Investigating Mathematics Teachers' Awareness in the Use of Modeling in Mathematics Education

[1]IJI, C. O. Ph.D, [2]ABAKPA, B. O. Ph.D, [3]AGBO-EGWU, A. O. Ph.D,& [4]FEKUMO, B.

[1,2,3]Department of Science Education, University of Agriculture, Makurdi.

[4]Senior Secondary School, Bulou-Orua, Bayelsa State.

Correspondence email: ijiclements07@yahoo.com

DOI: 10.29322/IJSRP.8.9.2018.p8112
http://dx.doi.org/10.29322/IJSRP.8.9.2018.p8112

Abstract: *This study investigated the use of modeling by mathematics teachers in their teaching of mathematics. In the specific objectives, it sought the mathematics teachers' awareness in the use of modeling in mathematics education as well as the level of utilization. The study was conducted in Kolokuma/Opokuma local government area of Bayelsa state in Nigeria. It adopted a survey research design with a population of 47 mathematics teachers in ten secondary schools. A sample of 20 out of this population was used. To arrive at this, purposive sampling technique was used. Instrument for data collection was Modeling Awareness Inventory (MAI) which was validated by experts. The instrument was trial tested using Cronbach Alpha formula and had a reliability coefficient of 0.86. Descriptive statistic was used to answer all the research questions asked. It was found among others that Majority of the mathematics teachers in Kolokuma/Opokuma local government area are not aware of modeling in mathematics education. Suggestions on how to improve their awareness were also made.*

Keywords: Teachers Awareness, Modeling, Mathematics Education.

Background of the Study

The instability of our economy due to much dependence on oil as the major source of income has been of great concern. That is why Nigeria today, in diversifying the economy emphasizes on developing her agricultural sector. The idea that agriculture could serve as viable and suitable source of income for the stabilization of our devastating economy is not out of place. To sustain these for meaningful development, mathematics education is a prerequisite.

Mathematics is an indispensable tool which has its contributions virtually in all spheres of life including agriculture. The importance of mathematics is known to be an essential discipline recognized globally, hence, agriculture cannot be practiced without mathematics. This is obvious because mathematics plays a vital role towards the development of agriculture, such as ascertaining the volume of crop that needed to be produced, based on the output and demand of the previous year. Also, knowing the quantity of chemical that is needed to induce the hatching of the eggs to fingerlings and the capacity of the fingerling that each pond should contain, all depends on mathematical knowledge. In addition, mathematical skills assist the evaluation of investment in trucks and storage thanks.

It is necessary to develop in learners the knowledge, reasoning capacity and problem solving skills required for such development. Today's world expects mathematics teachers to raise individuals who are able to create effective solutions in cases of

real problems and use mathematics effectively in their daily lives. Hence it is obvious that mathematical development of the learner has a great consequence for the agricultural development of the nation.

In spite of the importance of mathematics, it is very disappointing to note that students' achievement in the subject has remained consistently low (Uche, 2011). Students' lack of understanding of concepts in mathematics inevitably results in poor performance at external examinations and backwardness in technological and agricultural advances in our nation. This according to Jonah-Eteli (2007) and Ogunkunle (2007) is as a result of poor teaching approach and lack of awareness by mathematics teachers of recommendation from researches and professional organizations in mathematics education. There is no doubt that teachers play a major role in creating the environment in which students can best learn mathematics. Besides the mathematics teachers' content knowledge, his/her pedagogical approach is very essential.

One of the best ways to make mathematics concrete is to teach the lessons through relating or integrating. Students achieve a better understanding of mathematics in this way (Holmes, 2006).

Martin (1984) in Iji (2010) proposes for a general reorientation of mathematics education aiming at a mathematics that will be a useful tool for the majority of the students. Specifically, he stated that mathematics should be taught in such a way that it will perform the role of solving multidisciplinary problem of the students. This he said should be done through modeling methods that will restore students' interest and show mathematics as being useful.

Mathematical modeling is the transformation of any problem situation into a mathematical model. Most mathematicians, scientists, and engineers would agree that modeling involves using mathematics to distill key elements of real-world phenomena in order to articulate the relationships among these elements (Spandaw, 2011). To Heck (2010), mathematical modeling-based teaching activities make contribution to students' meaningful learning of both sciences and mathematics topics.

