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DEVELOPING A FRAMEWORK FOR MEASURING THE EFFECTIVENESS OF INNOVATIVE MEASURES ADOPTED AT SECONDARY EDUCATION LEVEL TO OVERCOME THE PHOBIA OF LEARNING AND APPLYING MATHEMATICS IN REAL LIFE SCENARIOS

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Abstract

India, as of today, is under the process of transformation and this transformation is visible at several dimensions such as education, transport, textiles and the like. However, in order to manage the transformation process (or in fact any process), we need numbers. For, unless and until we have numbers, we cannot manage the direction nor can we control or assess the rate of progress of transformation. But, to deal with numbers, is a complex and intriguing task on account of the fact that somehow or the other there exists a sort of phobia towards mathematics and the genesis of this phobia goes back to our secondary level education system (for mathematics at primary level was limited to learning by heart few tables and counting of numbers and the like).In fact, if we were to ponder, we find that mathematics was boring; somehow or the other we seem to struggle and adopt innovative measures such as learning the answers of the questions or resorting to guide books or reference books and what not. But, mathematics always won. We may have cleared the mathematics paper somehow or the other but its application is always following us every now and then and there are numerous examples to corroborate what is being talked about. For example, the management of our organization always questions us what is the rate of return of this initiative and this is calculus. And this goes on and on.

This paper addresses the issues related to implementing innovative measures so that phobia of studying mathematics at secondary level education is reduced to a great extent.

Keywords: Education, Mathematics Phobia

Introduction

The commercial world of today is hyper competitive due to several factors that directly or indirectly affects the normal functioning of the business operations. For, today, we find that pace of innovation is tremendous. For, the new product that came into the market yesterday is replaced by an improved version today and this improved version would be obsolete tomorrow. In other words, there is always an struggle to manage the process of innovation as well to manage the rate of innovation. Further, in order to manage we need numbers. In fact, numbers provide the necessary thrust and liveliness in our live. And, worth mentioning is the fact that these numbers are always pestering us every now then. For example, our boss most of the time quipping us with the familiar phrase 'How long will you take to complete this task?'. We struggle and falter to answer this question and yet we utter some number just to ensure that boss spares us for the moment. The story does not end here, in fact it trails to our homes also wherein the little master of the house comes in asks the 'daddy how far is the moon from the earth' or 'Daddy how much it costs to get the same model of the car which my friend's father has?' The questions are numerous but the commonality to all these questions is the averseness that is demonstrated for ensuring that these numbers somehow of the other leave us so that we may live in peace at the moment. In other words, the phobia of mathematics that was there while at school level continues to this day.

This paper is designed to address the issues related to the implementation of innovative means and mechanisms at the secondary education level so that phobia which the students have towards mathematics is reduced to a great extent when innovative measures are deployed for teaching and applying mathematics in day to day operations.

Basic terminologies

Before, we proceed further in this paper; let us cover some basic terminologies. For, a clear understanding of these will provide a level of comfort in understanding the paper as there may be slight variations on the accepted, or standardized or understanding of these terms.

I. Phobia. The term phobia, as used in this paper refers to the adoption of a mindset, a pattern of thinking wherein a student tries to develop feelings of insecurity and abhorrence. This feeling of insecurity may be demonstrated through helplessness or nervousness or avoidance or any other form of behavior wherein the student tries to escape or run away from the problem which has been presented to him.
II. Mathematics. It is a branch of study which deals with numbers and the process of arriving at these numbers is dependent on the context and of the means and mechanisms adopted. For, example, in order to determine the rate of Return, we may use calculus or to calculate the

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Compound Interest we have to use formula for compound interest or we may adopt simple step by step approach

III. Application of mathematics. It is the process wherein we use numbers for solving the problems involving day to day operations. For example, we use cumulative frequency distribution (again set of numbers) to arrive at the information about the number of students who or less than or more than a particular number.
IV. Framework. It is the structured block which simultaneously use numbers against the parameters which are required to be managed or evaluated so that information as whole pertaining to context can be determined
V. Effectiveness. It is the degree which uses demonstrable indicators to show that the process or activity which is conducted is producing some evidence of results either in increasing form or nearer to increasing form.
VI. Secondary education. It is the traditional education level wherein the student is on the verge of entering the college level of education.
VII. Innovation. This is the construed to ensure that a completely new product or a transformed product is introduced. The new product is an improved version of the existing product, if any.

Design of the paper

Having understood the basic terms let us now move ahead to the process of designing the paper. The process that is followed for the construction of the paper is step by step approach. The following are the steps for constructing the paper.

I. Identifying the parameters of mathematics phobia.
II. Once the parameters of phobia are identified they are now required to supported with plausible reasons as to why this is included in the process for determining the effectiveness
III. Based on the above steps appropriate weight age are assigned
IV. The ratings are given by the authorized person
V. Once the ratings are given then the evaluation process begins which will demonstrate the effectiveness of innovative measures

Identifying the parameters of mathematics phobia

Having defined the step by step measures, let us now dwell further into the process of identifying the parameters which induce an inherent phobia towards mathematics among the secondary level students. Based on the review of primary data collection among the parents and the students as well as teachers of secondary school, the following parameters have been identified.

