

H0: There is no significant difference between the means of Pre and Post Test Scores of Students.

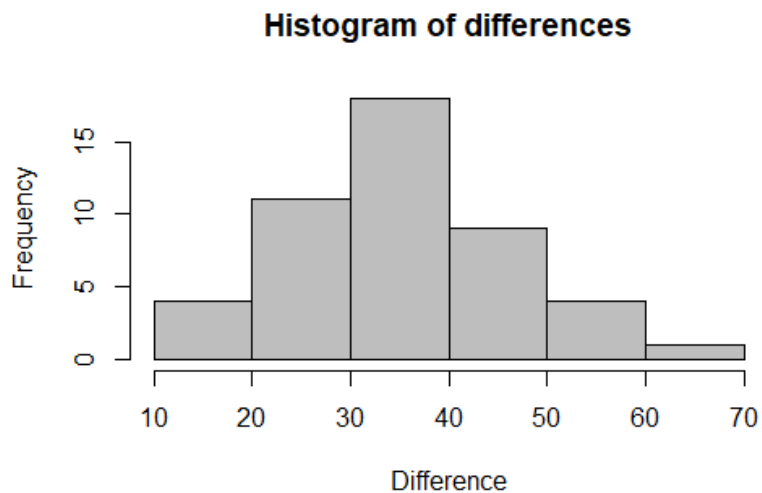
H0:  $\mu_{pre} = \mu_{post}$

Ha:  $\mu_{post} \geq \mu_{pre}$

Single tailed Paired T test is performed to analyze above hypothesis.

Following assumptions for paired T test were validated prior to conducting paired sample T test.

- 1) The pre and post scores are continuous in nature.
- 2) Observations for post and pre scores are independent of each other.
- 3) There were no significant outliers in the data.
- 4) The distribution of differences between two groups is approximately normal. This is evident in the figure below.



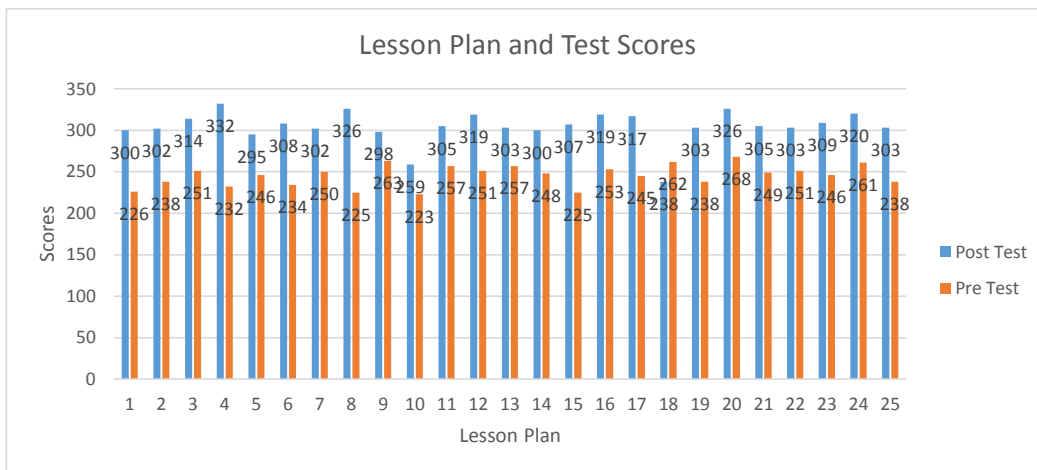
The skewness for both Pre and Post Test scores was less than 1 in absolute terms. Hence, the data for both Pre and Post test can be assumed to be normal as per George & Mallery (2010).

The result of Single tailed Paired sample T test is as follows.

**Comment [KJ1]:** George, D., & Mallery, M. (2010). SPSS for Windows Step by Step: A Simple Guide and Reference, 17.0 update (10a ed.) Boston: Pearson.

