Education

Application of bass model to the adoption of innovative teaching strategies

Obasi Chinedu Victor

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

Correspondence Author: Obasi Chinedu Victor

Received 6 Feb 2021; Accepted 26 Mar 2021; Published 21 Apr 2021

Abstract

The Bass model developed for adoption process for new products is applied to a teaching situation. It is tested by fitting and forecasting the adoption of innovative teaching strategies. The model predicts that fewer teachers will adopt innovative teaching strategies in classroom instruction at all time. The model can be successfully applied to adoption in teaching and learning process. It is successful in forcasting the adoption of innovative teaching strategies in Nigeria.

Keywords: teaching, innovative teaching strategies, bass model

1. Introduction

Teaching can be termed a change in behavior or the imparting of knowledge. Good teaching occurs when a person has started to perform what he is not capable of performing before. However, teaching is more than impacting knowledge, it is inspiring change. Albert Einstein would say that, it is the supreme art of the teacher to awake joy in creative expression and knowledge. This by implication goes to show that the role of a teacher cannot be over-emphasized. This is because a teacher is a compass that activates the magnates of curiosity, knowledge and wisdom in the students. Thus, for teachers to be effective in their instructional delivery, they need to use the innovative strategies as supplementary or alternative techniques to the convent methods of instructional delivery (Anaekwe, Nzelum, Olisakwe & Okpala, 2010) [1]. Innovative teaching strategies (ITS) entails structuring instructional processes in such a way that the learner is the focal point of the interaction. It is about creating a learner-centred classroom environment, where the teacher serves as a facilitator of learning. Under a condition where students are taught with inappropriate teaching strategy, they are not likely to acquire needed knowledge and skills for science, technology and engineering advancement. Ultimately, a teacher tries his best to impart knowledge as the way he understood it. So, any communication strategies that serve this purpose without destroying the objective could be considered as innovative strategies of teaching (Damodhara & Rengarajan, 2013) [3]. The use of innovative strategies in educational institution has the potential not only to improve education, but also to empower people, strengthen governance and galvanize the effort to achieve the human development goal for the country.

In spite of the importance and usefulness of innovative teaching strategies (ITS), secondary school students' achievement in many subjects is very discouraging. The poor performance trend is indeed worrisome. This is despite various efforts by government and its agencies, private organizations and other stakeholders in the education business to boost achievement of students. The effect of regular organized workshops, seminars and conferences where teachers are pulled together to be exposed to innovative instructional strategies has not shown itself in the performance of the students (Obasi, Ezekwe, Mba, & Ugo, 2016) [6]. Many researchers have blamed the poor achievement on the use of inappropriate teaching strategies which might lead to lack of interest and retention. Recent studies have discovered some innovative teaching approaches to offset the problem of poor performance of students (see Anaekwe *et al*, 2010; Obasi *et al*, 2016) [1, 6]. In all these studies, a recommendation that teachers should be encouraged to adopt these innovative teaching strategies in the teaching was made. The adoption process in this context is the steps a teacher goes through from the time he hears about innovative teaching strategies until final adoption, i.e. the decision to use an innovation regularly. The difference among individual teachers in their response to the new teaching ideas is called their innovativeness: the degree to which a teacher is relatively early or late in adopting a new teaching strategies. One of the most widely used models in the innovative adoption process is the Bass mixed influence model (Bass, 1969) [2] which has not been extended to teaching situation. Although Bass modeling research has been around longer in the field of technological forecasting (Speece & Maclachlan, 1995) [7]. So far, the Bass model has been tested mostly on high-tech and/or durable products where it has been applied to product categories. In these kinds of situations, it seems to work quite well. But it has not been tested in education situation especially in the adoption of innovative teaching strategies. In this paper, the Bass model developed for adoption process for new products is applied to a teaching situation. It is tested by fitting and forecasting the adoption of innovative teaching strategies (ITS). Here we use teachers' utilization of innovative strategies data to show that the model may have applications in education.

2. The Bass Model

In this context, the Bass model is designed to answer the question: How many teachers will eventually adopt or use the innovative teaching strategies and when? It is assumed that adoption process is binary (teachers either adopts, or waits to

adopt), constant maximum potential number of users (m), eventually, all m will use the ITS, and the impact of the word-of-mouth is independent of adoption time. Let $N(t)$ be the numbers of adopters of the ITS at time *t*. Then the Bass model in the form of differential equation is:

$$\frac{dN(t)}{dt} = \left(p + \frac{q}{m}N(t)\right)\left(m - N(t)\right) \quad (1)$$

where m, p and q are positive parameters. More exactly, if

$N(t)$ = Total number of adopters of the ITS at time *t.*

p = Likelihood that a teacher who is not yet using the ITS will start using it because of mass media or conferences, seminars, workshops etc. (awareness rate due to mass media).

q = Likelihood that a teacher who is not yet using the ITS will start using it because of word-of-mouth or other influence from those already using ITS.

m = Total number of potential users of the ITS.

