

## ANALYSIS OF SUBJECT ACHIEVEMENT IN LINEAR ALGEBRA BY USING MATHEMATICAL SOFTWARE

Mr. Subhash G. Pawar,  
Research scholar, J.J.T. University.  
and  
Dr. C. M. Borse.

### *Abstract :*

*Mathematics software has been viewed as potential tool for helping students increasing motivations, gain a deeper understanding of concepts and develop better problem solving skills. In present study, main focus was given on to determine the effectiveness of mathematical software as a teaching resource for the subject of linear algebra over the traditional teaching method.*

### **Introduction**

Mathematics is very important subject for human society. It is subject which has its own culture. Mathematics helps person to develop his logical abilities. Mathematics is the language of all sciences. It is called as the queen of sciences. As such it may regard as the most fundamental branch of science. It is useful to all branches of education, so it plays an important role in development of civilization.

In today's world teachers need to be equipped not only with subject-specific expertise and effective teaching methodology, but with capacity to assist students to meet the demands of the emerging knowledge-based society. Therefore teachers require familiarity with new information and communication technology and need to have ability to use that technology to enhance the quality of teaching and learning. Educational technology involves applying ideas from various resources to create the best learning environments possible for students. Educational technology helps teacher to perform his task in effective and efficient manner. It also helps the teacher to find and develop the new systems, processes and strategies to achieve educational objectives to its maximum level in effective and efficient manner. Educational technology enables the teacher to make sensible and systematic use of computer, LCD projector, software etc. It helps the teacher in the development of cognitive, affective and thinking abilities of the students.

This is the technology era and the advances in science and technology are happening at the

rapid rate. The World Wide Web has transferred the world into global village. The internet has become the words biggest library and the great source of information. It is the knowledge bank for the younger generation. There are many e-resources available for learning, teaching and research activities in Mathematics on the internet. There are highly technical and advanced software in Mathematics such as Mathematical Laboratory, Maple, Sage, Science Laboratory, Maxima, CAS (Computer Algebra Systems), *fx-CG20* etc. There are also specific software designed for many specialized topics. Besides these software, there are many freeware, applets and utilities available on the internet. Mathematics software has been viewed as potential tool for helping students increase motivation, gain a deeper understanding of concepts and develop better problem solving skills. The use computer, scientific calculator and mathematical software in education have grown tremendously over the last three decades.

**Need of the study :**

The most of the colleges in the country are having the high-speed internet connections in the campus for the students and the faculty. The main question arises in the researchers mind that whether the available e-resources are used by the teachers of mathematics for the teaching and learning process. If so, how their use of these e-resources relates to the understanding of undergraduate students. Does this create the profound understanding in the subject? Is it the interesting way to explain the topic? Does this promote the further thinking amongst the students? The researchers' research will throw focus on all these questions.

**Aim of the study :**

The present study aims to compare the effectiveness of mathematical software vis-à-vis the traditional method of teaching in the subject of linear algebra, by comparing the mean score achievement from the post-test of the experimental and control groups.

**Hypothesis of the study :**

There is no significant difference between the achievement of experimental group and control group.

**Methodology :**

As per aim of the present study, the experimental methodology was used for this study. Topics related with Linear Algebra were selected for teaching, from second year B. Sc. of Pune University. Selected topics were taught in total 45 days.

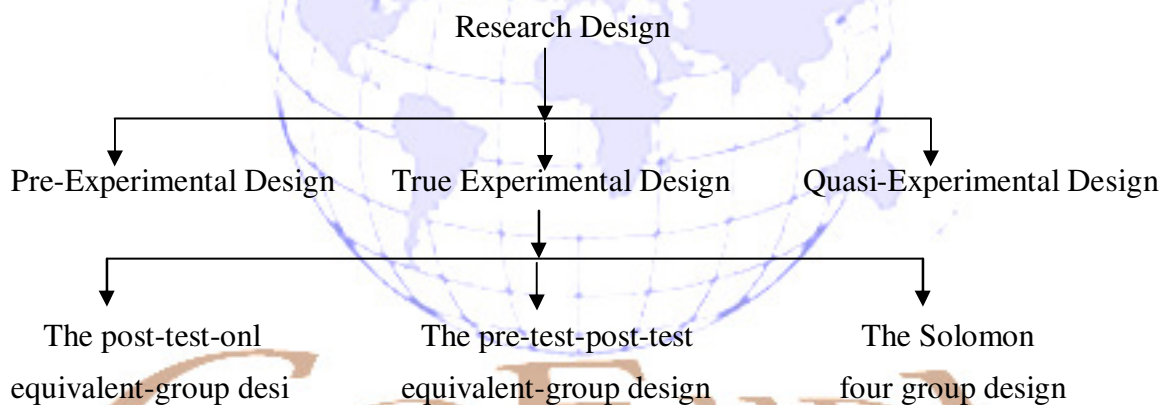
### Research Design :

Experimental design classified in to three categories.

- 1) Pre-experimental design.
- 2) True experimental design.
- 3) Quasi-experimental design.

From these above three categories, true experimental design is proposed for the present study, because it is the stronger type of design. In true experiment the equivalence of the experimental and control groups are provided by random assignment of subjects to experimental and control treatments. Again True experimental design classified in to three categories.

- 1) The posttest-only, equivalent-group design.
- 2) The pretest-posttest equivalent-groups design.
- 3) The Solomon four-group design.



As per aim and hypothesis of the present research study, the post-test-only equivalent-groups design from True experimental design is useful for testing the hypothesis.

### Variables :

Variables are the conditions or characteristics that the experiment manipulates, controls or observes. There are two types of variables independent and dependent variables.

- 1) **Independent Variables** : Teaching by mathematical software.
- 2) **Dependent variables** : Test score.