The P value came out to be  $< 2.2e-16$  and t value was 21.499, at 46 degrees of freedom. As P value is lesser than 0.05 alpha level and hence, the NULL hypothesis is rejected in favour of alternate hypothesis. Hence, it may be safe to assume that Post Test scores have a higher mean value than Pre Scores. This indicates that the Cooperative Learning Strategies are effective in developing English language skills of students at secondary level.

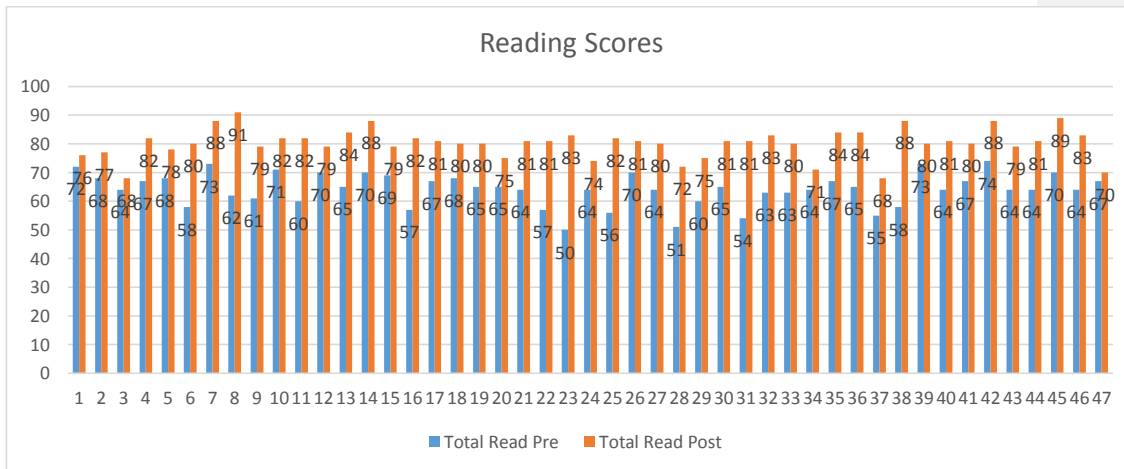
**Lesson Plan VS Pre and Post Test Scores:** The below graph and table summarize the scores for pre and post Tests against Lesson plans. All (for all lesson plans) Post Test scores are better than Pre Test scores with only exception in case of lesson plan 18, where pre score was higher than post score. The highest difference came out to be for lesson plan 8, followed by 4.



Lesson Plan	Post Test	Pre Test
1	300	226
2	302	238
3	314	251
4	332	232
5	295	246
6	308	234
7	302	250
8	326	225
9	298	263
10	259	223
11	305	257

12	319	251
13	303	257
14	300	248
15	307	225
16	319	253
17	317	245
18	238	262
19	303	238
20	326	268
21	305	249
22	303	251
23	309	246
24	320	261
25	303	238

**Pre Reading vs Post Reading Test Scores:** The graph and the table below summarize the pre and post reading test scores. All post reading scores are better than the pre reading scores. The highest difference of 33 is observed in record no. 23 and least difference of 3 is observed in record no. 47.