I. Incapability of students which includes shyness, excessive timidity, extreme nervousness, inability to learn, retain and apply the basic principles of mathematics
II. Inadequate aptitude towards mathematics
III. Examination pattern inappropriately designed
IV. Home environment which penalizes students for low scoring marks and other factors responsible for generating deterrent towards mathematics

Thus, having obtained the parameters which are responsible for inducing mathematics phobia let us discuss the process of assignment of weights to these parameters. In particular, the following is the criterion for assignment of weights along with the reasons as to why these parameters have been given the weight ages

- Highest weight age is to be given to those parameters which have an element of intrinsic characteristics. In other words, a student who has an element of inadequacies since birth is to be given highest weight age. This is due to the fact that is a single parameter which will require more effort by the teacher and that the process of effectiveness of an innovative measures will be slow
- An examination system which is heavily focussed on the outcome rather than the process for solving mathematical problems. This is one of the most important factor for generating phobia as the student surrenders to the application of basic principles instead he resorts to just mugging up the answers to the questions which are similar in nature or which have been taught in class
- The element which has an element of aptitude will require next weight age after personality defect. This is due to the fact that with little more efforts by the teachers as well as by the student the aptitude can be developed.
- Home environment factors will be next in sequence of allocation of weight ages. This is due to the fact a hostile home environment generates disinterest among the students even though the student has an aptitude towards mathematics. The hostile environment acts as a deterrent.

Thus, with the basic criterion for allocation of weight ages in place, table 1 depicts the allocation of weight ages to the identified parameters

Table 1: Depiction of allocation of weight ages to the identified parameters

Sr. No.	Parameter	Weigh age (out of a scale of 100)
1.	Incapability of students which includes shyness, excessive timidity, extreme nervousness, inability to learn, retain and apply the basic principles of mathematics	45%
2.	Examination pattern inappropriately designed	10%
3.	Inadequate aptitude towards mathematics	25%
4.	Home environment which penalizes students for low scoring marks and other factors responsible for generating deterrent towards mathematics	20%

We will now dwell on the criterion for measuring the effectiveness of innovative measures. In particular, the effectiveness of the innovative measures will be determined on the basis of the following criterion as enumerated below

I. The effectiveness of innovative measures would be determined on the basis of visible or demonstrable indicators. In other words, rating would be given on the basis of these indicators
II. The demonstrable indicators which involve the application of critical thinking must be given highest ranking. However, this aspect of critical thinking parameter is not applicable in the cases wherein shyness, excessive timidity, extreme nervousness, inability to learn, retain and apply the basic principles of mathematics and the like
III. The students who demonstrate rote learning such as cramming etc. would be given lowest rating irrespective of the fact that whether he has an aptitude or not
IV. The rating is to be given by head of the institution and which would be vetted by a member of the management body

Table 2: Depiction of applied template for measuring the effectiveness of innovative measures

Sr. No	**Target Parameter**	**Assigned Weights**	**Innovative measures inducted**	**Visible or demonstrative indicators**	**Rating**	**Total**
1.	Incapability of students to apply the basic principles of mathematics	45%	Linkage of Mathematics with day to day activities	• Students able to apply the concepts of permutations and combinations while forming groups for extra-curricular activities such as selection of team members for group related tasks • Students able to understand the application of basic trigonometry by observing slope of buildings; Construction of Sundial in Jan Mantar Buildings and the like • Other examples of day to day examples such as application of differential calculus in the working of escalators; the force required at different level of elevation to pull materials of such as wooden logs, concrete corridor during construction of metro elevated track	8	3.6
2.	Examination pattern inappropriately designed	10%	Questions designed to address critical thinking	• Students were able to apply critical thinking skills such as selection of cricket team members based on the data available such as mean and standard deviation of individual team members • Students were able to determine with justification on the application of usage of various measures of central tendency such as mean, media, mode and the like in a given situation or scenarios • Students were able to interpret the measure so obtained	7	0.7
3.	Inadequate aptitude towards mathematics	25%	Play method to generate interest	• Students were able to determine with justification the correct mathematical technique which is to be applied based on the current situation such as determining the top 75 percentile students in a competition • Students are able to determine the difference between the samples and among the samples from a set of data for percentage of marks of 3 to 4 classes and interpret the significance of that difference on the ultimate result	4	1.0
4.	Home environment which penalizes students	20%	Frequent interaction with parents	• Parents were requested to adopt the pro-active method in generating interest in the student such as what mathematical or statistical technique to be applied in the situation at hand • Parents to ensure that they reward the student for applying mathematical or statistical techniques in real life situations	3	0.6

Total Effectiveness = 3.6 + 0.7 +1.0 + 0.6
= 5.9

Interpretation of the effectiveness index

Having constructed the framework and after having arrived at a number which denotes the effectiveness co-efficient, let us now interpret the value so obtained.

- The value of 5.9 indicates that the degree of the innovative measures and their effectiveness requires concerted efforts in the sense that the figure fails to demonstrate a healthy number. In general the value of 6.5 or more is considered as an average
- The figure on the whole indicate that the authorities have adopted measures but there needs to be sustained and implemented on continuous basis. The figure will fail to improve unless these measures are adopted on sustained basis

Future Recommendations

The value can be interpreted as under

- This number can be utilized as a benchmark which will depict the minimum points which need to be addressed by the institution so as to emphatically say that the measures so deployed are effective in manner
- The low scoring parameter can be given more attention to ensure that this is areas of concern requires more attention from all the concerned
- This value can be used to compare other institutions so as to draft a common measurement system across the branches or cities

Conclusion

The framework developed in this paper provides a means and mechanism to determine the degree and depth of the innovative measures that can be implemented to remove the maths phobia among the students. The point that this framework highlights is the fact that this can be implemented at several levels such as across the institute and across several branches of the institute.

By appropriately modifying the parameters and the weight ages this framework can be customized for other subjects as

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