### Population :

A group of objects or individuals taken in to consideration for certain objective is called population. Here will have to define the population of undergraduate learners in mathematics in



Pune University.

**Sample :** The collection of some Representative of the whole population which helps in the analysis of the complete population.

The sampling methods are classified in to two main categories :

1. Non- probability sampling.( Purposing sampling)
2. Probability sampling. (Random sampling)

**Purposive Sample:** “Purposive Sample, a kind of non probability sample, is one which is based on the typicality of the cases to be included in the sample. The investigator has some belief that the sample being handpicked is typical of the population.

In this study aim was compare the effectiveness of mathematical software vis-à-vis the traditional method of teaching in the subject of linear algebra, hence the most important criterion for selecting the college for the purpose of experiment was the availability of well equipped computer laboratory with mathematical software.

By using purposive sampling the investigator has selected K. T. H. M. College from Nashik District. In this college total 166 second year students were learning in mathematics and they were divided into two divisions. These divisions assign to the experimental group or control group by tossing a coin.

**Tools:** In the present study following tools were used by the researcher to collect the data.

- 1) Mathematical software
- 2) Teacher made achievement test

**Statistical tools:** In the present study following statistical tools were applied by the researcher to Analysis the data.

- 1) Measures of Central tendency: Mean
- 2) Measures of dispersion: Variance, S.D.
- 3) t-test

**Planning :**

In the beginning researcher has prepared planning for the execution experiment.

1. **Selection of software :** The mathematical software *fx-CG20* is available in calculator form, so it easy to handle and carry. Operating system of this software is easy to understand for learners. *fx-CG20* mathematical software was selected for these study.
2. **Selection of topic :** Linear algebra is an important branch of pure mathematics that is used throughout the all branches of sciences. It is very important in the branch of computer science.



### Execution of the experiment :

There were two groups under the study. One was experimental group which given the treatment and other was the control group which taught by traditional method. Both groups were treated in the usual manner. They were asked to be regular, punctual and neat in their work. Whenever there was an execution of the experiment students were informed well before. Regular, Sincere and continuous effort will yield good result and better learning takes place.

### Observations :

During the implementation of teaching programme using mathematical software researcher recorded some observations at the time of the experiment. Description about topics and observations are given bellow.

a) **Simultaneous Equations:** This topic related with system of simultaneous equations. Students were familiar with linear equation, system of two equations and two variables.

Researcher explains about definition of homogenous and non-homogenous system of equations, consistent and inconsistent system of equations. Some examples were solved by researcher using software and some different types of examples were given to students for solving.

In this topic students learned that every system of equations either consistent or inconsistent. If the system is consistent then it has either unique solution or infinitely many solutions.

b) **Linear Independence:** This topic is related with vectors and vector space. Students were familiar with axioms of vector space.

Researcher explains the definition of linear combination, linear dependence and independence. Few examples were discussed and solved by researcher using mathematical software and some different types of examples were given to students for solving.

In this topic students learned that, in dependent set at least one vector can be expressed in the linear combinations of other vectors.

c) **Basis and Dimensions of vector space:** This topic is related with linear span and linear independence. Students were familiar with definitions of linear spanning and linearly independence.

Researcher explains the definition of basis, standard basis, coordinates of vector and dimension also discussed some results on basis. Few examples were solved by researcher using software and some different types of examples were given to students for solving.



In this topic students learned that whether the given set is basis or not and how to find coordinate vector relative to the basis and dimension of a vector space.

After the study sessions a post-test of one hour was administered to the both groups to determine the level of achievement of learners.

**Analysis of the data :**

The data obtained from post-test of the experimental and control groups was subject to descriptive statistical analysis by finding the mean and standard deviations. T-value was calculated and compared with critical t value.

**Table No. 2**  
**Post-test data**

Group	Sample Size n	$\Sigma X$	Mean( $\bar{X}$ )	$\Sigma(X - \bar{X})^2$	S.D.	t-value
Experimental	80	1198	14.97	363.95	2.13	12.25
Control	86	982	11.41	216.93	1.58	

The calculated value of t is 12.25 ( $t_{0.05} = 1.645$ ,  $t_{0.01} = 2.326$  at 164 degree of freedom) is significant at both 5% and 1% level of significance.

**Conclusions:** The data suggests that the average score in the post test of experimental group (who learnt by using mathematical software) is significantly better than that of control group (who learnt through the traditional method). Therefore the null hypothesis is rejected. It was concluded that there is significant difference between the achievement of experimental group and control group.

The achievement of the experimental group students was significantly higher than that of control group students. This can be attributed to effective communication of the linear algebra by using mathematical software.

**References :**

- 1) **Best, J. W. and Kahn, J.V.**( 1989). *Research in Education*, New Delhi : Prentice Hall of India.
- 2) **Bhamre, Bhagat, Patil & Rayarikar**, (2009), *Linear Algebra*, Pune : Nirali Prakashan.
- 3) **Bhupendra Shing**, (2013), *Advanced Abstract Algebra*, Meerut : Pragati Prakashan

ISBN 978-93-5006-826-7.

- 4) **Desai Swati**, (2011). *Quantitative Techniques*, J.J.T. University
- 5) **Horton, R.M., Storm, J. & Leonard, W.H.** (2004). *Contemporary Issues in Technology and Teacher Education*, 4(2), page 152-162.
- 6) **Lokesh, Koul.** (1996). *Methodology of Educational Research*, New Delhi: Vikas Publishing House PVT. LTD.
- 7) **Mathomo, M. Moila.** (2006). “*The use of educational technology in Mathematics teaching and learning: An investigation of a South African rural secondary school*”, University of Pretoria.
- 8) **Paino, Tara L.** (2009). “*Effects of technology on student Achievement and motivation in mathematics*” Ph.D. Thesis.