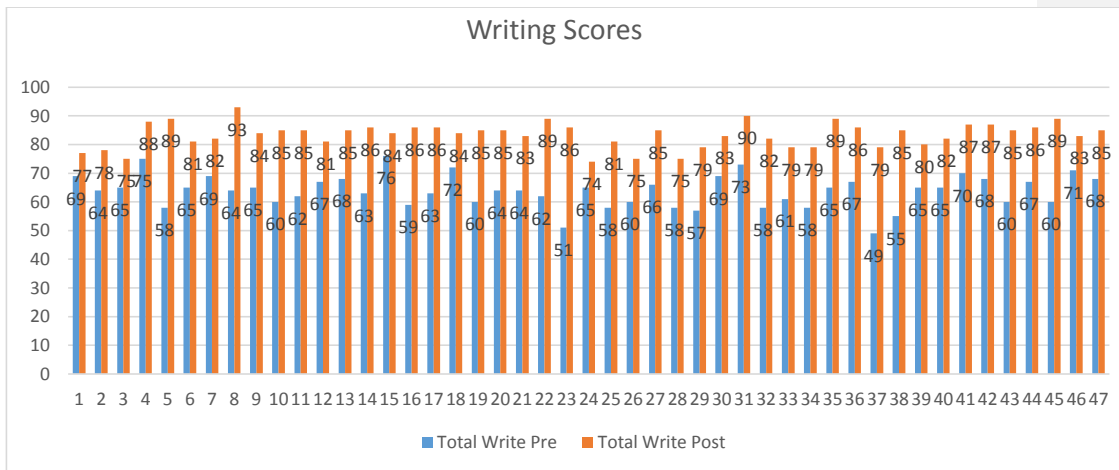


S.No	Total Read Pre	Total Read Post
1	72	76
2	68	77

3	64	68
4	67	82
5	68	78
6	58	80
7	73	88
8	62	91
9	61	79
10	71	82
11	60	82
12	70	79
13	65	84
14	70	88
15	69	79
16	57	82
17	67	81
18	68	80
19	65	80
20	65	75
21	64	81
22	57	81
23	50	83
24	64	74
25	56	82
26	70	81
27	64	80
28	51	72
29	60	75
30	65	81
31	54	81
32	63	83
33	63	80
34	64	71
35	67	84

36	65	84
37	55	68
38	58	88
39	73	80
40	64	81
41	67	80
42	74	88
43	64	79
44	64	81
45	70	89
46	64	83
47	67	70

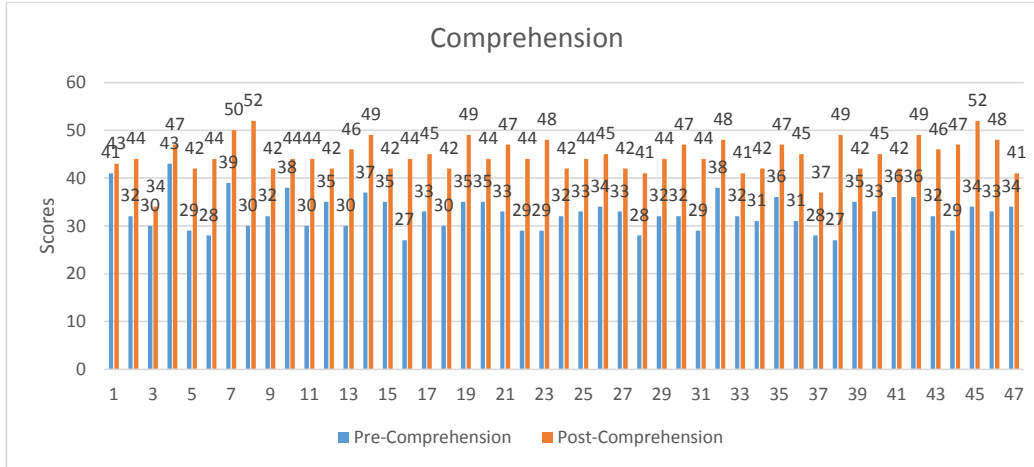
**Pre Writing Vs Post Writing Test scores:** The graph and the table below depicts the pre and post writing test scores. All post writing scores are better than the pre writing scores. The highest difference between the two is observed in record no. 23 and the least difference is observed in record no. 1 and 15.



