

# **INVESTIGATING SCIENCE TEACHERS' UTILIZATION OF RESEARCH FINDINGS AND INNOVATIONS IN TEACHING BASIC SCIENCE AND TECHNOLOGY USING VERHULST LOGISTIC MODEL**

**CHIMA UGO**

*Department of Computer Science,  
Alvan Ikoku Federal College of Education, Owerri,  
Imo State.*

**IJEOMA ODOEMENE**

*Department of Computer Science,  
Alvan Ikoku Federal College of Education, Owerri,  
Imo State.*

**And**

**CHINEDU OBASI**

*Department of Mathematics,  
Alvan Ikoku Federal College of Education, Owerri,  
Imo State.*

## **Abstract**

*This paper investigated science teachers' utilization of research findings and innovations in teaching basic science and technology using Verhulst logistic model. A cross-section of teachers numbering 106 were continuously observed and surveyed to decipher their utilization of research findings and innovations in classroom teaching. The result indicates that the model is good for the prediction of teachers' utilization and shows that science teachers rarely have access to research findings and innovations and therefore utilize them to a very low extent. It is important to note that though science teachers believe that utilizing research findings and innovations in classroom teaching is worthwhile, they were not utilized for the teaching of basic science and technology. It was recommended that schools should encourage science and technology teachers by sponsoring them to conferences and workshops so as to expose them to the latest research findings and innovations in their fields.*

**Keywords:** Science, Technology, Research, Innovation, Teachers, Verhulst logistic model

Science and technology are the foundation of economic and industrial development of the world. The effect of science and technology on industrial revolution cannot be overemphasized. In fact, countries of the world are classified as developed and developing nations based on their scientific and technological development (Ukah, 2015). For such development to take place, the education sector of the nation should not be downplayed. This is because education has remained an instrument of change and national development (Danmole in Ukah, 2015). It is in this scenario that the Federal Government of Nigeria introduces the Universal Basic Education (UBE) as a reform programme to serve as a catalyst for achieving free, compulsory and universal 9-year education for every child of school age in Nigeria (Danmole in Ukah, 2015).

Following the decision of Federal Government to introduced the 9-year Basic Education programme and the need to attain the Millennium Development Goals (MDGs), and by extension the need to implement the National Economic and Empowerment Development Strategy (NEEDS), it becomes imperative that the existing curricula for primary and junior secondary schools should be reviewed, re-structured and re-aligned to fit into a 9-year Basic Education programme. The National Educational Research and Development Council (NERDC) carried out this assignment as directed by National Council on Education (NCE) and NCE also approved a new curriculum structure namely: Lower Basic Education Curriculum (Primaries 4-6) and Upper Basic Education Curriculum (JSS 1-3) with subject listings that include Basic Science and Technology (Ibrahim & Muhammad, 2015).

The overall objectives of the new Basic Science and Technology (BST) curriculum as outlined by Adeniyi (2007) are to enable the learners to: develop interest in science and technology; acquire basic knowledge and skills in science and technology; apply their scientific and technological knowledge and skills to meet societal needs; take advantage of the numerous career opportunities offered by science and technology; and become prepared to further studies in science and technology. According to Ukah (2015), in order to achieve a holistic presentation of science and technology contents of learning, the thematic approach to contents organization was adopted. Thus, four themes were used to cover knowledge, skills and attitudinal requirements. These are you and environment; living and non-living things; you and technology; and you and energy.

According to Obioma in Ukah (2015), the 9-year basic education curriculum for BST reflects depth, appropriateness and inter-relatedness of the curricula contents. He suggested that since the curriculum represents the total experiences to which all learners must be exposed, the contents, performance objectives, activities for both teachers and learners and evaluation guides were provided. The prescriptions represent the minimum content to be taught in the schools to achieve the objectives of 9-year basic education. However, science teachers are encouraged to enrich the contents with research findings and innovations by utilizing them in classroom teaching. This is because effective teaching involves the application of new research findings in a classroom environment (Obasi, 2015). He noted that practical application of educational research outcomes

improves both pedagogical practices and student learning. Stafford cited in Obasi (2015) reported that his classroom delivery is much more effective since he began to integrate new approaches and ideas from recent educational research.

