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DEVELOPMENT OF MICROECONOMIC MODELS FOR EFFECTIVE TEACHING OF MICROECONOMICS IN THE NATION'S TERTIARY INSTITUTION

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Abstract
It is a well-established fact that Economics in the recent time is becoming a highly quantitative subject, borrowing a lot from mathematics. Disappointingly, not all students in Nigeria are aware of this feature of microeconomics programme, given that the mode lesson delivery is discursive and text-based rather than the use of analytical models. In a situation where teaching methodology departs clearly from the nature of the subject, it creates some learning difficulties, and poor performances, consequently watering down the quality of Economic graduates in the labour market. These learning difficulties are sometimes seen as students quit their programme of studies at the Department of Economics in our College, for other programmes, in say, political science or Social Studies. This becomes easy because of less stringent measures in the change of study programmes in the College. In order to arrest the declining students' population in the Department of Economics, and also retain and improve students' academic quality there is the need to re-examine Lecturer's teaching methodology with a view to reducing the difficulties encountered by the students in the teaching and learning of microeconomics. To this end, this research work is geared towards developing microeconomics models for active and effective lesson delivery. In doing this, two objectives were stated with a corresponding two null hypotheses and their alternatives. Sign test statistical analysis was applied on the hypotheses. The result suggests that there is significant difference in the student's perception of their learning abilities when mathematical and graphic models are predominantly used in the teaching of microeconomics lessons as opposed to the presentation of learning materials in a lecture format. This work recommends that desperate effort should be made in helping to improve mathematical ability of students more especially at the early stage of their study programme.

1.1 Introduction

Microeconomics course is one of the compulsory courses that students in tertiary institutions are required to do while undertaking economics study Programs. This course is intended to provide the basis for broader studies in economics, and students ought to show good mastery of it in order to be successful in these other programs. Microeconomic study is concerned with the behavior of individual economic units; consumers, firms, workers, and investors, as well the markets that these units comprise. Microeconomic analysis attempts to explain how scare economic resources are allocated among competing ends through the market mechanism in the real world.

The real world is composed of immense, bewildering array of facts which defy ready comprehension. To make some sense out of the complex economic world and to derive economic propositions that have explanatory and predictive power, economists abstracts from the complex world and build economic models. To abstract is not ignore the complexity of the real world; rather it is a necessary procedure in discovering reality, which otherwise remains too complex to be understood. Put more simply, a model is a formal statement of a theory.

Studying and learning microeconomic theory by the students require mastery of the geometry of lines and curves in the graphs used for the exposition of microeconomic theory. Students are also meant to understand that in order to bypass some of the limitations imposed by graphic exposition of a microeconomic

theory, when three or more variables are involved, mathematical equation becomes necessary in modeling a theory.

It is of general believe that the use of graphic and mathematical models in the teaching of microeconomic lessons, introduces some level precision and concision in the presentation of an economic theory. The success of learning is very much determined by the teacher's approach in delivering lessons on microeconomics, the accuracy of the learning design, lecturer professionalism, the readiness of students, and the availability of learning resources supported by the environment and adequate facilities and infrastructure (Sukirno, 2010).

In tertiary institution in Nigeria, teacher's approach to microeconomic lesson delivery is usually lecture method. Traditionally, College lectures consist of teachers verbally communicating information to the students who passively receive and encode it in their memories (Boyer, 1990; Machel, Carter III, and Verela, 2009; Stewart – Wingfield & Black, 2005). In a typical College classroom, the lecturer delivers his lecture by reading through his notes for one or two hours, while students simply listen and take notes.

However, it is possible and probably more likely that most lecturers do not solely teach in this passive fashion, but also do engage the students in a more interactive classroom session. Perhaps this is because many recent studies by (Bonwell & Eison 1991; Michel et al, 2009) suggest that passive methods may not be the most effective way for students to learn at any level of the educational system. Rather, current research advocates for teaching technique that encourages students to actively get engaged in the material presented because classroom engagement has been found to promote deeper level of thinking, and it facilitates better encoding, storage and retrieval than the traditional lecture method (McGlynn, 2005; Peck, Ali, Matchock and Levine, (2006).

Consequently, it is likely that most lecturers attempt to incorporate techniques that involve students and get them thinking about and the materials (see Michel et al.., 2009 for a review). These techniques can range from demonstration, to discussion, and to in-class activities, in combination with appropriate instructional materials and media, that would appeal to students' various sense organs, for impactful visual impressions and auditory perception for reflective and creative thinking.