<b>S.No.</b>	<b>Total Write Pre</b>	<b>Total Write Post</b>
1	69	77
2	64	78
3	65	75
4	75	88
5	58	89
6	65	81
7	69	82
8	64	93
9	65	84
10	60	85
11	62	85
12	67	81
13	68	85
14	63	86
15	76	84
16	59	86
17	63	86
18	72	84
19	60	85
20	64	85
21	64	83
22	62	89
23	51	86
24	65	74
25	58	81
26	60	75
27	66	85
28	58	75
29	57	79
30	69	83
31	73	90

32	58	82
33	61	79
34	58	79
35	65	89
36	67	86
37	49	79
38	55	85
39	65	80
40	65	82
41	70	87
42	68	87
43	60	85
44	67	86
45	60	89
46	71	83
47	68	85

**Pre Comprehension vs Post Comprehension Test Scores:** The graph and table below shows the pre and post comprehension scores. All post comprehension scores are better than the pre comprehension scores. The highest difference between the two is observed in record no. 8 and 38 with difference being 22. The least difference is observed in record no. 2 with difference being 2.



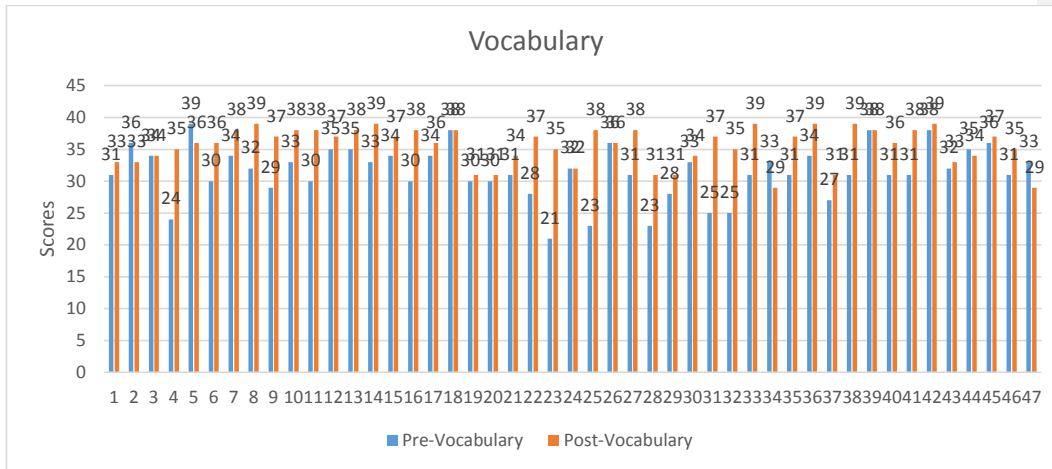
S.No.	Pre-Comprehension	Post-Comprehension
1	41	43
2	32	44
3	30	34
4	43	47
5	29	42
6	28	44
7	39	50
8	30	52
9	32	42
10	38	44
11	30	44
12	35	42
13	30	46
14	37	49
15	35	42
16	27	44
17	33	45
18	30	42
19	35	49



20	35	44
21	33	47
22	29	44
23	29	48
24	32	42
25	33	44
26	34	45
27	33	42
28	28	41
29	32	44
30	32	47
31	29	44
32	38	48
33	32	41
34	31	42
35	36	47
36	31	45
37	28	37
38	27	49
39	35	42
40	33	45
41	36	42
42	36	49
43	32	46
44	29	47
45	34	52
46	33	48
47	34	41

**Pre Vocabulary vs Post Vocabulary Test Scores:** The graph and the table below summarize the pre vocabulary and the post vocabulary test scores. Mostly post vocabulary test scores are better than the pre vocabulary test scores. Exception is seen in record no.2, 34, 44, and 47 where the pre vocabulary score is better than the post vocabulary score with the difference being

