IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Effectiveness Of Online Tutoring On Achievement In Mathematics Of Students At Secondary Level

[1] Vinny Catharine Sam, [2] Dr. Sajna Jaleel

[1]M.Ed. Student, [2] Professor

School of Pedagogical Sciences

Mahatma Gandhi University, Kottayam, India

Abstract:

Online tutoring is a virtual learning method where the students obtain extra help or assistance from the expert tutors. The entire process of teaching and learning takes place in online mode and tutors will be available from across the world. Tutors will be registered on different platforms and can contact them as per our requirement. After the pandemic, the scope of online tutoring has increased and there is great demand for online tutors. Many of the students today join the online platforms for tuition and say that they benefit highly from them in their academic performance in Mathematics. The question before the investigator is whether online tutoring is effective in improving achievement in Mathematics. Hence, through the study, the investigator tried to find the effectiveness of online tutoring on achievement in Mathematics of Students at Secondary Level. The investigators adopted Experimental Method in the present study on a sample of 100 Secondary School Students taken at random. This study revealed that the Online Tutoring is effective over Activity Oriented Method in enhancing the achievement in Mathematics among the secondary school students.

Index Terms - Online Tutoring, Mathematics Achievement, Secondary School Students

1.INTRODUCTION

Education is the pathway offering new opportunities to the learners to explore and implement their ideas. There were many preconceived notions that education is complete only through the traditional classroom interaction between a teacher and students. But it was later accepted by educationists across the world that education outside educational institutions also has a positive impact on learning. It is evident that education, as organized and imparted, is mainly divided into three; formal education, informal education, and non- formal education. Majority of us used to believe that this was the best and only way of imparting quality education, and the world failed to acknowledge the other type of education in the long run. But all of a sudden, when the pandemic hit the world, the schools and colleges around the world were forced to shut down. The education

system has been affected by several challenges ranging from changes in the education curriculum to closing down the education system due to widespread pandemic (Mustafa, 2020). The sudden transition was welcomed by the teachers and students and efforts were taken from both sides. Even though the e- learning was not a novel learning method, it has reached all over the world in a short span of time and today the entire education system is functioning in e-platform.

Learning under technological circumstances has proven not always to be a proper solution in education. A highlight challenge, in this regard, is considered to be learning Mathematics online. While some support its positive impact, others greatly oppose it by arguing that neither teaching nor learning has proven successful (Çerkini et al., 2022). Mathematics has always been considered a difficult subject. A teacher needs to have some basic knowledge about technology to handle a subject like Mathematics in e-platform and have to develop some skills to help students understand and cater their interest and expand their excellence in Mathematics. Along with the sudden shift, many students found it very difficult to learn Mathematics through online learning. The sudden failure in the subject Mathematics worried not only the students but upset the parents as well. The one option they found was Online tutoring. Online tutoring is a form of teaching, usually one to one, that takes place over the internet in real time. Online tutoring must involve a 'real person' despite what some technology platforms may claim (Williams, 2023). The parents opted for Online tutoring thinking that this would uplift their students from poor academic performance. Online tutoring is a virtual learning method where the students obtain extra help from the expert tutors. The entire process of teaching and learning takes place in online mode and tutors will be available from across the world. Not all support this new process, thinking that it does not elevate the academic performance of the students. In response to the significant demand, many online learning platforms started approaching parents nowadays offering access to quality services. Many of the students stated that they benefitted highly from them in academics. The question before the investigator is whether online tutoring is effective in improving achievement in Mathematics.

Research as the systematic and objective analysis and records of controlled observation that may lead to the development of generalization, principles, and theories resulting in prediction and possibility ultimate control of events (Best & Khan, 1998). Here the researcher tries to find the effectiveness of online tutoring on Achievement in Mathematics of Students at Secondary level.

2. NEED AND SIGNIFICANCE OF THE STUDY

Online learning is not the next big thing, it is now the big thing (Abernathy, 1999). Today, the teaching and learning has found new spaces and dimensions for their implementation and transaction. E-learning is the next big education that is evident in today's world. eLearning is training, learning, or education delivered online through a computer or any other digital device (Caroline, 2023). Through e-learning, people learn and are educated without any limits. There are still students who struggle to cope up with the post covid classroom scenario and fail to perform well in the classroom. For some students, the pandemic has resulted in learning losses and knowledge gaps, particularly in mathematics (Dunford, 2022). They depend on the novel teaching method, online tutoring, which functions outside the classroom to deliver lessons to the students who are in need. This study is to find the effectiveness of online tutoring on Achievement in Mathematics.

The transaction of an abstract subject through online platforms is of huge concern. But it is believed that online tutoring of Mathematics was successful to an extent through the many different methodologies used in the new teaching. Since education is to be treated with utmost attention and care, it is important to learn more about the ways of teaching and learning Mathematics in online tutoring and how effective it is. Since education is finding its way through online tutoring, we have to make sure the teaching and learning is appropriate and is meeting the needs of the students and is helping the students attain better achievement.

Many studies had been conducted in the previous years across the world about online tutoring and their effectiveness on Achievement in Mathematics. But all the studies so far have only studied and evaluated a certain online tutoring program and their effectiveness on Achievement in Mathematics. And many other studies had been conducted to investigate the impact of Online tutoring and their usefulness in education. And few studies had been conducted to find out how the technology collaborating with Online tutoring had improved the student interest and attitude in Mathematics. There are theses addressing the current e-tutoring opportunities for improved teaching-learning interplay and few studies concentrated on designing and implementing e-tutoring packages.