In the recent time the question that agitates one's mind is whether the current lecture method applied solely, meets the need arising from the newly and constantly changing economic context of globalized world. It is equally questionable if this method addresses personal and social identity of today's students. Absolutely, the answer is no, though the fundamental role of education and the teaching of microeconomics in our school is to redirect existential confusion of individual students in microeconomics and to convert it into creative intellectual powers. It is difficult to associate this with economic education, particularly the teaching and learning of microeconomic theories and principles in all the tertiary institutions in this country, including our College. Simply put, traditional ideas of lecture methods have developed such a bad reputation that some teachers may be ready to banish them from their teaching repertoire.

This provides the imperative for a search for alternative teaching techniques for the teaching of Microeconomics principles and theories to our students in our Colleges, which even at the present moment, is predominantly done using solely lecture methods without appropriate pre-prepared instructional media. Therefore, this research proposes to provide an alternative teaching technique that would effectively sensitize and appeal to individual students' sense organs and at the same time help them to develop reflective and creative mind set or thinking. This alternative technique involves the intensive use of microeconomic models in combination with lecture method as effective means of microeconomics lesson delivery

A model expressed in oral form needs to be supplemented with graphic and algebraic equation models for conciseness, and precision. This teaching methodology is expected to equally assist in the development of critical and reflective thinking in the students. This is the central focus of this research work, which is meant to give support to various learning styles that would appeal to student's individual differences for effective learning. This research involves finding an alternative teaching strategy whose dominant feature is the intensive use of simple mathematical models in the teaching of microeconomics as opposed to the popular lecture method used in all the tertiary institution in the country.

1.2 Statement of Problem

Economics is an attractive course to students as, alongside, Medicine and Law. It offers students the prospect of high-earning graduate employment. This gives lecturers some interesting challenges in their teaching – as they face a body of learners who may be focused on what their discipline can offer them in the future rather than having an intrinsic interest in it as an area of study. It is not just this, Economics. in the recent time, is fast becoming quantitative and scientific in nature, borrowing a lot from mathematics and requiring the application of mathematical approaches in its enquiry. Like in other departments that require good mathematical abilities, economics department had witnessed a sharp drop in the enrollment of freshmen in our college.

Given this nature, the teaching of microeconomics, in particular, ought to align itself closely to its mathematical inclination in order to produce graduates whose vision and aspirations could be met. Disappointingly, not all students are aware of this feature of microeconomics programme, given that the mode lesson delivery is discursive and text-based rather than the use of analytical models. In a situation where teaching methodology departs clearly from the nature of the subject, it creates some learning difficulties, and poor performances, consequently watering down the quality of economic graduates in the labour market. These learning difficulties are sometimes seen as students quit their programme of studies at the Department of Economics, for other programmes, in say, political science or Social Studies.

This becomes easy because of the less stringent measures in the change of study programmes in some Colleges. In order to arrest the declining students' population in the Department of Economics, and also retain and improve students' academic quality, there is the need to re-examine Lecturers' teaching methodology with a view to reducing the difficulties encountered by the students in the teaching and learning of microeconomics. This work, therefore, is suggesting predominant use of graphic and mathematical model in the teaching of microeconomics lessons where plausible and applicable. Mathematical and graphic models are theoretical representations of some economic phenomena. They are formal statement of theories.

The strong extrinsic motivation of students, in going into Economic discipline as an area of study, can be an effective motivator that can be harnessed, where lecturers are able to do their teaching in a more precise and compact manner by using microeconomic models in the teaching of individual and industrial economic activities. This project is, therefore, meant to arrest the movement of students out the Department by making teaching and learning of economics very simplistic, through the development and use of simple algebraic equations and graphical models. The planned process is to introduced the models in piece meal fashions that build into a bigger picture, thus reducing the mathematical frustration, and also creating and retaining students' interest over the period of lesson delivery and beyond. The goal of Education defined through learning outcome or development of competencies cannot be realized by sheer usage of traditional didactic approaches and methods, but rather by more effective and efficient form of teaching and learning (Mocinc, 2012).

The justification of this work is that through the activities of the Tertiary Education Trust Fund (TETFUND), Tertiary Institutions in the country had acquired a lot of physical academic infrastructure that required a complementary innovative teaching in various departments, particularly in Economics Department, nationwide.

1.3 The Objective of Study

The goal of this research project is to direct attention to a teaching strategy which would foster active learning and knowledge acquisition, not only of new knowledge but also of the skills and attitudes in providing answers to the requirements of the contemporary microeconomic challenges.

Specifically, the objectives of this work are stated as follows:

1. To develop microeconomic models that will ease the burden of teaching and learning of microeconomics for active learning to take place.
2. To develop microeconomic models that will enhance reflective and creative thinking.