Thus, owing to the important contributions to education and training, mathematical modeling practices are applied and used in the establishment of daily life (Perry and Todder, 2009; Saglam-Arslan and Arslan, 2010). Literature indicate that mathematical modeling practices enhance conceptual developments of individuals, their interdisciplinary relating capabilities (Munier and Merle, 2009), development of their modeling abilities and their use of their mathematical knowledge (Blomhoj, 2007; Blomhoj and Kjeldsen, 2007). Their social skills, their inter-disciplinary skills, conceptual structures in mathematics and in the related disciplinary, their skills for coping with situations encountered in their daily life, as well as their team work and problem solving skills (Klymchuk *et. al*., 2008).

Moreover, mathematical modeling has been explicitly included in national curriculum standards in various countries. For example, in the United States, real-world applications and modeling are recurring features throughout the Common Core State Standards for Mathematics (CCSSM; National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010).

One may be wondering how mathematical modeling differs from what one already teach, particularly, "problem solving". Problem solving may not refer to the outside world at all. Even when it does, problem solving usually begins with the idealized real-world situation in mathematical terms, and ends with a mathematical result. Mathematical modeling, on the other hand, begins in the "unedited" real world, requires problem formulating before problem solving, and once the problem is solved, moves back into the real

world where the results are considered in their original context. However, despite the increased interest in mathematical modeling, a large number of questions remain unanswered (Lesh & Fennewald, 2013).

Mathematical modeling is today considered a 21st century skill (English & Sriraman, 2010). Enabling students to explore relations between mathematics and the real world is an explicit goal in many mathematics curricula (Common Core State Standards Initiative, 2012). Considerable research has been devoted to explore how mathematics teachers from different grade levels solve modeling problems (Blum & Borromeo Ferri, 2009) and to describe their beliefs and conceptions of the role of modeling activities in the classroom (Kaiser and Maass, 2007). However, little is known about teachers' awareness about mathematical modeling. Thus the study is to investigate mathematics teachers' awareness in the use of modeling in mathematics education.

Objective of the Study

The main purpose of this study was to find out the extent to which mathematics teachers are aware of the use of modeling in mathematics education. Specifically, the study sought to:

1. Determine the awareness of modeling in mathematics education by mathematics teachers.
2. Determine the utilization of modeling in mathematics education by mathematics teachers.

Research Questions

The following research questions guided the study.

1. To what extent the mathematics teacher is aware of modeling in mathematics education?
2. To what extent do mathematics teachers use modeling in their teaching?

METHODOLOGY

Research Design

The study adopted descriptive survey design. Survey design was used because the population is large such that the study was limited to a sample size. Moreover, it sought and elicited opinion of the subjects on the issue under discussion.

Area of the Study

This study was carried out in Kolokuma/Opokuma Local Government Area of Bayelsa State in Nigeria. Kolokuma/Opokuma Local Government Area is made of two clans namely Kolokuma and Opokuma, and two constituencies, constituency I and II. The Local Government Area is located in the Central Senatorial District of Bayelsa State with the headquarters at Kaiama. It has an area of 361 km². There are nine communities that made up Kolokuma Clan while Opokuma Clan has ten communities. Kolokuma/Opokuma Local Government Area was chosen based on her desire for educational growth which equally led to creation of state of emergency on her education sector in the year 2013.

Population of the Study

The target population for this study comprised the entire Secondary Schools mathematics teachers in Kolokuma/Opokuma Local Government Area of Bayelsa State. It consists of 47 mathematics teachers in the 10 secondary schools. Secondary schools were used because this is the level of school were teachers who have their bachelor degrees in mathematics education do teach the subject, also this level is comprised of both the upper basic education levels and senior secondary level of education.

Sample and Sampling Techniques

The sample size was 20 mathematics teachers in the ten Secondary Schools in the two constituencies (I and II) in the Local Government Area with two mathematics teachers in each of the schools. The sample consists of one upper basic mathematics teacher and one secondary school mathematics teacher. To obtain this sample, purposive sampling technique was used. The mathematics teachers were purposively chosen for the study.

Instruments for Data Collection

A Modeling Awareness Inventory (MAI) containing ten (10) items was developed by the researcher and used for the study. The MAI is a questionnaire of two sections which solicits for information on mathematics teachers' awareness in the use of modeling in mathematics education, and the utilization of modeling in mathematics education by teachers. The MAI is on a four-point scale (Strongly Agreed, Agreed, Disagreed and Strongly Disagreed).