Michela (2021), Carlana & Ferrara (2020), Johns & Mills (2020) studied about the effectiveness of online tutoring on academic achievement during the Covid 19 pandemic. Gewertz (2022) and Makombe & Motaung (2021) studied online tutoring can be a powerful ally to a student to overcome the learning gap. Cheng et al. (2020), Arnold et al. (2019), and Amy et al. (2014) evaluated and examined different online tutoring programs and what impact they have on Mathematics Achievement. Benjaminsson et al. (2019) and Allessio et al. (2017) published articles on how a perfect online tutoring can be planned. Belgiawan et al. (2022) and Cukurova (2022) studied about approach to online tutoring from various perspectives and tried to measure students' intention and quality in online tutoring. But there is no study exclusively testing the effectiveness of online tutoring in Mathematics. Hence the investigator decided to test the effectiveness of online tutoring on achievement in Mathematics among secondary school students.

3. RESEARCH METHODOLOGY

The research methodology talks about how the researcher had done the research to give the readers clarity in how the research process was carried out. This includes population and sample of the study, data and sources of data, and theoretical framework. The details are as follows:

3.1 Population and Sample

In the present study, the population is the students at secondary level following Kerala State Syllabus. The sample consists of 100 secondary school students from a school of Pathanamthitta district.

3.2 Data and Sources of Data

For this study primary data has been collected. The data was collected from the students after conducting an Achievement Test in Mathematics to two divisions of Standard VIII. The tool was pre-tested and post-tested to Experimental and Control groups and the observations were noted down.

3.3 Theoretical Framework

The present study consists of mainly two types of variables, independent variables and dependent variable. Since the present study aims to test the effectiveness of the Online tutoring in Mathematics, the independent variables for the present study are Activity Oriented Method along with Online tutoring and Activity Oriented Method. And the dependent variable considered in the present study is Achievement in Mathematics.

Many studies had been conducted in the previous years across the world about online tutoring and their effectiveness on Achievement in Mathematics. But all the studies so far have only studied and evaluated a certain online tutoring program and their effectiveness on Achievement in Mathematics. And many other studies had been conducted to investigate the impact of Online tutoring and their usefulness in education. And few studies had been conducted to find out how the technology collaborating with Online tutoring had improved the student interest and attitude in Mathematics. There are theses addressing the current e-tutoring opportunities for improved teaching-learning interplay and few studies concentrated on designing and implementing e-tutoring packages.

Michela (2021), Carlana & Ferrara (2020), Johns & Mills (2020) studied about the effectiveness of online tutoring on academic achievement during the Covid 19 pandemic. Gewertz (2022) and Makombe & Motaung (2021) studied online tutoring can be a powerful ally to a student to overcome the learning gap. Cheng et al. (2020), Arnold et al. (2019), and Amy et al. (2014) evaluated and examined different online tutoring programs and what impact they have on Mathematics Achievement. Benjaminsson et al. (2019) and Allessio et al. (2017) published articles on how a perfect online tutoring can be planned. Belgiawan et al. (2022) and Cukurova (2022) studied about approach to online tutoring from various perspectives and tried to measure students' intention and quality in online tutoring. But there is no study exclusively testing the effectiveness of online tutoring in Mathematics. Hence the investigators decided to test the effectiveness of online tutoring on achievement in Mathematics among secondary school students.

3.4 Statistical tools and econometric models

This section elaborates the proper statistical/econometric/financial models which are being used to forward the study from data towards inferences. The details are given as follows.

3.4.1 Descriptive Statistics

For this study, the statistical techniques used are descriptive statistics: mean, median, mode, skewness, kurtosis, and standard deviation.

3.4.1.1 Arithmetic Mean

The Arithmetic Mean is calculated using the formula

$$M = \frac{\sum fx}{N} \qquad \text{(Garett, 1981)}$$

where X represents the midpoint of the class interval, f its respective frequency and N, the total number of samples.

3.4.1.2 Median

If the items of a series are arranged in ascending or descending order of magnitude, the measure or value of the central item in the series is termed as median. If n is the total frequency, the median lies somewhere between $\frac{N}{2}$th and $(\frac{N}{2}+1)$ th items in the given distribution. Thus, the median class should be identified in such a way that the class in which the $\frac{N}{2}$th item belongs. After estimating the median class, the median may be calculated with the help of the following formula

$$Md = L + [\frac{\frac{N}{2}-F}{f}]\ xi \qquad \text{(Garett,1981)}$$

where L - Exact lower limit of the median class

F - Total of all frequencies before the median class

f - Frequency of the median class

i - Class Interval

N -Total Frequency

3.4.1.3 Mode

Mode is the value which occurs most frequently in a set of data. The mode is calculated using the formula,

Mode (Mo) = 3 Median - 2 Mean

3.4.1.4 Standard Deviation

Standard deviation of a set of scores is defined as the square root of the average of the squares of the deviations of each score from the mean. Thus, it can be calculated using the formula

$$SD = \sqrt{\frac{\sum (X-M)2}{N}} \qquad \text{(Garett,1981)}$$

Where, X – Individual Score

M – Arithmetic mean of the given scores

N - Total number of scores

3.4.1.5 Skewness

The lack of symmetry forms the normal curve is termed as skewness and it is computed by the formula,

$$\text{Skewness (Sk)} = \frac{3(\text{Mean}-\text{Median})}{SD}$$

3.4.1.5 Kurtosis

The characteristic of being flat or peaked from normal is termed as kurtosis and the value of kurtosis for a given curve may be computed through the formula

$$\text{Kurtosis (Ku)} = \frac{QD}{\text{P90}-\text{P10}}$$

Where QD – Quartile Deviation of the distribution and

$QD = \frac{Q3-Q1)}{2}$ where, Q1 and Q3 represent the 1st and 3rd quartiles of the distribution.