A model expressed in oral form needs to be supplemented with graphic and algebraic equation models for conciseness and precision. This teaching methodology is expected to equally assist in the development of critical and reflective thinking in the students. This is the central focus of this research work, which is meant

to appeal to student's individual differences for effective learning. This work involves finding an alternative teaching strategy whose dominant feature is the intensive use of simple mathematical models in the teaching of microeconomics as opposed to the popular lecture method used in all the tertiary institutions in the country.

It is expected that at the conclusion of this work, the College would have had microeconomic models that explains consumers and firms' optimizing behaviour, creating the urge for the development of micromodels for the teaching of other aspects of microeconomics. The models are meant to meet the need of the following groups of students; Students who have strong mathematical capabilities, Students who do not have problems with basic mathematics but do find concrete to abstract generalization problematic, and Students who are dyscalculia

1.4 Research Hypotheses.

For the purpose of this work the following Null hypotheses will be tested;

1) There is no significant difference in the students' perceived learning ability when mathematical and graphic models are applied in the teaching of microeconomic lessons in consideration to the predominant lecture method.

2) There is no significant difference in the students' mode of thinking as it relates to microeconomic policy initiatives of the government

2.0 LITERATURE REVIEW

In this section attempts are made in reviewing relevant literatures on the microeconomic teaching models, for the effective teaching of microeconomics. This section is broken into various subheads that span from model conceptual framework and the role of Mathematics in microeconomic modeling, to teaching strategies that guarantee active teaching and learning.

2.1 Microeconomic model – a conceptual framework

An economic model is a term used in different ways: sometimes as a synonym for theory, sometimes for a specific quantification of a general theory, sometimes for the application of a general theory to a specific context, and sometimes for an abstraction designed to illustrate some point but not meant as a full theory on its own. An economic theory is necessarily an abstraction from real world. For one thing, the immense complexity of the real economy does make it impossible for people to understand all the interrelationships at once; or, for that matter, are all these interrelationships of equal importance for the understanding of the particular economic phenomenon under study. The sensible procedure is, therefore, to pick out what appeal to common sense to be the primary factors and relationships relevant to the problem under study and to focus attention to those alone. Such a deliberately simplified analytical framework is called an economic model, since it is only a skeletal and rough representation of the actual economy.

Awh, (1976), stated that a model is merely a theoretical construct or analytical framework composed of a set of assumptions from which conclusions are derived. Accordingly, and in a simpler form, he stated that a model is a formal statement of a theory. It is usually a mathematical statement of presumed relationship between two or more variable. Models can be expressed in words, graphs and equations. Consider the following statements: Lower flight ticket prices cause people to fly more frequently; lower interest rates increase the rate of home sales; when firms increase output levels, more employment is generated; higher fuel prices cause people to drive less and to buy more fuel–efficient cars. Each of these statements expresses a cause-effect relationship between two variables that can easily be quantified. The most common way of expressing quantifiable statements in two variables is graphing, done in a two dimensional space. Quantitative relationships between two or more variables can easily be represented in an equation (Case, Fair ,and Oster , 2009) .

2 .2 Role of Mathematics in Microeconomic Modeling

A mathematical model of an economic agent is a formal description of certain relationships between qualities such as prices, output, cost revenue etc. in an isolated or individual economic environment. A model is formulated with a view to analyzing logical implications of such relationships (Medio, 2014). Some of these relationships are derived from empirical observation of a rational economic agent, the so called *homo oeconomicus.* Assuming no mathematical mistakes are made, the relevance of the conclusion of the analysis depends on the validity of the premise of the model and on the ability to find out all their consequences. No matter how sophisticated a microeconomic model is, the value of its final result heavily depends on the hypothesis of the model, though the use of mathematics in economic analysis always had in the past enthusiastic supporters as well as fierce opponents.

Today, there is a broad consensus that the discipline imposed by mathematics on economic reasoning was a fundamental factor in the development of economic theory as a science. Mathematics, to a very large extent, provides a useful tool for the economist to perform quantifiable experiments and create models for analysis and prediction of the future course of economic events. Through the inclusion of mathematics, theoretical economic models have become a useful instrument for day- to- day economic policy making. Therefore, mathematical modelling provides a frame work that facilities understanding of how changes within the framework can affect outcome. Modelling combined with data can explain past behavior, predict and forecast future behavour, and evaluate how changes may alter these predictions.

2,3 Approaches to teaching Microeconomics in Tertiary Institutions

2.3.1 Lecturing Approach

Lecturing has far remained dominant form of academic teaching in spite of the continued attacks, criticism and intentions to suppress and replace it with more efficient and effective methods and procedures (Apel, 2003). Lecturing, sometimes referred to as information dump is a commonly used approach that involves presenting specific information to students; taking a large part of lesson time; allowing for little or no opportunity for students' interaction; and expecting them to have mastered the lecture contents before the time of examination (Stewart -Wingfield and Black (2005); Whetten and Clerk,(1996)).

