2024

A Statistical Analysis on CKLA Curriculum

STA 419

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Introduction

Abstract

A statistical analysis on the impacts CKLA curriculum has on language and literacy development of English second language students.

CKLA (Core Knowledge Language Arts/Amplify) is language arts curriculum that uses sequential knowledge building and foundational skills instruction. Several tests are administered throughout the curriculum, scoring students on their skill level in phonics, fluency, spelling, and vocabulary. Pre and post test data will be analyzed to determine if the curriculum is effective for English learners. The goal is to prove that this approach to teaching can be used in secondary education as well.

Client Information

Jaimie Lomonaco is an English/ELL teacher at Godwin Heights high school, located in Wyoming, Michigan. Mrs. Lomonaco teaches English language arts to students who are English second language learners (ESL). Some of the students have also experienced an interruption in their schooling. The techniques developed by Mrs. Lomonaco aim to address these two issues, to more effectively impact her student's language arts learning experience.

The Project

Purpose

Ms. Lomonaco's research can be defined as an experimental study. In this case, the introduction of the CKLA curriculum is the treatment being applied to the students, who are the observational units. The population of interest for this study is all high school students who are English second language learners. The results are derived from a sample, which is all students in Ms. Lomonaco's class in 2024. The selection of the sample is not a random sample, since all the students will be used in calculating results. The total sample size is six, in which this restriction comes from the consent of each student's parents to participate in the study. At the start of the school year, each student is given a test that measures their initial knowledge of skills within the curriculum. Students are taught and tested on twenty-four different skills, increasing in difficulty throughout the program. The difference between the scores prior to, and after CKLA curriculum will be used as the response variable in the data analysis. Ms. Lomonaco shared that some values may be missing from the data set, due to students being absent on the day she administers a skill test. Some students do complete make-up tests, but some choose not to. Missing values will need to be removed to maintain the integrity of the results. Conclusions drawn from the analysis will need to include some discretion. Since this study involves information on students under 18, parental consent is required to be included in the data set. As it stands, data is only available to use from five different students. The lack of student data available make it challenging to draw proper conclusions for the population of interest. It is

important to clarify that findings from this study are limited, due to the sample's insufficient size. However, when more data is introduced into the study, the results will become more reliable.

Scope

The focus for our analysis is the results from the word recognition portion of the class. Word recognition refers to the ability of student to identify and understand words they are given in text. This includes the ability to comprehend words, as well as the patterns within the words. Patterns include recognizing elements such as phonics, syllables, prefixes, suffixes, and root words. Word recognition skills are a foundation for a student's ability to succeed in other areas of English, like reading comprehension and fluency. CKLA emphasizes these skills using special instructions and learning techniques. Since CKLA is predominately an elementary educational practice, Mrs. Lomonaco has developed all her own materials using the traditional ideas of the existing curriculum. Through the administration of test and collecting data on students, Mrs. Lomonaco is working towards influencing others to include these techniques into the secondary education level. Our role is to use the information she has collected to begin investigating how the program has performed thus far.

Analysis

Exploratory Data Analysis

To begin the analysis portion of our project, we started by doing exploratory analysis on student's scores for word recognition. Below is a side-by-side box plot showing the comparison in distribution of pre and post test scores. From this, we found that pre-test scores are normally distributed. Post test scores are also approximately normally distributed, but with a lot less variability that pre test scores.