P90 - 90th percentile

P10 – 10th percentile

3.4.2 Inferential Statistics

For this, the statistical techniques used are Inferential Statistics: Test of significance of difference between means, ANOVA, and ANCOVA.

3.4.2.1 ANOVA

An ANOVA test is a way to find out if survey or experiment results are significant. In other words, they help you to figure out if you need to reject the null hypothesis or accept the alternate hypothesis. It deals with the task of analysing the total variance of the large sample or a population consisting of a number of equal groups or sub samples into two components such as (1) within group variance – This is the average variance of the members of each group around their respective group means and (2) between group variance – this represents the variance of group means around the total or grand mean of all groups. The comparison of the size of between group variance and within group variance called F – ratio and it is denoted as

$$F = \frac{(\text{Within Group Variance})}{(\text{Between Group Variance})}$$

3.4.2.2 Analysis of Covariance (ANCOVA)

The experiment was done using intact classroom groups which are non-equivalent. Analysis of covariance is used to test the main and interaction effects of categorical variables on a continuous dependent variable, controlling for the effects of selected other continuous variables, which co-vary with the dependent variable. The control variables are called the covariates. In the present study, the technique ANCOVA was adopted for sharper experimental comparison of performance between experimental and control groups. The steps adopted for the computation of Analysis of Covariance are discussed below.

Let X_1, X_2, $X_{3,...}$be the initial scores and Y_1, Y_2, Y_3,… be the final scores of the experiment. Before going through the actual steps of Analysis of Covariance, various sums and means are computed. The following formulae are used for the computation of various sums and means.

$\Sigma X = \Sigma X_1 + \Sigma X_2 + \Sigma X_3 + \ldots\ldots$

$\Sigma Y = \Sigma Y_1 + \Sigma Y_2 + \Sigma Y_3 + \ldots\ldots$

$\sum X^2 = \sum X_1^2 + \sum X_2^2 + \sum X_3^2 \ldots\ldots$

$\sum Y^2 = \sum Y_1^2 + \sum Y_2^2 + \sum Y_3^2 \ldots\ldots$

$\Sigma XY = \Sigma X_1 Y_1 + \Sigma X_2 Y_2 + \Sigma X_3 Y_3 + \ldots\ldots$

After computing these sums and means, the following steps were adopted.

Step 1: Computation of Correction Terms (C's)

Different corrections are applied to different sums of squares and these can be computed using the following formulae.

$Cx = \frac{(\sum X)2}{N}$, $Cy = \frac{(\sum Y)2}{N}$, and $Cxy = \frac{(\sum x \sum y)}{N}$

Step 2: Computation of total sum of squares (total SS)

SS among means for $X = \frac{(\sum X1)2}{N1} + \frac{(\sum X2)2}{N2} + \ldots\ldots\ldots - Cx$

SS among means for $Y = \frac{(\sum Y1)2}{N1} + \frac{(\sum Y2)2}{N2} + \ldots\ldots\ldots - Cy$

SS among means for $XY = \frac{(\sum X1 \sum Y1)}{N1} + \frac{(\sum X2 \sum Y2)}{N2} \ldots\ldots\ldots - Cxy$

Step 4: Computation of sum of squares (SS)

Within groups SS for X = SSx (total) - SS among means for X

Within groups SS for Y = SSy (total) - SS among means for Y

Within group SS for XY= SSxy (total) - SS among means for XY

Step 5: Calculation of the number of degrees of freedom

df (Among means) = K-1, where K is the number of groups

df (within groups) = N-K, where N is the total sample

Step 6: Analysis of Variance of X and Y scores taken separately

Let Fx and Fy be the F-ratios of X and Y scores taken separately. These can be calculated using the formula

$$Fx = \frac{MSx(\text{ among} - \text{groups })}{MSx\ (\text{ within} - \text{groups})}$$

$$Fy = \frac{MSy(\text{ among} - \text{groups })}{MSy\ (\text{ within} - \text{groups})}$$

Where $MSx = \frac{SSx}{df}$ and $MSy = \frac{SSy}{df}$

The computed values of F for X and Y scores are tested for significance at both levels.

Step 7: Computation of adjusted sum of squares for Y (SSyx)

The initial differences in the groups X scores may cause variability in their final scores measured after giving the treatment. Hence for controlling this variability in the final scores, necessary adjustments are made in the sum of squares for Y by using the formula given below.

$$SSyx = SSy - \frac{(SSxy)2}{SSx}$$

Step 8: Computation of Analysis of Covariance

The analysis of Covariance FYX is calculated using the formula

$$Fyx = \frac{MSyx\ (\text{among})}{MSyx\ (\text{ within})} \text{ where } MSyx = \frac{SSyx}{df}$$

The computed value of F is tested for significance at both the levels of significance. If there exists a significant difference among the means of final scores, it can be concluded that one treatment is better than others. In such cases, further steps can be outlined finding the better treatment among others.