This approach is beneficial because it is a convenient and efficient method of introducing a vast amount of information especially in large classes where activities may be impracticable. Consequently, lecturing as a method of teaching microeconomics has developed a reputation of being mundane, disengaging or monotonous activity (Dorestani, (2005) ; Miner, et al, (1984); Stewart -Wingfield and Black(2005). Some lecturers worry that their students retain less information and many lecturers find themselves dealing with students who pay less attention, play games or send messages on laptops or even sleep in class.

Barmet (2009), stated that lecturing is used extensively in most economic programmes and in a survey of undergraduate economic students conducted by economic network (2006), over 75% of the students indicated that they found lectures useful/very useful – the top scoring teaching method in the discipline. The study also found lecturing to be most popular with the older students, female students and final year students rather than the freshmen.

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2.3.2 Improving Lecture method for effective lesson delivering

The economic network (2005), survey indicated the three main areas where students felt lecturer need to improve their practice. These areas are (i) In structuring lecture procedures, (ii) In reducing complexity of visual models and (iii) In making lectures more interesting. In structuring, a simple guiding principle, here is to ensure that each lecture starts with the "big picture", sets the particular step to be achieved from the broader context, then links back to step already covered, and then moves forward to the next.

An article by Turner (2006), summarizes the key features of effective graphic or visual model in economics as simplicity, accuracy, and flexibility. On simplicity, the lecturer should pay very close attention to graphical presentations. A much more helpful approach in graphical modeling is to take a complex graph back to its basics, starting for example, with labeling axis and curve rather than a single slide. It can be

helpful to show for example, how the equation of a curve is turned into the actual plot, making the connection between the curve and the associated algebraic equation model.

On accuracy, and with graphical model, remembering to label the axis is an important aspect. Other aspects of accuracy are with regards to mathematical notations as each textbook tends to adopt its own system of notation.

Appropriate use of technology can be useful in allowing for flexibility, for example, gradual exposition of an idea or the development of the basic graphical forms in assortments of interaction can provide the required flexibility. Flexibility of learning can be achieved through the development and application of microeconomics models which by extension will cover the following areas of students' individual differences.

1. Students, who have strong mathematical capabilities, but face difficulties with language-based work of reading large volumes of textual materials, and have short-term memory. These students may be attracted to more mathematical elements of economics, but struggle with the more discursive and business-related elements (Algebraic equation model can be very helpful).
2. Students who do not have problems with basic mathematics, but do find concrete to abstract generalization problematic and face difficulties with remembering and retrieving symbolic materials (graphic models suffices).
3. Students who are dyscalculia, having problems with understanding numerical concepts. These students may have high levels of anxiety to mathematics and possibly be unaware, prior to starting a programme of study, of the level of mathematics/statistics that is required (Oral Descriptive Model Suffices).

2.3.3 Active Teaching of Microeconomics

Active or experimental teaching is a student oriented approach to teaching. It includes any technique that involves the students in the learning process and holds the students responsible for their own learning (Bonwell and Eison (1991); Michel et al,.. (2009). Yoder and Hochevar, (2005)). Prince (2004), considered that active learning can be achieved by any method of teaching which actively involves students in the process of authentic learning. Zanchin, (2002), stated that active teaching implies involvement of students in the teaching of curriculum content, which fosters development of their procedural knowledge and its integration with declarative and Meta-cognitive knowledge. Active teaching Strategies must possess the following characteristics:

- Integrate thought and practical activities;
- Enable varied learning styles;
- Enable a methodological correct teaching of Curriculum contents regarding single disciplines;
- Promote cognitive interaction with others whether adult peer,
- Develop higher level cognitive process;
- Foster reflective and Meta Cognitive activity;
- Support readiness to carryout tasks and motivation to learn;
- Enable observation and monitoring of students.

While the literature on teaching effectiveness is vast, a large portion of the literature has been focusing on effectiveness or perceived effectively of interactive teaching strategy. These strategies include among others an appropriate use of media and electronic resources (Serva and Fuller, (2004)). From and innovative point of view, active teaching technique changes the pace of classroom instruction, and is a creative way to increase student's involvement, motivation, excitement, attention and it has perceived helpfulness and applicability (Binek-Rivera and Mathew (2004); Bonwell and Eison, (1991); Guthrine and Cox (2001); Stewart Wingfield and Blank (2005)).

From cognitive perspective, experientially taught students are better in identifying concepts in real world, in manipulating economic phenomena conceptually, and they can easily recall and memorize contents much better.