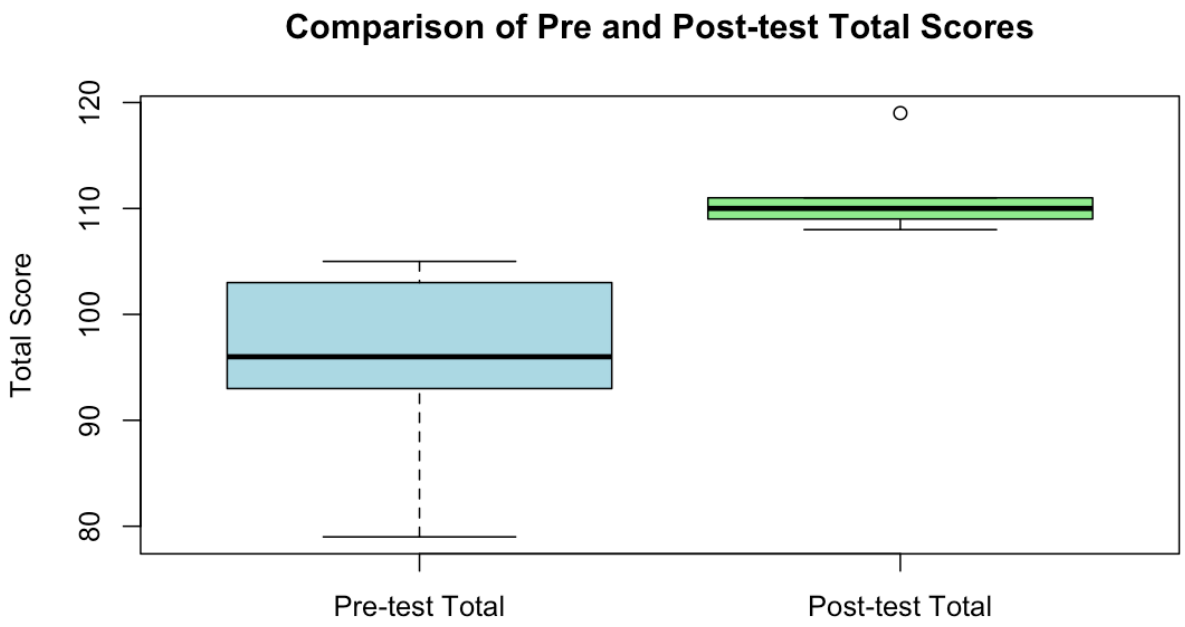


Figure 1

Five Number Summary

Figure [2] features a five number summary for pre and post test scores. Across the board, values for post test scores are higher than scores from the pretest. The average overall word recognition scores for pre and post are approximately 79% and 93%. These values gave us an initial insight as to how the post test scores consistently show improvement in the student's performance. In this figure we also found that the value for the median and average are very close for both scores. This is a sign that distribution of scores is approximately normal.

	Pre-Test	Post-Test
Minimum	66%	90%
Maximum	88%	99%
Median	80%	92%
Average	79%	93%

Figure 2

T-test

A Paired t-test is a procedure used for analyzing dependent samples of data. Since we will be using the comparison of each student's pre versus post test score, the data set is considered dependent.

The results from this test are shown below in figure [3]. The p value of 0.01802 tells us that at the 5% level, there is a statistically significant difference between the averages of pre and post test scores. Additionally, the mean difference value of -16.2 is less than zero, so we can say that on average, post-test scores are higher than pre-test scores.

From figure [3], we can also conclude with 95% confidence that average post test scores were between 4.57% and 27.83% higher than pretest scores. This is a positive sign, as it means Mrs. Lomonaco's teaching methods were successfully in increasing the student's ability to recognize words.

Paired t-test results

Test Statistics- t	-3.8681
Degrees of Freedom	4
p-value	0.01802
Mean Difference	-16.2
Lower Limit 95% Confidence Interval	-4.57203
Upper Limit 95% Confidence Interval	-27.82797

Figure 3

Linear Regression

Linear regression is used to assess whether pre-writing total scores serve as a significant predictor of post-writing total scores, providing insight into the relationship between initial writing proficiency and subsequent writing outcomes among students. Below in figure [4] is a linear regression analysis between pre-writing total and post-writing total scores.

The intercept is 94.4576, indicating that the estimated mean post-writing total score is 94.4576 when the pre-writing total score is zero. However, since pre-writing total scores are unlikely to be zero, the interpretation of the intercept in this context is not meaningful.

The coefficient estimate for pre-writing total score is 0.1780. This means that for every increase in pre-writing scores, the post-writing total score is expected to increase by 0.1780 points. However, since (p-value=0.4843) there is insufficient evidence to conclude that there is a linear relationship between pre-writing total and post-writing total scores. This model is not statistically significant at the 0.05 level.