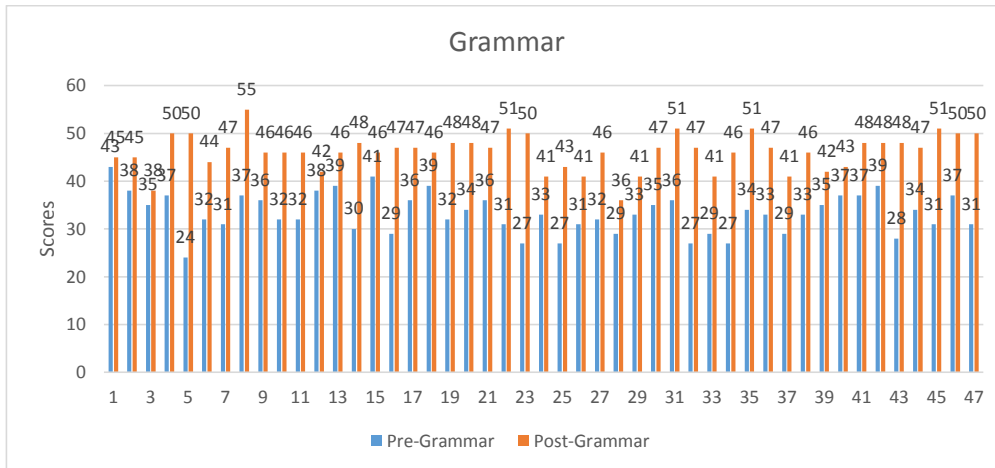
negative (post minus pre). The highest positive (post minus pre) difference between pre and post vocabulary score is observed in record no. 25, which is 15 units.



S.No.	Pre-Vocabulary	Post-Vocabulary
1	31	33
2	36	33
3	34	34
4	24	35
5	39	36
6	30	36
7	34	38
8	32	39
9	29	37
10	33	38
11	30	38
12	35	37
13	35	38
14	33	39
15	34	37

16	30	38
17	34	36
18	38	38
19	30	31
20	30	31
21	31	34
22	28	37
23	21	35
24	32	32
25	23	38
26	36	36
27	31	38
28	23	31
29	28	31
30	33	34
31	25	37
32	25	35
33	31	39
34	33	29
35	31	37
36	34	39
37	27	31
38	31	39
39	38	38
40	31	36
41	31	38
42	38	39
43	32	33
44	35	34
45	36	37
46	31	35
47	33	29

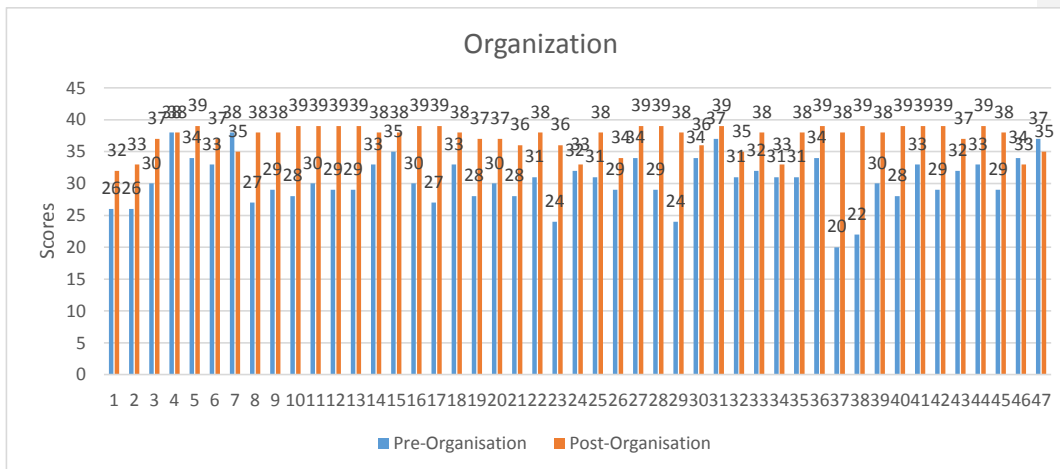
**Pre Grammar vs Post Grammar Test scores:** The graph and the table below depicts the pre grammar and post grammar test scores. All the post grammar scores are better than the pre grammar scores. The highest difference between the two is observed in record no.5 which is 13 units and the least difference is observed in record no.1, which is just 2 units.