Although it seems that active teaching strategies should be adopted in every classroom activity, the literature is mixed on its effectiveness. While it is important to understand why students perceive and appreciate active

teaching, the cognitive outcome offers a concrete evaluation of the degree to which students have learned (Tomcho & Foel (2008))

3 Research Methodology

As we are aware, microeconomics deals with the behaviour of individual households and firms. It explains how and why these units make rational economic decision (Pindyck and Rubinfield (2009); Case, Fair and Oster (2009). Consumer's and producer's optimization models are to be developed in such a manner that will attract and retain students' interest over an extended period of time in the course lesson delivery and beyond. It is expected that at the end of this study we will find students better equipped to understand and handle mathematical microeconomic models in a holistic form. Given this informed understanding of concepts and the role of mathematics in sharpening reflective and critical thinking, the students can apply models in the area of policy formation.

To achieve this, it is expected that our students would be entering the class with some basic knowledge of Geometry (lines, angles and slope) for graphical models and some level of mathematical algebra for algebraic equation models. It is on the basis of this foundation knowledge that the microeconomics model would be developed and used.

3.1 Research Design

In order to add to the literatures on the effectiveness of teaching and learning, this work empirically examined the effectiveness of intensive and dominant application of microeconomic graphic and mathematical models in teaching microeconomics. For each particular lecture content, the models were presented to students in piece meal fashion. In doing this, representative experimental design was adopted. The choice of this design is because it reflects an experimental design that takes into cognizance both the real-life environment in which learning occurs and the natural characteristic of the learner. This design equally addressed the issue of artificiality and lack of generalizability of systematic designs.

3.2 Research Technique

Two similar topics, in content and approach, in microeconomics were selected and taught to the same set of students in each experimental slot at different times. The students are allowed to remain in their classroom environment. They are kept unaware of the experiment in order to avoid Hawthorne effects. Twenty-five students of Economics in year II having done a course in mathematical economics in year I, were involved in this study. This work adopts a sign test statistical procedure.

The sign test is a non-parametric statistical procedure for determining whether there are differences in the central tendency of two dependent groups (paired samples). That is, it is a statistical method to test for consistent differences between pairs of observation, and it is also a non-parametric or distribution free test, which means that the test doesn't assume that the data comes from a particular distribution, like normal distribution (Srivastava, Shenoy, & Sharma, (1983)). The test is an alternative to a one sample t test or a pair t- test. It can also be used for ordered (ranked categorical) data.

Because, normal distribution is not a prerequisite, the sign test can be used in cases where the normal distribution prerequisites of interval scaled dependent variable is excessively violated, and also where an attempt in carrying out a t-test for paired samples is not possible.

The sign test determines test significance by means of the binomial test, which determines whether the frequency distribution of one variable matches that of an assumed distribution. It uses the number of positive differences in the paired samples as the test statistic. The one sample sign test works by calculating the difference between the two means and dividing by the standard deviation. A two tail Z-score approximation of a binomial distribution is applied in this study, since $N \geq 25$ (Anderson. Sweeney, & Williams, (1996)). If the absolute value of Z- score is greater than 1.96, then the null hypothesis is rejected at $p < 0.5$

3.3 Source of Data; The data for this work is primarily sourced from classroom activities.

3.3.1 Source of data for Analysis and Test of Hypothesis 1

The two similar topics referred to in section 3.2 were selected, and they are thus presented;
$U_{max} = U(X,Y)$ subject to $M = XP_X + YP_Y$ ……. ……...(1)
(Consumption & utility maximization model for households)
$Q_{max} = Q(K,L)$ subject to C = $Kr + Lw$ ……. (2)
(Production & Output maximization model for households)
Where U= Utility function, P_X = price of commodity X P_Y = price of commodity Y
Q= Production function, K= capital, L= Labour, r = rental price of capital and w = wage

These two equations have similar graphic models, in the frameworks of indifference and isoquant curves analysis respectively, though they relate to different microeconomic agents. These topics were taught as a-2 credit unit course for 3 weeks, using predominantly graphic and mathematical (G&M) model for equation (1) but using lecture methods (L), supplemented at interval with Lecturer's explanations, for equation (2). At the end of this first phase of experiment, the teaching methodology was swapped between the two topics, for the same lecture periods as in the first phase.