Validation of the Instrument

A Modeling Awareness Inventory (MAI) containing twenty (20) items was given to two experts in mathematics education and two experts in measurement and evaluation to ascertain the face validity. They assessed individual items on agreement with answer, clarity of the item, and suitability phrasing to enable subjects respond adequately to the questions. Repetitive items were removed by the experts. After removing unsuitable items, the corrections were used to produce the final instruments of 10 items.

Reliability of the Instrument

A trial test was done with 10 Secondary School mathematics teachers outside the study area and a reliability coefficient of 0.86 using Cronbach Alpha formula was obtained.

Method of Data Collection

The instrument was administered to the respondents and collected after an hour by the researcher. Thereafter, the instrument was subjected into data analysis.

Method of Data Analysis

Data was analyzed using descriptive statistics of mean and standard deviation. An overall mean of 2.5 and above was considered to have had awareness as well as utilized modeling in their classes, while below 2.5 is considered to have had no awareness and have not being using modeling in their classes.

Result

Research Question 1

To what extent the mathematics teachers are aware of modeling in mathematics education?

Answer to this research question is presented in table 1.

Table 1: Means and Standard Deviations of Extent Mathematics Teachers are Aware of Modeling in Mathematics Education.

s/n	Items	Means	Standard Deviations	Remark
1	Modeling can be used to promote students interest in mathematics	2.45	0.51	Disagree
2	Modeling can be used to provide students with the opportunity to have a deeper understanding of concepts in mathematics	2.30	0.66	Disagree
3	Modeling can be used to enhance learning	2.35	1.08	Disagree
4	Modeling can be used to help learners communicate among their peers	2.20	0.95	Disagree
5	Modeling reduces boring nature of classes	1.95	0.99	Disagree

Table 1 showed that all the items have means ranging from 1.95 to 2.45 with corresponding standard deviations of 0.51 to 1.08. The analysis showed that mathematics teachers are not aware of modeling in mathematics education.

Research Question 2

To what extent do mathematics teachers use modeling in their teaching?

Answer to this research question is presented in table 2.

Table 2: Means and Standard Deviations of Extent Mathematics Teachers Use Modeling in Their Teaching.

s/n	Items	Means	Standard Deviations	Remark
1	Use models to make students learn mathematics	2.47	0.51	Disagree
2	Use models to make students recall mathematics definitions	2.26	0.65	Disagree
3	I have being using modeling in teaching mathematics	2.16	1.17	Disagree
4	I am competent in using modeling in teaching	2.00	0.88	Disagree
5	I use modeling models in class as a teaching material	2.05	1.13	Disagree

Table 2 showed that all the items have means ranging from 2.00 to 2.47 with corresponding standard deviations of 0.51 to 1.17. The analysis showed that almost mathematics teachers have not used modeling in their classes.

Summary of the Findings

Based on the analyses of data from the study, the following findings were made:

1. Majority of the mathematics teachers in Kolokuma/Opokuma local government area are not aware of modeling in mathematics education.
2. Most of the teachers have not used modeling in their classes.

Discussion

The finding that mathematics teachers are not aware of modeling in mathematics education in not an encouraging one. The last finding that the mathematics teachers do not use modeling in their classes is therefore obvious. This implies that their attentions were not drawn to research recommendations on this subject matter. In other words, supervisory bodies do not show concern on issues that have to do with students learning.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Institutions that train mathematics teachers should emphasize the use of modeling in teaching mathematics in classes.
2. Schools should ensure that mathematics teachers employ modeling in their classes which could promote effective learning.

Conclusion

Considering the fact that modeling enhances effective learning in mathematics education, this study has shown that mathematics teachers need to be encouraged to incorporate modeling in the subject. Teachers in the study area are not aware of modeling in mathematics and have not adopted it in the teaching, therefore, it is stressed that teaching should be done such that learners are able to incorporate concepts learnt into their daily lives.