Step 9: Computation of regression coefficient for within groups. An unbiased estimate of the regression of Y on X can be computed by using the formula,

$$b = \frac{SSxy(\text{ within})}{SSx\ (\text{ within})}$$

Step 10: Computation of adjusted Y means

Let Myx be the means of the final score after ruling out the initial differences in X scores. This can be calculated using the formula Myx = My – b (Mx - GMx)

Where, My - Unadjusted means for Y scores

Mx - Means for X scores

b - Regression coefficient for within groups

GMx - General mean for X

Step 11: Significance of difference among adjusted Y means

The significance of differences among adjusted Y means is examined by applying the't' test for testing the separate differences between group means. This can be computed by using the formula

$$t = \frac{MD}{SE_D}$$

Where, MD is the difference between two means and SED is the standard error of difference between two adjusted means. It can be computed by the formula

$$SE_D = SD_{YX}\sqrt{\left(\frac{1}{N_1}+\frac{1}{N_2}\right)}$$

Where, SDYX is the standard deviation of the adjusted Y scores. It can be computed by the formula

SDyx = √Vyx (within)

4. RESULTS AND DISCUSSION

Effectiveness of Online Tutoring over Activity Oriented Method on Achievement in Mathematics among Secondary School Students for total sample

Descriptive statistics for pre-test scores of Achievement in Mathematics of Experimental and Control groups for total sample.

The measures of central tendency, measures of dispersion and measures of normality were calculated in order to get a general picture about the group. The descriptive statistics of pre-test scores of Achievement in Mathematics is given in Table 1.

Table 1

Group	N	Mean	Median	Mode	SD	Skewness	Kurtosis
Activity Oriented Group	50	5.24	5	4	1.93	0.46	0.01
Activity Oriented + Online Tutoring Group	50	5.62	5	5	1.85	-0.02	-0.70

The obtained mean values of pre-test scores of Achievement in Mathematics is 5.24 for Activity Oriented Group, and 5.62 for Activity Oriented plus Online Tutoring Group. The median value is 5 for both groups and modes are 4 and 5 respectively for Activity Oriented Group and Activity Oriented plus Online Tutoring Group. The obtained values of standard deviations are 1.93 for Activity Oriented Group, 1.85 for Activity Oriented plus Online Tutoring Group, which means that the whole data are concentrated close to the

mean, exhibiting little variation or spread. The distribution for Activity Oriented Group is positively skewed whereas the distribution for Activity Oriented plus Online Tutoring Group is negatively skewed. All the distributions are platykurtic as the obtained kurtosis values are less than the normal value.

Comparison Of Pre-Test Scores of Achievement in Mathematics Among Experimental and Control Groups for the Total Sample

OneWay ANOVA is used to compare the mean scores of pre-test scores of Achievement in Mathematics of Experimental and Control groups for the total sample. The summary of the result is given in Table 2.

Table 2

Group	Mean	SD	F
Activity Oriented Group	5.24	1.93	
		1.01	
Activity Oriented + Online Tutoring	5.62	1.85	

From Table2, it is clear that the obtained F value (F = 1.01, df (1,98), p < .01) is not statistically significant at .01 level of significance with df (1, 98). This implies that there exists no significant difference among the mean scores of pre -test scores of Achievement in Mathematics of students at Secondary level. It means that the mean scores of pre -test scores of Achievement in Mathematics among experimental and control groups does not differ significantly.

Descriptive statistics of post test scores of Achievement in Mathematics of Experimental and Control groups

The measures of central tendency, measures of dispersion and measures of normality were calculated in order to understand the nature of data in groups. The details of the result are given in Table 3.

Table 3

Group	N	Mean	Median	Mode	SD	Skewness	Kurtosis
Activity Oriented Group	50	6.94	6.5	5	3.15	0.71	-0.03
Activity Oriented + Online Tutoring	50	9.28	9.5	10	2.95	-0.34	-0.36

The obtained mean scores of post test scores of Achievement in Mathematics is 6.94 for Activity Oriented Group, and 9.28 for Activity Oriented plus Online Tutoring Group. The median value is 6.5 for Activity Oriented Group and 9.5 for Activity Oriented plus Online Tutoring Group. The mode values are 5 and 10 respectively for Activity Oriented Group and Activity Oriented plus Online Tutoring Group. The

obtained values of standard deviations are 3.15 for Activity Oriented Group, 2.95 for Activity Oriented plus Online Tutoring Group, which means that the whole data is not much deviated from the central value for all the Experimental and Control groups. The distribution for Activity Oriented Group is positively skewed whereas the distribution for Activity Oriented plus Online Tutoring Group is negatively skewed. All the distributions are platykurtic as the obtained kurtosis values are less than the normal value.

Comparison of means of post test scores of Achievement in Mathematics of students at Secondary level in Experimental and Control groups

The investigator compared the means of post test scores of Achievement in Mathematics of students at Secondary level in Experimental and Control groups using One Way ANOVA. The summary of the result is given in Table 4.

Table 4

Group	Mean	SD	F
Activity Oriented Group	6.94	3.15	8.42
Activity Oriented + Online Tutoring	9.28	2.95	

From Table 4, it is clear that the obtained F value (F = 8.42, df (1,98), p < .01) is significant at .01 level of significance with df (1, 98). This implies that there exists a significant difference among the mean scores of post test scores of Achievement in Mathematics among Secondary School students. It inferred that the mean scores of post test scores of Achievement in Mathematics among experiment and control groups differ significantly.

Comparison of gain scores on Achievement in Mathematics of Experimental and Control groups for total sample

The gain scores of Achievement in Mathematics of students at Secondary level of Experimental and Control groups were compared using Oneway ANOVA. The summary of results of ANOVA is given in Table 5.