The implication of this, is that at the end of six weeks, the students had been exposed to the two teaching methods. Having done this, they were asked to indicate their preferences for the two approaches in terms of the speed and clarity of understanding by assigning to them numbers ranging from 1 to 4, the higher numbers indicating better results. The data collected from this experiment are displayed in table 1 for the test of hypothesis 1

3. 3.2 Source of data for Analysis and Test of Hypothesis 2

Four questions coined around microeconomic policy initiatives and their implications were presented to the students from equation 1. They were required to use graphic/mathematical illustrations to present their solutions in a limited time frame. Correct and incorrect responses were generated from each student. The responses from the items were marked as correct or incorrect responses, denoted as (Correct (X), Incorrect (Y)). For instance, if a student got the 4 questions correct, it means 4 correct responses and zero (0) incorrect response, denoted as (4,0). Other expected response distributions can be stated as; (3,1), (2,2), (1,3), and (4,0), all interpreted in the same manner as above. The differences between each student's response (X-Y), provided the positive and negative sign for sign test of Hypothesis 2. For example, (4,0) implies (4-0) = +4, (2, 2) = (2-2) = 0, and (1,3) =1-3 = - 2
The data from students' responses are hereby displayed for analysis and sign test of hypothesis 2 in table 4

4 Presentation of Results. This section is concerned with data presentation and analysis of results. Tables I to 3 deals with data presentation and data analysis for the test of hypothesis 1, whereas tables 4 to 6 presents the statistics relating to hypothesis 2. From the literature and for the sample size of n > 20, the sampling distribution for the plus signs can be approximated by a normal probability distribution (Anderson, Sweeney, & Williams, 1996). This is what is applied in the analysis of results and the test of hypothesis 1 and 2

4.1 Data Presentation and Data Analysis for hypothesis 1

Data presented in tables 1,2, and 3 are for the analysis and test of hypothesis 1

Table 1**;** Ranking of Preferences between the two-teaching methods G&M and L

Student	(G&M) Score	L Score	(G&M) -L
1	4	1	+3
2	2	2	0
3	3	2	+1
4	1	2	-1
5	3	2	+1
6	3	1	+2
7	4	2	+2
8	3	3	0
9	3	2	+1
10	4	2	+2
11	3	2	+1
12	3	4	+1
13	2	1	+1
14	3	2	+1
15	1	3	-2
16	4	1	+3
17	2	1	+1
18	2	4	-2
19	4	1	+3
20	2	2	0
21	4	3	+1
22	2	3	-2
23	3	2	+1
24	4	2	+2
25	2	1	+1

Note: G&M = The use of predominantly graphic and mathematical model

L = Dominant use of lecture method

(G&M) - L = Sign difference of the rating of the two approaches

Table 2: Sign Data Distribution

No of ve^+ Sign	No of ve- Sign	No of zero	N	n
17	5	3	25	22

Note: N = Total number of observations

n = N less the number of zeros,

Table 3: Analysis of Result and Sign Test of Hypothesis 1

ρ	$\mu = np$	$\sigma = \sqrt{\frac{pq}{n}}$	$\hat{p} = \frac{NO\ OF\ ve^+}{n}$	$Z^t_{\alpha/2}$	$Z^C_{\alpha/2}$	Decision
0.5	11	0.107	0.772	$= 1.96$	2.54	Reject H_O

$\boldsymbol{\alpha}$ **= 0.05**

4.2 Data presentation and data analysis for Hypothesis 2

Data presented in tables 4,5, and 6 are for the analysis and test of hypothesis 2

Table 4 ; Scores for Analytical and Critical Thinking

Student	Correct Response X	Incorrect Response Y	The difference X-Y
1	3	1	+2
2	4	0	+4
3	3	1	+2
4	0	4	-4
5	3	1	+2
6	2	2	0
7	4	0	+4
8	2	2	0
9	1	3	-2
10	4	0	+4
11	3	1	+2
12	0	4	-4
13	4	0	+4
14	3	1	+2
15	1	3	-2
16	4	0	+4
17	3	1	+2
18	2	2	0
19	3	1	+2
20	4	0	=4
21	3	1	+2
22	0	4	-4
23	1	3	-2
24	4	0	+4
25	3	1	+2

Table 5: Sign Data Distribution

No of ve$^+$ Sign	No of ve- Sign	No of zero	N	N
16	5	4	25	21

Note: N = Total number of observations
n= N less the number of zeros

Table 6: Analysis of Result and Sign Test of Hypothesis 1

ρ	$\mu = np$	$\sigma = \sqrt{\frac{pq}{n}}$	$\hat{p} = \frac{NO\ OF\ ve^+}{n}$	$Z^t_{\alpha/2}$	$Z^C_{\alpha/2}$	Decision
0.5	11.5	0.109	0.762	$= 1.96$	2.40	Reject H_O

$\boldsymbol{\alpha}$ **= 0.05**

Note: ρ = 0.5 and q = 1- 0.5

5 Interpretation of Result and Conclusion1)

Hypothesis 1 states that here is no significant difference in the students' perceived learning ability when mathematical and graphic models are applied in the teaching of microeconomic lessons as opposed to predominant Lecture method

Let ρ represent the population of students who showed preference for G&M approach of lesson delivery on the Consumer's and firm's maximizing behavior, this study seeks to test thus stated;