Reference

Blomhoj, M. (2007). Developing Mathematical Modeling Competency through Problem Based Project Work - Experiences from Roskilde University, Ninth International History, Philosophy & Science Teaching Conference, Retrieved from http://www.ucalgary.ca/ihpst07/proceedings/IHPST07%20Blomboj.pdf

Blomhoj, M. and Kjeldsen, T. (2007). Learning the Integral Concept through Mathematical Modeling. In: Pitta-Pantazi, D and Philippou, G. (Eds): CERME 5-*Proceedings of the Fourth Congress of the European Society for Research in Mathematics Education* pp. 2070-2079.

Blum, W. and Borromeo-Ferri, R. (2009). Mathematical Modeling: Can it be Taught and Learnt? *Journal of Mathematical Modeling and Application*, *1*(1): 45-58.

Common Core Standards Writing Team. (2013). Progressions for the Common Core Standards in Mathematics (draft) High School, Modeling. University of Arizona.

English, L. and Sriraman, B. (2010). Problem Solving for the 21st Century. In Sriraman, B. and English, L. (Eds.), *Theories of mathematics education: Seeking new frontiers*, New York, NY: Springer, pp. 263-285.

Heck, A. (2010). Modeling in Cross-Disciplinary Authentic Student Research Projects, *International Journal of Technology and Mathematics Education*, 17(3): 15-120.

Holmes, M. H. (2006). Integrating the Learning of Mathematics and Science Using Interactive Teaching and Learning Strategies, *Journal Science Education. Technology* 15(3): 247-256.

Iji, C. O. (2010). Mathematics the Language of the New Millennium: Implication for Mathematics Teaching in Nigeria Primary Schools. *Benue Journal of Research in Science and Education* 1(2&3), 68-75

Jonah-Eteli, W. A. (2007). Teaching for Meaning, Concepts and Generalization Against, Teaching for examples, Methods and Formulae, Views of Mathematics Teachers in Bayelsa State. *Paper Presented at 44 Annual Conference of the Mathematics Association of Nigeria*. ASABA

Kaiser, G. and Maass, K. (2007). Modeling in Lower Secondary Mathematics Classroom – Problems and Opportunities. In Blum, W., Galbraith, P., Henn, H, W. and Niss, M. (Eds.) (2007), *Modeling and Applications in Mathematics Education. The 14th ICMI Study*. New York, NY: Springer pp 99-108.

Klymchuk, S., Zverkova, T., Gruenwald, N. and Sauerbier, G. (2008). Increasing Engineering Students' Awareness to Environment through Innovative Teaching of Mathematical Modeling, *Teaching Mathematics and Its Applications*, 27(3):123-130.

Lesh, R., and Fennewald, T. (2013). Introduction to Part I Modeling: What is it? Why do it? In Lesh, R., Galbraith, P. L., Haines, C. R. and Hurford, A. (Eds.), *Modeling students' mathematical modeling competencie*, NY: Springer, pp. 5-10.

Munier, V. and Merle, H. (2009). Interdisciplinary Mathematics–Physics Approaches to Teaching the Concept of Angle in Elementary School, *International Journal of Science Education*, 31(14):1857-1895.

National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common Core State Standards for Mathematics*. Retrieved from http://www.corestandards.org/math.

Niss, M. (2012). Models and Modeling in Mathematics Education. *Mathematics Education*, EMS Newsletter December, 2012.

Ogunkunle, R. A. (2007). Effects of Gender on the Mathematics Achievement of Students Non-Constructivist Groups in Secondary Schools. ABACUS, *The Journal of the Mathematics Association of Nigeria* 32(1), 41-50

Perry, Z. H. and Todder, D. (2009). Change in Senior Medical Students' Attitudes towards the use of Mathematical Modeling as a means to Improve Research Skills, *Teaching Mathematics and its Applications* 28(2): 88-100.

Saglam-Arslan, A. and Arslan, S. (2010). Mathematical Models in Physics: A study with prospective physics teacher, Scientific Research Essays 5(7): 634-640.

Spandaw, J. (2011). Practical Knowledge of Research Mathematicians, Scientists, and Engineers about the Teaching of Modeling. In G. Kaiser, W. Blum, R. Borromeo Ferri, & G. Stillman (Eds.), *Trends in Teaching and Learning of Mathematical Modeling*, Dordrecht, The Netherlands: Springer, Vol. 1, pp 679-688.

Uche, S. A. (2011). The Multiple Intelligences Teaching Method and Mathematics Teaching. *Journal of Research in National Development* 9(1): 116-123