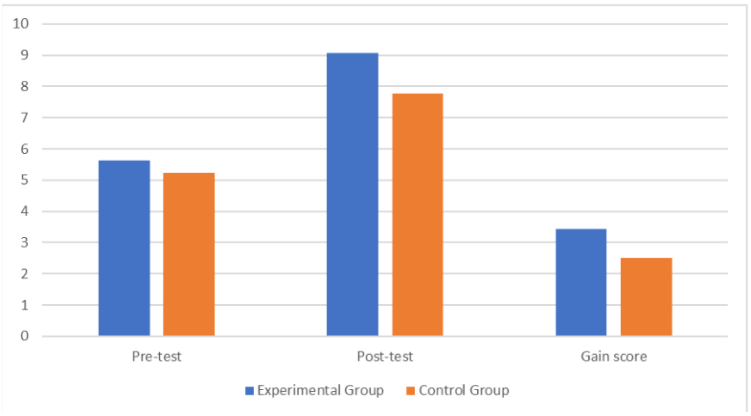
Table 5

Group	Mean	SD	F
Activity Oriented Group	3.44	3.15	4.19
Activity Oriented + Online Tutoring	2.52	2.95	

From Table 5, it is clear that there exists significant difference (F= 4.19, df (1,98), p > 0.05) in mean scores of gain scores of Achievement in Mathematics of students at Secondary level of Experimental and

Control groups. It indicates that the mean scores of gain scores of Achievement in Mathematics differ significantly among the Activity group and Activity plus Online tutoring group.

The comparison of Achievement in Mathematics of students at Secondary level in Experimental and Control groups in pre-test, post-test, and gain scores are depicted as shown in Figure 1.



Comparison of pre-test and post-test scores on Achievement in Mathematics of Experimental and Control groups for total sample using ANCOVA.

The analysis of post-test and gain scores of the Experimental and Control groups reveal that the two groups differ significantly on Achievement in Mathematics after the treatment. But the two groups were non-equivalent intact classroom groups. So, it cannot be concluded that the difference in mean post-test and gain scores of Experimental and Control groups are due to the treatment. Therefore, it becomes necessary to analyse the data using the statistical technique ANCOVA by which the difference in the initial status can be removed statistically. The Achievement scores of the Experimental and Control groups were subjected to ANCOVA to find out the effectiveness of Online tutoring in Mathematics over Activity Oriented Method. For this, the total sum of squares, mean square variances and F-ratios of pre and post test scores of the Experimental and Control groups were found out. The summary of ANCOVA of pre-test and post test scores of students in Experimental and Control groups is given in Table 6.

Table 6

Source of Variation	df	SSx	SSy	SSxy	SSyx	MSyx	Fx	Fy	Fyx
Among Groups	1	3.61	42.250	12.35	30.58	30.58	1.00	8.42	7.39
Within Groups	98	350.9	491.94	174.02	405.63	4.14			

The Table values for df (1, 98) for F are 3.92 at .05 level and 6.85 at .01 level. The obtained Fx value is 1.008 which is not significant at .05 level showing that initially the groups were not different. The Fy value obtained is 8.418, which is significant at .01 level. The obtained Fyx – ratio is significant (Fyx = 7.39, df (1,98), $p < .01$) at .01 level of significance, which shows that there is significant difference the pre-test and post test scores of the Experimental and Control groups for the total sample.

Effectiveness of Online Tutoring over Activity Oriented Method on Components of Achievement in Mathematics and its Retention among Secondary School Students for total sample

Descriptive statistics for the pre-test scores of Components of Achievement in Mathematics of Experimental and Control groups for the total sample

The pre-test scores of objectives of Achievement in Mathematics scores were tabulated and the measures of Central Tendency, measures of dispersion and measures of normality were calculated in order to get a general picture about the group. The descriptive statistics of pre-test scores of objectives of Achievement in Mathematics such as Remembering, Understanding, Evaluating and Creating is given in Table 7.

Table 7

Groups	Objectives	Mean	Median	Mode	SD	Skewness	Kurtosis
Experimental Group	Remembering	2.52	3	3	1.22	0.24	-0.33
	Understanding	1.74	2	1	1.10	0.54	-0.16
	Applying	0.98	1	1	0.87	0.62	-0.18
	Analysing	-	-	-	-	-	-
	Evaluating	-	-	-	-	-	-
	Creating	0.36	0	0	0.48	0.60	-1.71
Control Group	Remembering	2.2	2	2	1.29	0.14	-0.49
	Understanding	1.52	1	1	0.95	0.09	-0.88
	Applying	1.12	1	1	0.80	0.28	-0.36
	Analysing	-	-	-	-	-	-
	Evaluating	-	-	-	-	-	-
	Creating	0.36	0	0	0.48	0.61	-1.70

The mean scores of pre-test scores of components of Achievement in Mathematics of Activity Oriented plus Online group are 2.52, 1.74 ,0.98 and 0.36 respectively for the components - Remembering, Understanding, Applying, and Creating. In the case of the Activity Oriented group, the obtained mean scores of pre-test scores of components of Achievement in Mathematics are respectively 2.2 ,1.52,1.12 and 0.36. The standard deviations obtained for each group under each component indicate that the scores are not much deviated from the mean value. The distributions of students at Secondary level for Experimental group are positively skewed. In the case of the Control Group, the distributions are positively skewed for the components. Since the obtained

kurtosis values are less than the normal value (0.263), the distributions are platykurtic for the Experimental and Control groups under each category of components.