H_O: ρ = 0 .5

H_O: $\rho \neq 0$ .5 Given that $Z^c_{\alpha/2}(2.54) > Z^t_{\alpha/2}(1.96)$, the null hypothesis was rejected at 0.05 level of significance. This suggests that there is significant difference in the student's perception of their learning abilities when mathematical and graphic models are predominantly used in the teaching of microeconomics lessons as opposed to the presentation of learning materials in a lecture format. Mathematical model presents a volume of theoretical learning material in the most concise manner, hence making learning relatively easy to grapes and retained. Graphic models apart from having the same features as mathematical models, they do have an additional advantage of appealing, at the same time, to the various sense organs of the learner. Because of these obvious effects on learning environment, expectedly, learning outcomes were greatly improved and speedily internalized. This, of course, gives credence to the place teaching aids in effective lesson delivery and when built and transmitted electronically, it facilitates teaching and learning processes and saves teaching time for the desired outcome.

Interpretation of Result and Hypothesis Testing 2

Hypothesis 2 states that there is no significant difference in the students' mode of thinking concerning the implications of microeconomic policy initiatives of the government on the micro-economy

Let ρ represent the population of students who were able to graphically illustrate and label correctly the implications of tax policy on the consumer's maximizing behavior. The null and alternative hypotheses are thus stated;

H_O: ρ = 0 .5

H_O: $\rho \neq 0$ .5

Given that $Z^c_{\alpha/2}(2.40) > Z^t_{\alpha/2}(1.96)$, the null hypothesis was rejected at 0.05 level of significance. This suggests that the students were able critically think through, and evaluate government microeconomic policy action and communicate the same in a more compact and precise manner. This work has demonstrated this, by rejecting the null hypothesis as stated above. This, of course, is beside the advantage of visual impression it commands, and more in particular, when microeconomic question is presented in a geometric format. However, this work does not claim ignorance of dimensional limitations of graphical approach in presenting microeconomic questions. But rather it is meant to show the evidence that students can critically think,

analyze and reflect on the implications of introducing a shock on a microeconomic equilibrium state in a two dimensional space.

5 Summary, Conclusion, and Recommendation

Tetfunds has provided a lot of physical infrastructure for the smooth operations of educational enterprise in Nigeria. One other aspect that is left is for Colleges and Departments, to achieve the desired educational outcome which is domiciled in the lecturers and their teaching methodologies. This is of particular interest and with due regards to the teaching of microeconomics, whose dominant technique of lesson delivery is lecturing. This research work is to provide an alternative teaching style whose main feature is the application of mathematical and graphic models in the teaching of microeconomics to students in Tertiary Institutions in Nigeria. It is meant to supplant oral teaching and provoke various sense organs of students for assimilation of knowledge and at the same time, helping them to develop critical and reflective mindset. In doing this, two null hypotheses and their alternatives were developed and tested at 0.05 level of significance using sign test research methodology. The two null hypotheses were as follows;

1) There is no significant difference in the students' perceived learning ability when mathematical and graphic models are applied in the teaching of microeconomic lessons in consideration to the predominant lecture method.

2) There is no significant difference in the students' mode of thinking as it relates to the introduction of microeconomic policy initiatives of the government and its implication.

Both of these hypotheses were rejected at 0.05 level of significance. The results of these research findings suggest that;

i) that there is significant difference in the student's perception of their learning abilities when mathematical and graphic models are predominantly used in the teaching of microeconomics lessons as opposed to the presentation of learning materials in a lecture format

ii) the students were able to critically give thought and evaluate government microeconomic policy action and communicate the same in a more compact and precise manner.

The import or cachet of this work was that, besides the fact that
mathematical and graphic models present a volume of theoretical learning materials in the most precise and concise manner, hence making learning relatively easy. It equally had shown evidence that students can critically think, analyze and reflect on the implications of introducing a microeconomic policy shock on the equilibrium state. While this work limits it scope on consumer and firm's maximizing behavior, its implications can be extended to other microeconomic topics. By and large, the conclusions drawn from this work emphasized the importance of teaching aids in microeconomic lesson delivery.

This work is not unmindful of an expected argument and criticism that may be bothering on the cost involvements of procuring the materials and the maturity of the students involved at this stage of learning, requiring of course, an advanced and high order teaching pattern.

Given the above findings, this research work offers these recommendations;

1 Desperate effort should be made in helping to improve mathematical ability of students more especially at the early stage of their study programme. More emphasis should be placed on the geometry of curves, lines, angles, and slopes. Others are issues relating to various types of functions and the signs of each parameter. This should not be taken for granted as elementary topics studied at the lower levels of the students' academic career.

2 Mathematics credit units in NCE and First degree programmes should be increased to lay solid foundation for the study of microeconomics in nation's tertiary institutions.

