COMPARING THE LEARNING OUTCOMES IN SCIENCE OUTREACH BETWEEN ELEMENTARY CHARTER SCHOOLS AND TITLE ONE ELEMENTARY SCHOOLS

Atoosa M. Samani, Prerna Kamath, Mikayla Rosequist, Rebecca King, Bradford Stockman (Amy Sibul)
Department of Biology

Abstract

For the past 15 years, the outreach program Elemental Expeditions (EE), has made great strides towards broadening the educational opportunities available to local elementary schools. Even though Title One schools and Charter schools are both considered public schools, the population they serve is significantly different. Taking this into consideration, an experiment was designed using three different questions to measure student's ability to recognize factual and non- factual concepts taught during the demonstrations. The hypothesis stated that Charter school students would perform better than Title One students in all three tested categories. The results showed that both institutions displayed improvement in the post-assessment compared to the pre-assessment; however, there was a statistically significant difference between the scores of the students in all three tested categories. While Title One school students showed statistically significant improvement only in factual questions, the Charter school students showed statistically significant improvement in all three tested categories.

Introduction

Elemental Expeditions (EE) has built strong ties throughout the local community by promoting Science, Technology, Engineering, and Math education (STEM) to disadvantaged youth attending resource-limited schools through hands-on chemistry experiments and interactive lesson plans. For the past two years, EE has incorporated pre- and post-quizzes to measure the students understanding of the concepts taught.

This project was an expansion of the outreach program to compare results of Charter students and Title One students within the same geographic area.

Title One schools are elementary schools for children from low income families in need of financial assistance. [1] Charter schools are public, tuition-free schools that are open to all students and established by teachers, parents, or community groups under the terms of a Charter with a local or national authority. Parents also have more involvement with their child's education in a Charter school. [2]

Charter schools are structured differently across the United States. Nationally, over the past 10 years, the population of Charter schools has increased from 349,714 to 2.5 million and the number of Charter schools has increased from 1542 to 6440. [3]

Among the 40 states that provide the opportunity to attend a Charter school, the state of Utah was ranked 4th for having the best Charter law structure by the Center of Education Statistics in 2010. [4] Experimental testing was completed to determine whether there was a difference between Charter and Title One school students in grasping factual and non-factual concepts from the demonstrations. The study population was 1,108 divided equally between Charter and Title One schools.

Method

Target schools were contacted with information regarding the STEM outreach program and chemistry experiments. If the schools were interested, information was exchanged regarding pre- and post-assessments, demonstration dates, and class sizes. Arrangements were made for the students to take the pre-quiz prior to the expedition presentations.

The presentations included concepts of exothermic reactions, creating polymers, static electricity, physical changes and states of matter, temperature and pressure, surface tension, acid/base chemistry, and PH indicators. These were emphasized through oral and hands on experimental demonstrations by a diverse group of presenters of both genders and different cultural backgrounds. In addition to these concepts, the pre- and post-assessments included nonfactual questions regarding implicit biases and factual questions regarding chemical makeup. Several days after the expedition, reformatted versions of the pre-quiz were given to the students as a post-quiz. After both the pre- and post-assessments were collected, the data from every quiz was entered individually. For confidentiality reasons, the quizzes were not compared on an individual basis; rather, the responses were analyzed as a whole. When analyzing the data from both schools' pre- and post-quizzes, the percentage change was calculated. When the difference was compared, a percentage difference was found. A two tailed t-test was paired to find p-values between all the previously described relationships. P-values smaller than 0.05 are assumed to be significant while p-values greater than 0.05 are not significant. [5]

Results and Discussion

The results show that there was a significant difference between the scores of pre- and post-quizzes in Charter schools in all three tested categories. In total, Charter school students scored 15.24 out of 36 on the pre-quiz; on the post quiz they scored 17 out of 36, which is an 11.56% increase with a p-value of 1.44×10^{-5}.

Broken down, the average score of each Charter participant on pre-quiz question 1 was 3.94 out of 12; the post quiz score was 4.74 out of 12, which shows a 20.34% increase with a p-value of 5.17×10^{-6}. The average score on pre-quiz question 2 was 6.10 out of 12; the post quiz returned with a score of 6.68 out of 12, which shows a 9.56% increase and a p-value of 2.25×10^{-3}. The average score on pre-quiz question 3 was 5.20 out of 12; the post quiz was 5.61 out of 12, which shows a 7.88% increase and a p-value of 2.34×10^{-3}. Although the overall increase was small for questions 2 and 3, the data shows that the pre-quiz answers were already high to begin with. These results shows that Charter school students improved both on factual concepts and nonfactual concepts.

The results show that there was only a slight significant difference between the scores of the pre- and post-quizzes in Title One schools on the third question but there was no statistically significant improvement in questions 1 and 2. In total, Title One school students scored 13.72 out of 36 on the pre-quiz; on the post quiz they scored 14.45 out of 36, which is a 5.34% increase with a p-value of 6.02×10^{-2} which is not statistically significant.

When analyzed, the average score of each Title One participant for question 1 was 3.63 out of 12; the post quiz score was 3.82 out of 12, which shows a 5.42% increase with a p-value of 1.97×10^{-1} which does not show any statistical significance. For question 2, the average score was 5.34 out of 12 for the pre-quiz and 5.59 out of 12 for the post quiz. Which showed a 4.63% increase and a p-value of 1.92×10^{-1} which again doesn't show any statistical significance. For question 3, the average pre-quiz score was 4.75 out of 12 and 5.03 out of 12 for the post quiz. Which was a 6.08% increase and a p-value of 3.59×10^{-2} which is somewhat statistically significant.