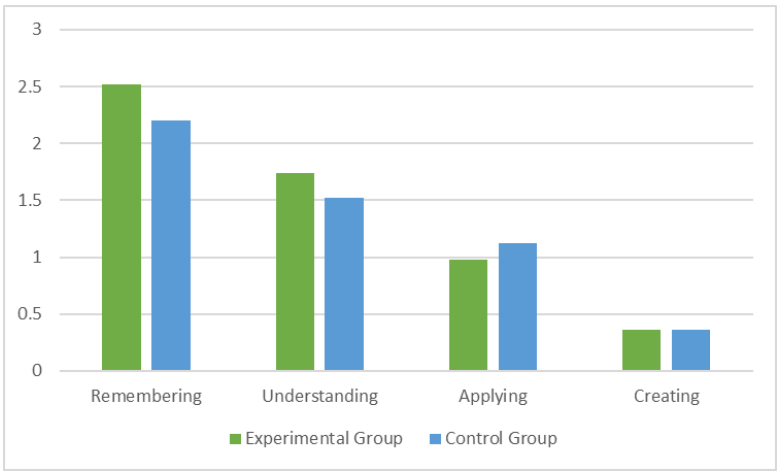
Comparison of pre-test scores of Components of Achievement in Mathematics of Experimental and Control groups for the total sample

Both the Experimental and Control groups were subjected to a pre-test before the experiment was undertaken. The component wise pre-test scores of both the groups were compared by computing the mean and standard deviation. The two groups' scores were subjected to the test of significance of difference between means and the values are presented in Table 8.

Table 8

Components	Groups	N	Mean	SD	t-value
Remembering	Experimental	50	2.52	1.22	1.27
	Control	50	2.20	1.29	
Understanding	Experimental	50	1.74	1.10	1.07
	Control	50	1.52	0.95	
Applying	Experimental	50	0.98	0.87	-0.84
	Control	50	1.12	0.80	
Creating	Experimental	50	0.36	0.485	0
	Control	50	0.36	0.485	

The t- value obtained for the different components on Achievement in Mathematics is not significant at .05 level. Remembering ($t = 1.27$; $p > .05$), Understanding ($t = 1.07$; $p > .05$). Applying ($t = -0.84$; $p > .05$), Creating ($t = 0$; $p > .05$). This shows that there is no significant difference between the means of pre-test scores of learners in the Experimental and Control groups before the treatment. The comparison of pre-test scores of components of Achievement in Mathematics of students at Secondary level in Experimental and Control groups is graphically depicted in Figure 2.



Descriptive statistics for the post-test scores of Components of Achievement in Mathematics of Experimental and Control groups for the total sample

The post test scores of components of Achievement in Mathematics scores were tabulated and the measures of Central Tendency, measures of dispersion and measures of normality were calculated in order to get a general picture about the group. The descriptive statistics of post test scores of objectives of Achievement in Mathematics such as Remembering, Understanding, Evaluating and Creating is given in Table 9.

Table 9

Groups	Objectives	Mean	Median	Mode	SD	Skewness	Kurtosis
Experimental Group	Remembering	4.7	5	6	1.30	-0.58	-0.89
	Understanding	2.32	2.5	3	0.99	-0.44	-0.37
	Applying	1.32	1	1	0.98	0.67	0.67
	Analysing	-	-	-	-	-	-
	Evaluating	-	-	-	-	-	-
	Creating	0.72	1	1	0.45	-1.01	-1.02
Control Group	Remembering	3.68	3.5	3	1.32	0.35	-0.60
	Understanding	2.12	2	2	0.96	0.33	0.36
	Applying	1.4	1	1	0.93	0.23	-0.71
	Analysing	-	-	-	-	-	-
	Evaluating	-	-	-	-	-	-
	Creating	0.64	1	1	0.48	-0.60	-1.71

The obtained mean scores of post test scores of components of Achievement in Mathematics of Experimental group are 4.7,2.32,1.32, and 0.72 respectively for the objectives Remembering, Understanding, Applying, and Creating. In the case of the Control group, the obtained mean scores of post test scores of components of Achievement in Mathematics are respectively 3.68,2.12,1.4, and 0.64. The standard deviations obtained for each group under each component indicate that the scores are not much deviated from the mean value. The distributions of students at Secondary level for Experimental Group are negatively skewed except for the distribution for the component Applying. In the case of Control Group, the distributions are positively skewed except for the component Creating. Since the obtained kurtosis values are less than the normal value (0.263) for the distributions of the components Remembering, Understanding, and Creating, the distributions are platykurtic and the distribution for the component Applying is leptokurtic. And for the Control group, since the obtained kurtosis values are less than the normal value (0.263) for the distributions of the components Remembering, Applying, and Creating, the distributions are platykurtic and the distribution for the component Understanding is leptokurtic.

Comparison of post test scores of Components of Achievement in Mathematics of Experimental and Control groups for the total sample

After the treatment, the same test was administered as a post-test to the Experimental and Control groups. From the scores obtained, mean and standard deviation were computed and the significance of difference between the mean scores of both the groups was tested. The t value obtained is given in Table 10.

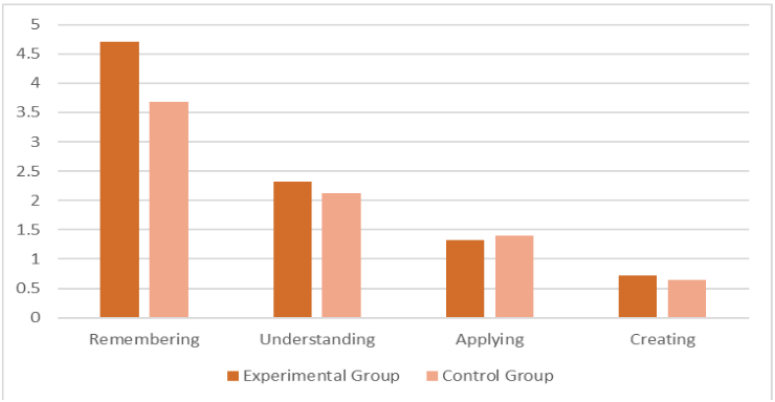
Table 10

Components	Groups	N	Mean	SD	t-value
Remembering	Experimental	50	4.70	1.30	3.90
	Control	50	3.68	1.32	
Understanding	Experimental	50	2.32	0.99	1.02
	Control	50	2.12	0.96	
Applying	Experimental	50	1.32	0.98	-0.42
	Control	50	1.40	0.93	
Creating	Experimental	50	0.72	0.45	0.85
	Control	50	0.64	0.48	