Research is the systematic investigation and study of materials and sources to establish facts and reach new conclusions, so it shapes people's understanding of the world around them. In the broadest sense of the word, the definition of research includes any gathering of data, information and facts for the advancement of knowledge (Shuttleworth, 2008). Educational research is an aspect of research which embraces those activities or processes which allows one to systematically test and obtain a body of information, data or knowledge about teaching and learning or conditions which affect teaching and learning (Ali in Awujo&Agbakwuru, 2013). Gay in Obasi (2015) defined it as the formal, systematic application of the scientific method to the study of educational problems. Research findings are very vital in any research endeavour. This is because through research findings, Psychologists are able to explain individual's behaviours, including how people think and their impact on the person and society, thus developing appropriate treatments to improve the individual's quality of life. In business, market research helps companies to make projections and formulate appropriate strategies to ensure survival. Research has led to the introduction of innovative teaching strategies that makes teaching to be learner-centred. The teacher being the most important determinant of what takes place in the classroom setting, seeks a perfect strategy to transmit knowledge so as to achieve a desirable result. This can only be done through research findings and innovations.

The concept of utilization of research findings and innovations in teaching has received increasing attention recently. For instance, Ado and Ugwu (2014) assessed science and mathematics teachers' utilization of activity-based approach in teaching upper basic school. Eze (2015) investigated science teachers' utilization of research findings on active-learning strategies in secondary schools. While Etiubon and Okopide (2015) investigated the utilization of research findings in science education curriculum for teachers' creative skills. These studies found that teachers have not been aware of the numerous research findings on improvement of teaching and learning practices or that they might have ignored their utilization. Perhaps, this could be one of the reasons why students' achievement in basic sciences and mathematics has been persistently poor. This is why the researchers are worried about the utilization of research findings and innovations in teaching basic science and technology, hence, the focal interest of this study. Also, this study suggests the use of observation and the Verhulst logistic mathematical model in achieving the objective of the study as against the everyday use of questionnaire analysis which characterized previous studies.

### **Verhulst Logistic Model**

This paper resorted to the mathematical model due to Pierre-Francois Verhulst. This is a model of human population whose rate of change is given as:

$$\frac{dP}{dt} = P(\alpha - \delta P)$$

where  $\alpha$  and  $\delta$  are positive constants and  $P$  is the population with time. The model above is called logistic equation, its solution is called logistic function and the graph is called the logistic curve. Logistic model has proved quite accurate in predicting growth pattern (Ugwu&Ikpegbu, 2000).

### Method of Solving Logistic Model

Separation of variables is used to solve the logistic equation of the model. Thus,

$$\frac{dP}{dt} = P(\alpha - \delta P)$$

$$\frac{dP}{P(\alpha - \delta P)} = dt \Rightarrow \int \frac{dP}{P(\alpha - \delta P)} = \int dt$$

Integrating by partial fraction, we have

$$\int \left[ \frac{1}{\alpha} \left( \frac{1}{P} \right) + \left( \frac{\delta}{\alpha} \right) \frac{1}{\alpha - \delta P} \right] dP = \int dt$$

$$\int \left( \frac{1}{\alpha} \frac{dP}{P} \right) - \int \frac{1}{\alpha} \left( \frac{-\delta}{\alpha - \delta P} \right) dP = \int dt$$

$$\frac{1}{\alpha} \ln|P| - \frac{1}{\alpha} \ln|\alpha - \delta P| = t + c_0 \Rightarrow \ln \left| \frac{P}{\alpha - \delta P} \right| = \alpha(t + c_0)$$

$$\Rightarrow \frac{P}{\alpha - \delta P} = c_1 e^{\alpha t} \text{ where } c_1 = e^{\alpha c_0} \Rightarrow P(t) = \frac{\alpha c_1 e^{\alpha t}}{1 + \delta c_1 e^{\alpha t}} = \frac{\alpha c_1}{\delta c_1 + e^{-\alpha t}}$$

If  $P(0) = P_0$ , provided  $P_0 \neq \frac{\alpha}{\delta}$ , we have that  $c_1 = \frac{P_0}{\alpha - \delta P_0}$

Substituting into the last equation and simplifying, we have the required solution as

$$P(t) = \frac{\alpha P_0}{\delta P_0 + (\alpha - \delta P_0)e^{-\alpha t}}$$

### Research Method

The study adopted a descriptive survey design where a cross-section of basic science and technology teachers in Imo State numbering 106 were continuously observed and on the fourth day of ascertaining those who are utilize research findings and innovations in the classroom to teach, eleven (11) teachers were found to have utilized research findings and innovations. The observations were carried out for some days and the data were recorded. The fourth day observation was used to predict the rest and comparison was done between the computed and observed data. All the teachers were observed by the researchers during classroom interactions using direct observational technique and personal interviews within the space of 14 days.