S.No.	Pre-Grammar	Post-Grammar
1	43	45
2	38	45
3	35	38
4	37	50
5	24	50
6	32	44
7	31	47
8	37	55
9	36	46
10	32	46
11	32	46
12	38	42
13	39	46
14	30	48
15	41	46

16	29	47
17	36	47
18	39	46
19	32	48
20	34	48
21	36	47
22	31	51
23	27	50
24	33	41
25	27	43
26	31	41
27	32	46
28	29	36
29	33	41
30	35	47
31	36	51
32	27	47
33	29	41
34	27	46
35	34	51
36	33	47
37	29	41
38	33	46
39	35	42
40	37	43
41	37	48
42	39	48
43	28	48
44	34	47
45	31	51
46	37	50
47	31	50

**Pre Organisation vs Post Organisation Scores:** The graph and the table below depicts the pre organization and post organization scores. Mostly post organization scores are better than the pre organization score. Exception is observed in record no. 7, 46, 47 where the pre organization score is more than the post organization score. The difference (post minus pre) between the pre and post organization score is highest in record no.37, which is 18 units.



S.No.	Pre-Organisation	Post-Organisation
1	26	32
2	26	33
3	30	37
4	38	38
5	34	39
6	33	37
7	38	35
8	27	38
9	29	38
10	28	39
11	30	39
12	29	39
13	29	39
14	33	38

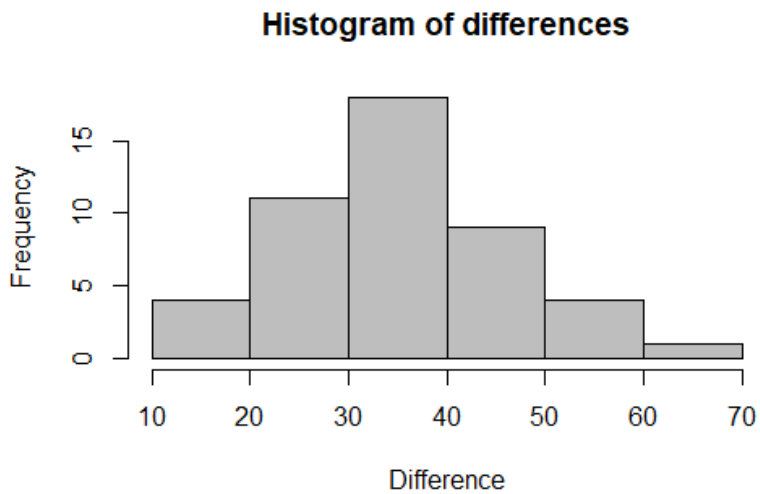
15	35	38
16	30	39
17	27	39
18	33	38
19	28	37
20	30	37
21	28	36
22	31	38
23	24	36
24	32	33
25	31	38
26	29	34
27	34	39
28	29	39
29	24	38
30	34	36
31	37	39
32	31	35
33	32	38
34	31	33
35	31	38
36	34	39
37	20	38
38	22	39
39	30	38
40	28	39
41	33	39
42	29	39
43	32	37
44	33	39
45	29	38
46	34	33
47	37	35

APPENDIX

R Code and Output

```
> library(moments)
Warning message:
package 'moments' was built under R version 3.4.4
> skewness(df$Score_PreTest)
[1] -0.7183304
> skewness(df$Score_PostTest)
[1] -0.4369948
```

```
Difference = df$Score_PostTest - df$Score_PreTest
> hist(Difference,
+ col="gray",
+ main="Histogram of differences",
+ xlab="Difference")
```



##### T TEST#####



T Test

```
t.test(x = df$Score_PostTest, y = df$Score_PreTest, alternative = "greater", paired = TRUE, var.equal = TRUE)
```

Paired t-test

data: df\$Score\_PostTest and df\$Score\_PreTest

t = 21.499, df = 46, p-value < 2.2e-16

alternative hypothesis: true difference in means is greater than 0

95 percent confidence interval:

33.11059    Inf

sample estimates:

mean of the differences

35.91489