usual educational methods do not reach may be the answer to those poor students who do not have a, mathematical brain. The theory of multiple intelligences and brain-based learning may be the tool that will aid these students to be more confident about their mathematics ability. Oral presentations provide all students with a chance to display their knowledge in fun and creative ways. Firstly, this method is regarded as an alternative mode of assessment for teachers to gather information about their students‟ learning of mathematics and hence make relevant instructional decisions. Secondly, it is also viewed as a tool for developing students‟ communication skills. One general purpose of oral presentation is to allow teacher to hear what students think about mathematics, and how they express it and their understanding of mathematics in their own words.

Thus, in history, mathematics has been used to supply fundamental needs of societies; as mathematical knowledge progressed, so did technology, with many new scientific branches emerging (Tahta 2015).Mathematics curriculum have aimed to provide students with the fundamental mathematical skills needed for further education, including understanding mathematical concepts; developing their own mathematical thinking and problem-solving processes; using these skills both in real

life and in the classroom; systematically improving their skills, and behaving responsibly (MEB, 2013).

The chief aim of mathematics education extends beyond motivating students to learn the basic mathematics that they will need in school; rather, it is to convince them (in the hope that they will continue to learn beyond the classroom) to adapt to the mathematical challenges that their future lives will present (Sullivan 2011).

Mathematics, as an academic course and as a mode of thought, begins in students' primary education and continues throughout their lifetime learning; moreover, there is a strong relationship between mathematical success and academic success in other courses.

In the mathematics context, the ability to understand, assimilate and ensure excellent practical and mathematical judgment is crucial for the future of the students. It is especially necessary in today's increasingly complex society, where Pollock (2001) opined that learning and understanding mathematics and natural sciences have become necessary for full development of everyone. And in turn, the development of each country's economy depends on the individual simulation, development of new modern technologies and reinforcement of the connections between science disciplines.The importance of mathematics in the recent period is increased because of the huge application of the computers, information technologies, modeling and simulation (Anımasahun, 2007). Sadly, mathematics, even as important as it is, and its central position since the ancient period till date, has not been of interest to many students. Some reasons have been postulated. To Baykul (2019), this is mainly because understanding mathematics is hard to achieve regardless the aspiration for it. Being highly abstract, it is concerned with ideas, although interrelated, and involves manipulation of symbols. Teaching of mathematics is not only concerned with the computational of the subject, but also concerned with the selection of the mathematical contents and the communications leading to its understanding and application (Akınsola & Anımasahun, 2014).

Teachers have many roles, from planning classroom activities, to instructing, disciplining, motivating and guiding students. Teachers are also expected to both use teaching techniques effectively and to have modern management skills in classroom environments (Kahyaoğlu & Yangın 2010). In order to establish learning that can be defined as permanent changes in behavior. Those factors which most impact students' learning and performance are not only teachers' attitudes, choice of methodology, and the content of curriculum, but also students' background, behavior, and personal characteristics,Reynolds (2010). Effective teaching, therefore, must place equal emphasis on teacher, student, environment, curriculum and other factors.

Teaching mathematics is related to more than one variable as well as to other disciplines. The primary goal of efficient mathematical teaching is to transfer mathematics knowledge in a way that allows students to adapt to new situations and knowledge (Oğuzkan, 2019). Teachers' preferences and opinions regarding pedagogical techniques in mathematics courses are important, because they may reveal their ability to address the needs of students at different learning levels. The study began with a self-evaluation of the teachers' strengths and weaknesses regarding their teaching preferences. As teachers develop their teaching skills, they may help students integrate their mathematical knowledge with other activities, and find out what works best for their personalities and curriculum (Santos-Trigo 2007).

The following principles may provide guidance for effective classroom practices in supporting mathematics teaching. First, it is recommended that teachers build on students' natural interest in mathematics, and on their intuitive and informal mathematical knowledge. They should encourage inquiry and exploration to foster problem-solving and mathematical reasoning (Güçlü 2014). Second, teachers are expected to use both formal academic lessons and everyday activities as natural vehicles for developing children's mathematical knowledge.

Finally, it is recommended that teachers establish partnerships with parents and other caregivers in order to support children's mathematical development.It is against these conflict findings, justify the need for another study such as Innovation in the methods of teaching mathematics with preference reasons.

Purposes of the Study

The main purpose of this study was to determine the innovation in methods of teaching mathematics with reason for preferences in secondary school Enugu south Local Government Area. Specifically, the study sought to:

1. Determine the reasons for preference in methods of teaching mathematics in secondary school.
2. Statistically examine the extent of innovationin methods of teaching mathematics and its reasonfor preference in secondary school.

Research Questions

The researcher formulated the following research questions for the study:

1. What are the reasons for preference in methods of teaching mathematics in senior secondary school?
2. To what extent would innovation in methods of teaching mathematics influence the reason for preference in secondary school?