These results showed that the Title One students improved in factual questions, even if the improvement was significant. However, their implicit bias was not reduced in this process.

Comparing pre-quiz results of the Charter and Title One schools, revealed that there was a difference in responses to the factual and nonfactual questions.
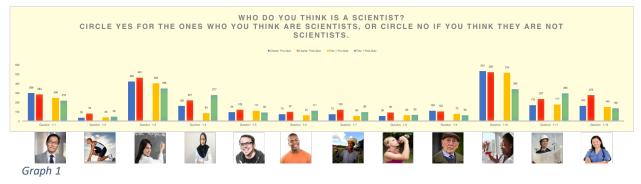
Overall, there was a 10.46% difference with Charter school students having higher scores than Title One school students. A paired two tailed t-test showed that the p-value is equal to $4.59×10^{-5}$ which indicates that there is a statistically significant difference between the scores of Charter school students and Title One school students.
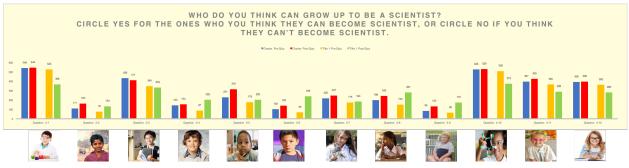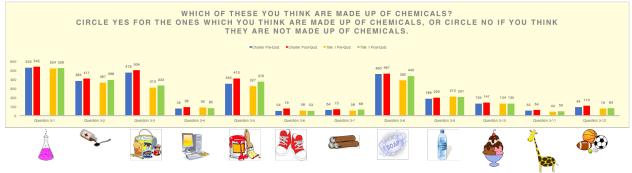
Broken down, in question 1 (nonfactual), there was an 8.25% difference with Charter school students having a statistically significant higher score with a p-value of $3.43×10^{-2}$. In question 2 (nonfactual), there was a 13.19% difference with Charter school students having a statistically significant higher score with a p-value of $1.97×10^{-5}$. In question 3 (factual), there was a 9.00% difference with Charter school students having a statistically significant higher score with a p-value of $6.79×10^{-4}$. title One schools were compared as well.

This comparison exposed that the gap between Charter and Title One students grew more significantly in the post-quizzes of the Charter schools and T the post-quizzes. Overall, there was a 21.00% difference with Charter students having higher scores than Title One students. The paired two tailed t-test showed that the p-value is equal to $2.29×10^{-9}$ which indicates that the difference is much higher than what it was in the pre-quiz.

Broken down, in question 1 (nonfactual), there was a 27.56% difference with Charter school students having a statistically significant higher score with a p-value of $3.65×10^{-7}$. In question 2(non-factual), there was a 23.01% difference with Charter school students having a statistically significant higher score with a p-value of $9.39×10^{-8}$. In question 3 (factual), there was a 14.00% difference with Charter school students having the higher score and a p-value of $5.45×10^{-5}$ which is statistically significant.

While the presentations significantly improved the students answers in factual questions in both schools, the same cannot be said for nonfactual questions related to personal implicit biases in Title One schools. It is believed that the form of the presentation was not reaching Title One school students' implicit biases.
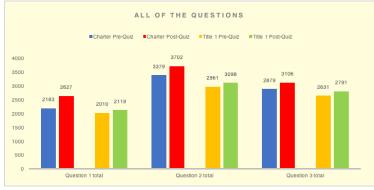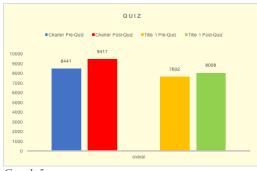

Graph 1

Graph 2

Graph 3

Graph 4

Graph 5

Percent Change	20.34%	5.42%	9.56%	4.63%	7.88%	6.08%	11.56%	5.34%

Graph 6

Conclusion

A significant improvement has been observed for Charter school students in all three tested categories of factual and nonfactual questions; however, the students at Title One schools only showed improvement in the factual questions, and didn't show any significant change overall. Charter school students had stronger results in all three tested categories when compared to Title One school students. Therefore, the null hypothesis can be refuted and the original hypothesis can be accepted.

Future Work

Elemental Expeditions will continue its outreach programs to Title One schools, Charter schools, and Title One Charter schools by improving the way the experiments are taught to the students of from all institutions and by enhancing our presence throughout the year. Utilizing the data compared between institutions, we will be using different approaches and alternative experiments for Title One schools to improve their understanding and retention of STEM subjects, while also growing their excitement for these fields.

References

1- *The NCES Fast Facts Tool provides quick answers to many education questions* (National Center for Education Statistics). (n.d.). Retrieved from https://nces.ed.gov/fastfacts/display.asp?id=158.

2- *National Alliance for Public Charter Schools*. (n.d.). Retrieved from https://www.publicCharters.org/about-Charter-schools.

3- Berends, M. (2015). Sociology and School Choice: What We Know After Two Decades of Charter Schools. *Annual Review of Sociology, 41*(1), 159-180. doi:10.1146/annurev-soc-073014-112340.

4- Ni, Y., & Rorrer, A. K. (2012). Twice considered: Charter schools and student achievement in Utah. *Economics of Education Review, 31*(5), 835-849. doi:10.1016/j.econedurev.2012.06.003.

5- Boos, D. D., & Stefanski, L. A. (2011). P-Value Precision and Reproducibility. *The American Statistician, 65*(4), 213-221. doi:10.1198/tas.2011.10129.