Then the number of teachers who will utilize the ITS at time *t* [= $n(t)$] is equal to $\frac{dN(t)}{dt}$.

3. Solving the bass model

Considering the Bass model equation with the initial condition:

$$\begin{cases} \frac{dN(t)}{dt} = \left(p + \frac{q}{m}N(t)\right)\left(m - N(t)\right), \\ N(0) = 0 \end{cases} \quad (2)$$

Cumulative number of adopters:

$$N(t) = m\frac{1 - e^{-(p+q)t}}{1 + \frac{q}{p}e^{-(p+q)t}}, \quad t \geq 0. \quad (3)$$

Noncumulative number of adopters:

$$n(t) = \frac{dN}{dt} = m\frac{p(p+q)^2 e^{-(p+q)t}}{\left[p + qe^{-(p+q)t}\right]^2} \quad (4)$$

Time of peak adopters:

$$T^* = -\frac{1}{p+q}In\left(\frac{p}{q}\right) \quad (5)$$

Number of adopters at the peak time:

$$n(T^*) = \frac{1}{4}(p+q)^2 \quad (6)$$

4. Estimating the parameters of the bass model

The methods of estimating the parameters of models of innovation diffusion play a leading role in fitting models to empirical data and using these models for forecasting (Mahajan, 1986) [5]. Mahajan *et al*. in Kijek and Kijek (2010) [4] described four procedures used to estimate the parameters of diffusion models. For the Bass model, let N^* be the cumulative number of innovation adopters at time t^*, i.e. at the point of inflection in the diffusion curve, and n^* is the rate of increase in the number of innovation adopters at time t^*, we have (Kijek & Kijek, 2010) [4] that:

$$N^* = m\left(\frac{1}{2} - \frac{p}{2q}\right), t^* = -\frac{1}{p+q}In\left(\frac{p}{q}\right), n(t^*) = m\left(\frac{q}{4} + \frac{p}{2} + \frac{p^2}{4q}\right) \quad (7)$$

If n^*, N^*, and t^* are known, equations (7) can be solved to yield:

$$p = \frac{n^*\left(m - 2N^*\right)}{\left(m - N^*\right)^2}, \quad (8)$$

$$q = \frac{n^* m}{\left(m - N^*\right)^2}, \quad (9)$$

$$t^* = \frac{\left(m - N^*\right)}{2n^*}In\left[\frac{m}{m - 2N^*}\right] \quad (10)$$

Consequently, equation (10) can be used to find m numerically or by trial and error. Once m is known, equations (8) and (9) can be used to estimate p and q.

5. Forecasting using the bass model

Now we test the predictions of the model with some observed data on utilization of ITS from Obasi *et al* (2016) [6]. How many teachers will eventually adopt or use the innovative teaching strategies and when? For the model considered, the estimates of parameters are given as:

$$m = 50, t^* = 5, N^* = 15, n^* = 0.5, p = 0.0048, q = 0.02, T^* \approx 32, N(32) \approx 30$$

These results show that the cumulative number of teachers adopting ITS at time of peak adopters is 30. This is indication of a weak adoption of ITS. This is a realistic situation in Nigeria. It goes to show that the model can be successfully applied to adoption in innovative teaching strategies.

6. Discussion and Conclusion

Bass model is successful in forecasting the adoption of innovative teaching strategies in Nigeria. The result based on this model indicates that fewer teachers will adopt ITS in classroom instruction, as time progresses; implying that teachers will continue to utilize conventional (lecture) method which has been shown, over time, to be less effective. This result agrees with Obasi *et al* (2016) [6] who stated that one problem with teaching and learning is that most teachers continue to keep faith with the old system of teaching that has nothing interesting or enjoyable to offer to the learner. This

could be one of the reasons why the problem of poor performance of students in sciences still persist even when taught by experience teachers. This result is not surprising because previous studies reported that over ninety percent of the teachers still use the traditional method of teaching (Obasi *et al*, 2016) [6]. This model can be applied to study the adoption of ITS in specific school subject. In fact, the model predicts that the number of teachers that will eventually adopt ITS in future is very small. This is what is happening in Nigeria classrooms at a moment. The questions now is why are teachers not adopting ITS in their classroom teaching? Teachers are advised to adopt innovative strategies in teaching because they are promising and effective. More so, school supervision and inspection should be revived in the schools in order to encourage teachers to always adopt innovative strategies in their teaching. Finally, further research should be conducted on the factors hindering the effective adoption of innovative strategies in teaching school subjects.

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