3 Lecturers on their part, and as matter of urgency should reconsider an intensive use of graphic and Mathematical models in the delivery of lessons on microeconomics, except in cases where such application is not possible.

4 Department of Economics in conjunction with lecturers in the department should invest in the development and procurement micromodels for the teaching of microeconomics in nation's Colleges and Universities.

This research work provides an alternative strategy by developing simple graphic and algebraic equation models from the basics for easy comprehension, and retention of microeconomic concepts thereby enhancing teaching effectiveness.

References

Anderson, D. R,. Sweeney, D. J., & Williams, T.A (1996).Statistics for Business and Economics. New York, West Publishing Company.

Apel, H.J, (2003), Predavanje, uvod u akademeki oblik poucavanja, Zagreb: Erudita A.

Awh, R.. Y, (1976). Microeconomics, Theory and application. John Wiley & Son, Inc. New York

Barnett Liz,(2009) , Kay Aspects of teaching and learning in Economics, in Fry, Ketteridge, and Marchal, (eds). A Handbook for Teaching in Higher Education, Enhancing Academic practice 3rd ed. New York and London; Routledge,.

Barnett Liz, Key aspects of teaching and learning in Heather, F. Steve, K and Stephanie M (2009), A Handbook for Teaching and Learning in Higher Education. Enhancing Academic Practice (3rd Edition) New York; Routledge,

Bonwell, C.C & Eison J. A, (1991). Active learning, Creating excitement in the classroom. (ASHE – ERIC) Higher Education Rep 1) Washington DC: The George Washinton University School of Education and Human Development.

Boyer, E (1990). Scholarship Reconsidered; the Carnegie Foundation for Advancement of Teaching , New York,

Case, K .E; Fair, R. C ;& Oster S M; (2009), Principles of Economics. Practice Hall Pearson Education International; Canada

Gruthrie, J. T, & Cox, K (2001). Classroom Condition for motivation and Engagement in reading. Educational Psychology , Review 13 (3), 283-302

Economic Network (2005); Relation Between Teaching, Research and Technology in Economics HE: result of the 2005 Economic Network Survey of Lecturers. Available online at http://www.economicsnetwork.ac.uk/project/lec.survey2005pdf

Economic Network, (2006). National Economic student survey (2006) Report: Available online at <http://ww.economicsnetwork.ac.uk/project/stud_survey2006 pdf.

McGlynn, A.P; (2005). Teaching Millennials Our Newest Culture cohort. Educational Digest 12-16.

Michel, N; Cater III, J.T; & Varela O. (2009). Active Versus Passive Teaching Styles: An Empirical study of Student Outcome, Human Resource development Quarterly, 20(4), 297-418

Mocinic , S .N (2012). Active Teaching Strategies in Higher Education , Metodicki Obzori 15(7),Department of Educational Science Juraji Dobrila University , Pula Croatia

Peck, A.C; Ali, R.S; Matchock, R.L; & Levine, M. E; (2006). Introductory Psychology Topics and Student Performance where's the challenge? Teaching of Psychology, 33(3), 167 – 170.

Pindyck, R.S; & Rubinfeld, D. L. (2009). Microeconomics. London; Pearson Education Ltd.

Prince M; (2004). Does Active Learning Work? A Review of Research Journal of Engineering Education, 29(3), 223 – 231.

Stewart-Wingfield, S, & Black G. S (2005). Active versus passive cause designs. The Impact on Student's outcome. Journal of Education for Business, 81 (119-125)

Srivastava, U. K.,Shenoy, G.V., & Sharma, S.C., (1983). Quantitative Technique for Managerial Decision, 3rd Edition;New Delhi, New Age International Publisher.

Sukirno, S (2010). Microeconomics Introduction Theory, Jakarta: Rajawali .

Terhart E; (2001); Metode, Poucavanja I ucenje, Zegrab: Educa.

Tomcho , J . D; and Feel, R . (2008). A Meta- Analytic Integrated of Lesson Outcome, Teaching Psychology

Turner, P (2006), Teaching Undergraduates Macroeconomics with the Taylor- Romer Model; International Review of Economics Education 5(1): 73-82, Available online at http://www.economicnetwork.ac.uk/iree/v5nl/turner.pdf(accessed 14 Jan 2008.

Whetten, D. A; & Clerk, SC; (1996). An Integrated Model for Teaching Management Management skill, Journal of Management Education 20 (152 – 181)

Yoder ,J . D; and Hochevar, C.M; (2005). Encouraging Active Learning can Improve Student's performance on Examination, Teaching Psychology , 32(2). 91-95p

Zanchin , M.R (2020) Le Strategie attive UAAVV, Le Interazioni Educative, Rome Armande