Hypotheses

The research hypotheses formulated and tested at 0.05 level of significance were;

Ho_1: There are significant between the male and female mathematics teachers on innovation in methods of teaching mathematics and reason for preference.

Ho_2: There are no significant between the male and female mathematics teachers on innovation in methods of teaching mathematics and reason for preference.

Methods

The study was quantitative study which aimed to identify various innovations in methods of teaching mathematics and to understand why teachers prefer them. Descriptive models describe past or present situations as it was characteristically. These methods could be described as survey methods in which situations, events, objects, circumstances, institutions, groups and various areas have been tried to describe in their contexts as well (Karasar, 2013).

Data were collected for this study using case studies, a qualitative research method. According to Yıldırım and Simsek (2013), case studies enable researchers to prioritize questions of "what" and "why," by examining individual cases in detail. Qualitative research can therefore be described as "research in which qualitative data-collecting methods such as observation, interview and document analysis are used, and a qualitative process carried out to reveal perceptions and cases in their natural environment as exact and integrated." Güven (2012) defines the case study as a relative research model, used when case borders are uncertain and there are enough data sources in real life borders.

The study's central subjects are teachers, represented here by a focus group composed of Mathematics teachers in some selected senior secondary schools in Enugu south L.G.A., Enugu State, Nigeria.Interviews were conducted with 300 teachers, who were selected for the study by a random sampling method. The study group was constituted of 137 male and 163female teachers.

The researcher visited the various selected sampled secondary school with semi-structured interview were applied to mathematics teachers last period before the break period. This was done with the permission of the secondary school principals. This give the researcher the opportunity to attend to issues required. More so, the researcher had an opportunity of ensuring 100% completion. Data were collected using semi-structured interview, one of the qualitative data-collecting methods. Interviews are one of the most frequently used data collection tools in qualitative research. An interview is an interaction process based on asking and answering questions designed to provide insight on a predetermined and specific topic. Patton (2014) also explains the interview's purpose as stepping in a person's inner world and understanding his perspective. In the interview form of this research, selected innovations in methods of teaching mathematics (Inductive, Deductive, Lecturing, Laboratory and Oral presentation) which were proposed by recent studies were listed and teachers were asked to indicate how often they used each method in mathematics. They were also asked to explain the reasons why they preferred those teaching methods.

Data analysis

Statistical package for social science (SPSS) was applied for the analysis. The two research questions were answered using mean and standard deviation while the hypotheses were analyzed using linear regression and F-tested with at 95% (0.05) level of significance between male and female mathematics teachers on methods of teaching mathematics and their reasons on preference.

Results

The data collected with the semi-structured interview were summarized, analyzed and then presented as follows.

Research Question one:

What are the reasons for preference in methods of teaching mathematics in senior secondary school?

Table 1: Mean and Standard deviation of male mathematics teachers and reasons for preference in methods of teaching mathematics in senior secondary school

Descriptive Statistics

METHODS	N	Sum	Mean	Std. Deviation
INDUCTIVE	9	200.00	22.2222	5.69600
DEDUCTIVE	9	98.00	10.8889	5.01110
LECTURING	9	83.00	9.2222	3.19287
LABORATORY	9	85.00	9.4444	3.24465
ORAL	9	72.00	8.0000	2.50000
TOTAL		538.00	59.7777	19.64462

As seen in table 1, that the mean summation of male mathematics teachers and reasons for preference in methods of teaching mathematics has mean value of 59.8 with standard deviation of 19.6. The table 1 also shows that inductive method of teaching mathematics has highest sum of 200, mean score of 22.22 and standard deviation of 5.69, while deductive method of teaching mathematics has sum of 98, and mean score of 10.89 and standard deviation of 5.01. Lecturing method of teaching mathematics has sum of 83, mean score of 9.22 and standard deviation of 3.19, while Laboratory method of teaching mathematics has sum of 85, and mean score of 9.44 and standard deviation of 3.24. More so, oral presentation has the least sum of 72 and mean score of 8.0 with standard deviation of 2.5.

Research Question two: To what extent would innovation in methods of teaching mathematics influence the reason for preference in secondary school?