From Table 10, it is clear that the t value obtained for the different components on Achievement in Mathematics is not significant at .01 level except the component Remembering. Remembering ($t = 3.90$; $p < .01$), Understanding ($t = 1.02$; $p < .01$). Applying ($t = -0.42$; $p < .01$), Creating ($t = 0.85$. $p < .01$). This means that there is significant difference between the means of post test scores of learners in the Experimental and Control groups for the component Remembering. Since the mean scores of the Experimental group is greater than that of the Control group, in the case of the components Remembering, Understanding and Creating , it can be inferred that the Experimental group excelled in the components Remembering, Understanding and Creating on Achievement in Mathematics, when the total sample is considered. Therefore, it can be concluded that the Online tutoring in Mathematics has significant impact on the Components Remembering, Understanding and Creating on Achievement in Mathematics as compared to the Activity Oriented Method for the total sample.

The comparison of post test scores of components of Achievement in Mathematics of students at Secondary level in Experimental and Control groups is graphically depicted in Figure 3.

Figure 3



Comparison of gain scores on Components of Achievement in Mathematics of Experimental and Control groups for the total sample

The gain scores of the Experimental and Control groups were found out using the pre-test and post test scores. The mean, standard deviation and value for t of the gain scores are tabulated in Table 11.

Table 11

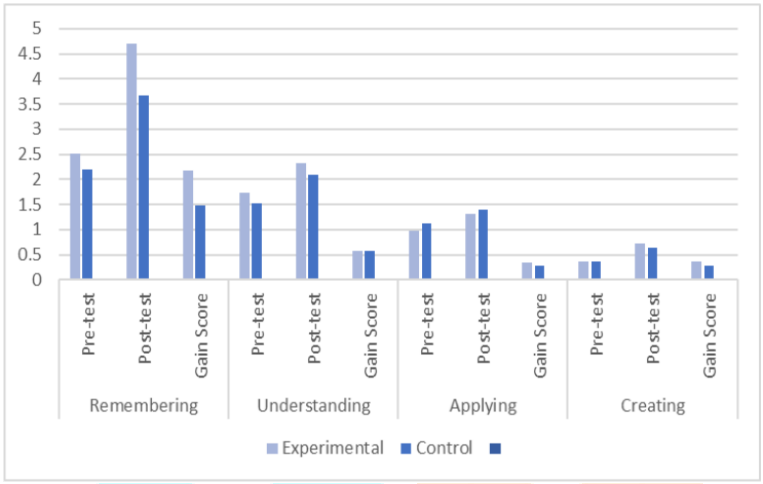
Components	Groups	N	M	SD	t value
Remembering	Experimental	50	2.18	1.45	
	Control	50	1.48	1.53	2.34
Understanding	Experimental	50	0.58	1.39	
	Control	50	0.58	1.18	0
Applying	Experimental	50	0.34	1.30	
	Control	50	0.28	1.18	0.24
Creating	Experimental	50	0.36	0.72	
	Control	50	0.28	0.64	0.59

From Table 11, it is clear that there is no significant difference in the mean gain scores of the Experimental and Control groups except for the component Remembering. The t-value obtained for the different components are Remembering ($t = 2.34$; $p < .05$), Understanding ($t = 0$; $p < .05$). Applying ($t = 0.24$; $p < .01$), Creating ($t = 0.59$. $p < .05$). That is, the two groups does not differ much significantly after the treatment. Since the mean gain scores of the Experimental group is greater than that of the Control group, it is clear that the

Experimental group has outperformed the Control group in the component concept on Achievement in Mathematics. Therefore, it can be interpreted that Online tutoring in Mathematics is more effective in enhancing the Achievement of learners than Activity Oriented Method.

The graphical representation of the pre, post and gain scores of the Experimental and Control groups on the different components of Achievement in Mathematics for the total sample is shown in Figure 4.

Figure 4



5. CONCLUSION

When it comes to the subject Mathematics, most of the teachers in the classroom fail to bring a new perspective towards teaching Mathematics in the 21st century classroom. The Online Tutoring in Mathematics is more effective than Activity Oriented Method on enhancing Achievement in Mathematics of students at secondary level. That is, the students who had access to Online Tutoring along with the classroom teaching performed better than those taught using only Activity Oriented Method. The Online Tutoring is also effective in enhancing the various components of Achievement. For many students, getting passing marks in Mathematics is a big task in their academic life. This is the core reason why parents are forced to seek help from the private tutors outside the classroom. Online Tutoring is found to be effective in enhancing the Achievement in Mathematics. This method of education delivery has rapidly gained popularity during the COVID-19 pandemic as the entire education system has witnessed the shutdown of educational institutions (Team & Team, 2023). There are six levels of cognitive learning according to the revised version of Bloom's Taxonomy. The six levels are remembering, understanding, applying, analysing, evaluating, and creating. It is found that the Online tutoring is effective in enhancing the achievement in the components Remembering, Understanding and Creating. Remembering means recalling facts and concepts. Understanding means explaining ideas or concepts. Creating means producing new or novel works. Learners can adopt the online methodologies to remember the concepts learned, understand them deeply, and create something new out of it.