**Results and Analysis**

Considering the following values  $\alpha = 106k, P_0 = 1$  and  $\delta = k$ , thus from the logistic function,

$$P(t) = \frac{106k}{k + 105ke^{-106kt}} = \frac{106}{1 + 105e^{-106kt}}$$

Since  $P(4) = 11$ ,  $k$  was determine from  $\frac{106}{1+105e^{-106(4)k}} = 11 \Rightarrow k = 0.00589$

Thus,  $P(t) = \frac{106}{1+105e^{-0.624t}}$ . Now  $P(5) = \frac{106}{1+77e^{-0.624(5)}} = 19$

The other computed values and observed values of teachers who utilize research findings and innovations in teaching basic science and technology are shown in Table 1.

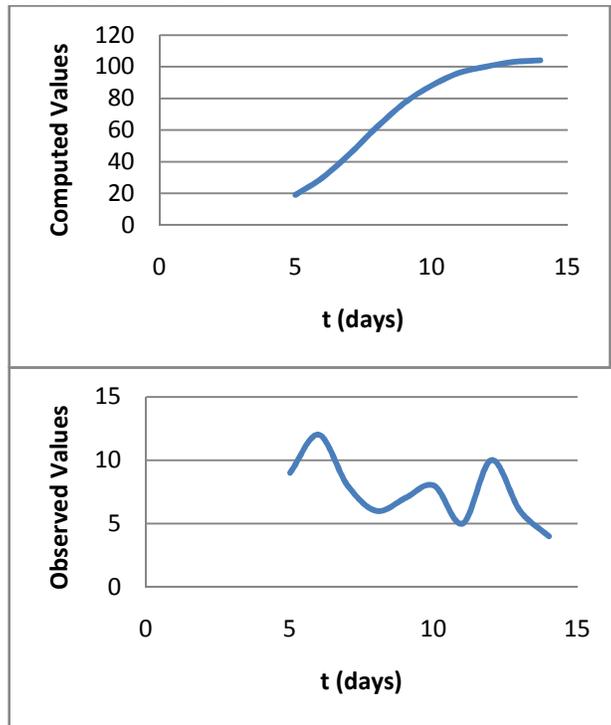
**Table 1:** Computed and Observed values

<b>t (days)</b>	<b>P (Observed)</b>	<b>P (Computed)</b>
<b>5</b>	9	19
<b>6</b>	12	30
<b>7</b>	8	45
<b>8</b>	6	62
<b>9</b>	7	77
<b>10</b>	8	88
<b>11</b>	5	96
<b>12</b>	10	100
<b>13</b>	6	103
<b>14</b>	4	104

**Source:** Researchers' Field Survey, 2016

Table 1 shows the computed and observed values of basic science and technology teachers who utilized research findings and innovations in teaching. The table suggests inconsistency in the utilization of research findings and innovations. The graphical illustrations are shown below.

**Graphical illustrations of teachers' utilization of research findings and innovations based on the data**



**Figure 1:** Graph of  $P$  (Computed and Observed Values) against time  $t$

**Discussion and Recommendation**

The results from Table 1 and the graphs in Figure 1 showed that the observed values and the computed or predicted values never correspond, indicating that basic science and technology teachers rarely have access to research findings and innovations and therefore utilize them to a very low extent. This result agrees with Ado and Ugwu (2014), and Eze (2015) who found that teachers have not been aware of the numerous research findings on improvement of teaching and learning practices or that they might have ignored their utilization. It is important to note that basic science and technology teachers believed that utilizing research findings and innovations in classroom teaching is worthwhile, they were not utilized for the teaching of basic science and technology (BST). Therefore, schools should encourage science and technology teachers by sponsoring them to conferences and workshops so as to expose them to the latest research findings and innovations in their fields.

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