Table 2: Mean and Standard deviation of female mathematics teachers and reasons for preference in methods of teaching mathematics in senior secondary school

Descriptive Statistics

	N	Sum	Mean	Std. Deviation
INDCTIVE	9	160.00	17.7778	6.35959
DEDUCTIVE	9	131.00	14.5556	7.68295
LECTURING	9	100.00	11.1111	6.19363
LABORATORY	9	83.00	9.2222	3.59784
ORAL	9	67.00	7.4444	2.55495
TOTAL	9	541.00	60.1111	26.38896

Table 2 shows that the mean summation of female mathematics teachers and reasons for preference in methods of teaching mathematics has grand mean value of 60.1 with standard deviation of 26.4. The table 2 also shows that inductive method of teaching mathematics has highest sum of 160, mean score of 17.8 and standard deviation of 6.4, while deductive method of teaching mathematics has sum of 131, and mean score of 14.6 and standard deviation of 7.7. Lecturing method of teaching mathematics has sum of 100, mean score of 11.1 and standard deviation of 6.2, while Laboratory method of teaching mathematics has sum of 83, and mean score of 9.2 and standard deviation of 3.6. However, oral presentations have the least sum of 67 and mean score of 7.4 with standard deviation of 2.6.

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Table 3: F-test of There is no significant relationship between the male and female mathematics teachers on reasons for preference of innovation in methods of teaching mathematics.

ANOVA[a]

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	0.120	1	0.120	0.168	0.694[b]
Residual	4.983	7	0.712		
Total	5.102	8			

As seen in ANOVA table 3, it shows that sum of squares has the following values via, regression with 0.120, Residual with 4.983 and Total with 5.102. The degree of freedom (d.f) for regression has value of 1, residual has value of 7 and total has the value of 8. ANOVA table also has mean square of 0.120 for regression and 0.712 for residual.

The table also shows that F-test value is 0.168.Since calculated value is lesser than the tabulated value at p=0.05=2.40 while the calculated value of F=0.168, therefore accept the null hypothesis (Ho_1) that there are significant relationship between the male and female mathematics teachers on innovation in methods of teaching mathematics and reason for preference.

Discussion of the findings

These findings clearly demonstrate that there are significant relationship between the male and female mathematics teachers on innovation in methods of teaching mathematics and reason for preference.Inductive and deductive methods of teaching mathematics areteachers' favorite teaching method since they are simply and require less time and preparation. Grasha (2013) suggests that it is not easy for teachers to take on a less central role and to empower students. Mathematics in the making is experimental and inductive. Induction is that form of reasoning in which a general law is derived from a study of particular objects or specific processes. The child can use measurement, manipulator or constructive activities, patterns etc. to discover a relationship which he shell himself, later, formulate in symbolic form as a law or rule. The law, the rule or definition formulated by the child is the summation of all the particular or individual instances.In all inductions, the generalization that is evolved is regarded as a tentativeconclusion.

The most teachers from the study are using Lecturing method and find it useful in introducing new topics. Mathematics is based on previous knowledge of facts. This method can be used to teach a topic requiring some previous knowledge of facts. Also a large number of acts can be presented in a short period of time. At times, when the knowledge of some units in textbooks is not sufficient, then the lecture method by teachers can be used. The matter to be presented should be selected according to the level of students.

Corresponding research conducted by Aydın and Doğan (2012) has investigated some of the various obstacles or barriers to successful mathematics teaching, arguing that teachers should receive qualitative education, and should use modern pedagogical methods rather than traditional, teacher-centered techniques. Instead of memorizing concepts, knowledge should be constructed in students' minds through questioning and discussion, and through early learning. Information should be made meaningful to students in order to establish permanent learning (Dereli, 2008)

Active participation, the reasons for these teachers' preferences, most methods were valued for the sake of inevitable in mathematics and geometry. It means thatthey have been using those techniques in their course but they didn't have a clearreason or explanation for their preference. It appears that many of these teaching techniques were employed because of the expectation that they would simplify mathematical subjects.

Based on these findings, it appears that Enugu south senior secondary schools were assumed to be not well-equipped, with adequate access to technology. In this context, it must be emphasized that, in mathematics classes, learning environment is vitally important as well as teacher and materials. Öztürkand Güven (2012) and Verschaffel et al. (2013) stated that there is a direct relationship between mathematical thinking, problem solving and physical, social, academic designed learning context.

Cotton and Doğan (2012) stated that any approach that relies on a sequence of pre-structured questions and does

not provide students with adequate time to explore their own responses. In teaching mathematics, pre-structured questions should allow enough time to organized students' exploration of their own responses to situations. Moreover, such questions must be structured to inspire students' wonder and interest, which enhance participation and self-confidence.

Conclusions of the findings

Based on the analyses, the following findings were made:

1. There is significant between the male and female mathematics teachers on innovation in methods of teaching mathematics and reason for preference.
2. There is no gender difference on the innovation in methods of teaching mathematics and the reasons for preference
3. Teachers have genuine reasons for preference on the innovations in methods of teaching mathematics.

Recommendations

1. Teachers should be periodically undergoes formal training and retraining in new pedagogical developments.
2. During the innovation, teachers should be carried along and objectives should be clearly stated.
3. Teachers should be allowed to engage in mapping out the scope of the innovation and how to implement it.

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