REFERENCES

[1] Alegre, F., Moliner, L., Maroto, A., & Lorenzo-Valentin, G. (2019). Peer tutoring in mathematics in primary education: A systematic review. Educational Review, 71(6), 767–791. https://doi.org/10.1080/00131911.2018.1474176

[2] Arroyo, I., Wixon, N., Allessio, D., Woolf, B., Muldner, K., & Burleson, W. (2017). Collaboration improves student interest in online tutoring. In E. André, R. Baker, X. Hu, Ma. M. T. Rodrigo, & B. Du Boulay (Eds.), Artificial Intelligence in Education (Vol. 10331, pp. 28–39). Springer International Publishing. https://doi.org/10.1007/978-3-319-61425-0_3

[3] Atkinson,R.C., Atkinson,R.L., & Hilgard,E.R.(2017).Introduction to Psychology. New Delhi: Cengage Learning

[4] Banyard, P. (2010). Essential psychology: A concise introduction.London: SAGE Publications.

[5] Barr, A.S., Good, C.V., & Scates,D.E.(2004). Encyclopedia of Educational Research Methodology.Hariyana:Shubhi Publications.

[6] Basavayya, D., & Venkataiah,N.(2016).Essence of Educational Research Methodology (1st ed.).Hyderabad: Neelkamal Publications.

[7] Best, J.W., & Khan, J.V. (2010). Research in Education (10th ed.). New Delhi: Prentice Hall of India (pvt) Ltd.

[8] Carlana,M. & Ferrara, E.L.(n.d.).Improving Educational Outcomes through Online Tutoring during Schools Closures in Italy during the Covid-19 Outbreak.J-PAL.https://www.povertyactionlab.org/evaluation/improving-educational-outcomes-through-online-tutoring-during-schools-closures-italy

[9] Çerkini, B., Zejnullahu, F., & Hyseni, D. (2022). Learning Mathematics Online Using Information Technology Tools during COVID-19 in Kosove. Journal of Computer and Communications, 10(04), 63–71. https://doi.org/10.4236/jcc.2022.104006

[10] Chappell, S., Arnold, P., Nunnery, J., & Grant, M. (2015). An examination of an online tutoring program's impact on low-achieving middle school students' mathematics achievement. Online Learning, 19(5), 37–53. https://eric.ed.gov/?id=EJ1085790

[11] Chauhan,S.(2020, July 8).Lesson Planning using Bloom's Taxonomy in my Math Classroom.Teachers of Tomorrow.https://connectedtot.com/2020/07/08/lesson-planning-using-blooms-taxonomy-for-math/

[12] Chu, H.-C., Chen, J.-M., & Tsai, C.-L. (2017). Effects of an online formative peer-tutoring approach on students' learning behaviors, performance and cognitive load in mathematics. Interactive Learning Environments, 25(2), 203–219. https://doi.org/10.1080/10494820.2016.1276085

[13] Clark, A. K., & Whetstone, P. (2014). The impact of an online tutoring program on mathematics achievement. Journal of Educational Research, 107(6), 462–466. https://doi.org/10.1080/00220671.2013.833075

[14] Cukurova, M., Khan-Galaria, M., Millán, E., & Luckin, R. (2022). A learning analytics approach to monitoring the quality of online one-to-one tutoring. Journal of Learning Analytics, 9(2), 105–120. https://eric.ed.gov/?id=EJ1358958

[15] Eyyam, Ramadan & Yaratan, Hüseyin. (2014). Impact of Use of Technology in Mathematics Lessons on Student Achievement and Attitudes. Journal of social behavior and personality. 42. 31-42. 10.2224/sbp.2014.42.0.S31.

[16] Field,A.(2016).An Adventure in Statistics: The Reality Enigma.California: SAGE Publications Inc.

[17] Freedman, D.,Pisani, R., & Purves, R.(2010).Statistics (4th ed.).New York: W.W.Norton & Company,Inc.

[18]Gewertz, C. (2022, April 18). Online tutoring can be effective, research shows. Education Week. https://www.edweek.org/leadership/online-tutoring-can-be-effective-research-shows/2022/04

[19] Hrastinski, S., Stenbom, S., Benjaminsson, S., & Jansson, M. (2021). Identifying and exploring the effects of different types of tutor questions in individual online synchronous tutoring in mathematics. Interactive Learning Environments, 29(3), 510–522. https://doi.org/10.1080/10494820.2019.1583674

[20] Johns, C., & Mills, M. (2021). Online mathematics tutoring during the covid-19 pandemic: Recommendations for best practices. PRIMUS, 31(1), 99–117. https://doi.org/10.1080/10511970.2020.1818336

[21]Keystone Education Group.(2022).Online Learning in 2023 - What Is It And How Does It Work.https://www.educations.com/study-guides/study-online/

[22] Kothari,C.R.(1992).An Introduction to Operational Research (3rd Revised ed.).New Delhi: Vikas Publishing House Pvt Ltd.

Koul, L. (1984). Methodology of Educational Research (3rd Revised ed.). New Delhi: Vikas Publishing House Pvt Ltd.

[23] Salmon,G.(2011).E-Moderating:The Key to Online Teaching and Learning (3rd ed.).New York: Routledge.

[24] Salmon,G.(2013).E-tivities The Key to Active Online Learning (2nd ed.).New York: Routledge.

[25] Samagra.(2021). e-Resources.https://samagra.kite.kerala.gov.in/#/layout/presentation

[26] Samagra.(2021). Textbooks.https://samagra.kite.kerala.gov.in/#/textbook/page

[27] Samagra.(2021).Question Bank.https://samagra.kite.kerala.gov.in/#/question-bank/page

[28] Thakur, P. (2016, August 30). Achievement Tests for Students Education. Your Article

[29] Williams, E. (2019, February 6). Online tutoring vs in-person tutoring: 10 reasons why online is better!.Third Space