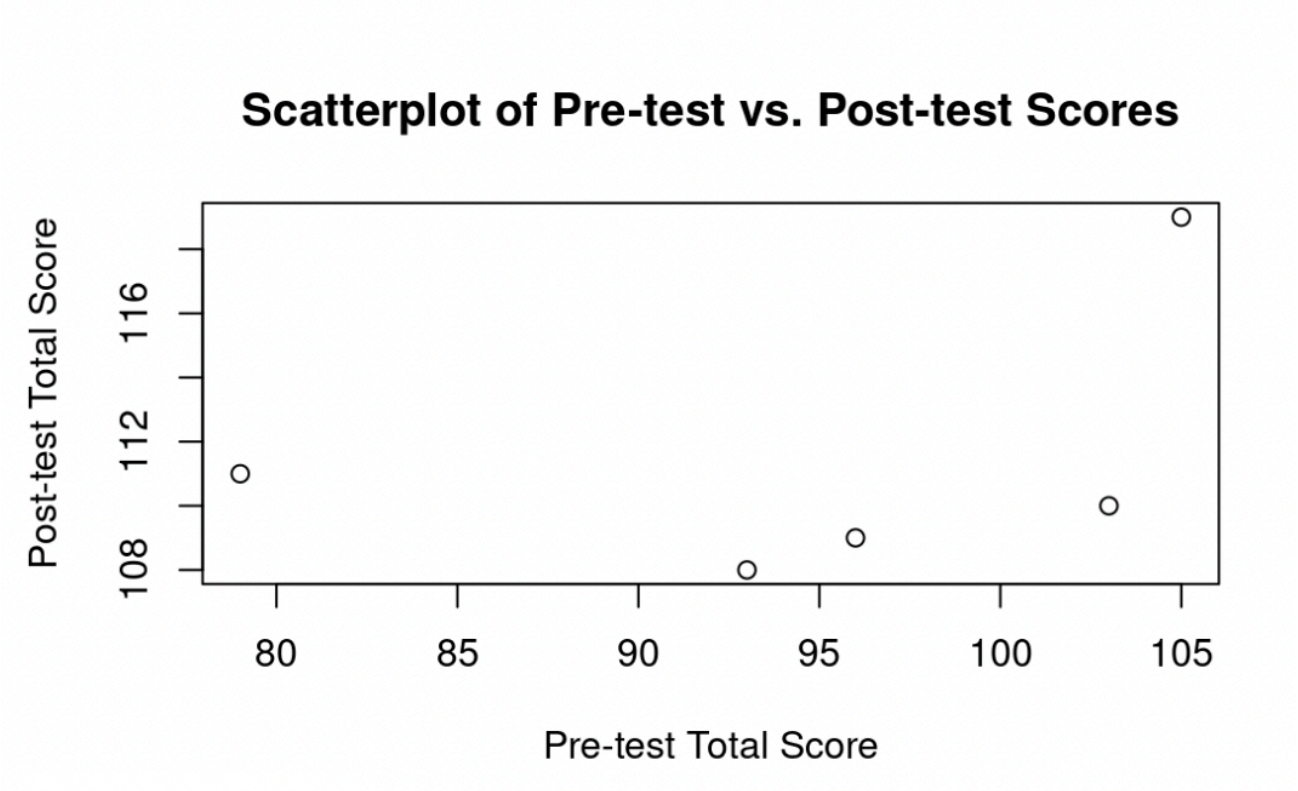
The multiple R-squared value of 0.1743 indicates that approximately 17.43% of the variability in post-writing total scores is explained by the linear relationship with pre-writing total scores. However, the adjusted R-squared value is negative (-0.101), which suggests that the model may not adequately fit the data.

In conclusion, there is insufficient evidence to conclude that there is a linear relationship between pre-writing total and post-writing total scores. The regression model does not provide a good fit to the data, and the pre-writing total score does not significantly predict the post-writing total score.

```
Call:
lm(formula = PoWRTotal ~ PreWRTotal, data = CKLA)

Residuals:
     1      2      3      4      5
 5.856 -2.542  2.483 -3.008 -2.788

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  94.4576    21.3912   4.416   0.0216 *
PreWRTotal    0.1780     0.2237   0.796   0.4843
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 4.61 on 3 degrees of freedom
Multiple R-squared:  0.1743,    Adjusted R-squared:  -0.101
F-statistic: 0.6332 on 1 and 3 DF,  p-value: 0.4843
```

Figure 4

Correlation Coefficient




```
[1] 0.4174658
```

Figure 5

Correlation coefficients quantify the strength and direction of the relationship between variables. The correlation coefficient value of 0.417 between pre and post scores indicates a moderately positive correlation between the two variables. Since the correlation is positive, it suggests that higher pre-test scores are associated with higher post-test scores, and vice versa. From the graph, an exponential relationship appears to be a better fit for this data set.

Conclusions

Results

The exploratory data analysis gave insight into the progress student's experienced because of CKLA curriculum. The results from the five number summary in figure [2] showed that post test scores were higher across the board. This tells us that the student's did tend to improve their word recognition ability.

In figure [3], the results from the one sample dependent t-test indicated that a statistically significant difference between pre and post test scores was present. This means that the curriculum did succeed in increasing skills in word recognition. Additionally, the confidence interval provides an estimate as to how significant the student's improvement was.

As shown in figure [4], a weak linear relationship is present between pre and post test scores. Further analysis into this relationship is shown again in figure [5]. The correlation coefficient of 0.417 tells us that a moderately positive relationship is present in the scores. This meaning that as pre-test scores increased, post-test scores tending to increase on average as well. These results are likely due to the individual abilities and prior knowledge of each student.

Further analysis can be done regarding the relationship between pre and post test scores once more data has been collected. Based on the scatter plot shown in figure [5] a linear relationship may not be the best fit for this data. An exponential relationship appears to be present, which can be analyzed further with more observations.

Limitations

Due to a lack of permission from the parents of Mrs. Lomonaco's students, we were only able to access data for six different individuals. In statistical analysis, a lack of data poses a threat to the reliability of the results. Although we were able to find some significant evidence of the student's improvement, the results are limited due having only six students included in the data set. It is important that the conclusions made from our analysis continue to be monitored as more data becomes available.

Recommendations

Our recommendation to Mrs. Lomonaco is to continue collecting scores for several more years. Keeping consistency in the test given and materials used to teach each skill will also be integral to maintaining the integrity of future analysis. Scores will also need to be recorded in the same manor, to allow the existing code to be ran again as more data is collected.

When more data is included in the study, the results from statistical test will be more reliable. This will also provide Mrs. Lomonaco's with stronger evidence to prove the success of her curriculum.

Appendix

Sources

“Language Arts.” *Core Knowledge Foundation RSS*, www.coreknowledge.org/language-arts/.