Impact of *Science from Scientists* Programming on the Science Achievement of Participating Students

Summary of Technical Report—September 2020

Evaluation design, analysis and reporting conducted by STEM Education Consultant Beth Murphy, PhD & Data Scientist Eric Vanden Berk, PhD. For more information, contact Renee Piersa, Minnesota Operations Director, Science from Scientists at renee@sciencefromscientists.org or (952) 686-1271.

STUDY DESIGN

Purpose. This report summarizes findings from a study to answer the question: *Do students who participate in Science from Scientists programming demonstrate improvements to academic achievement in science compared to those who did not participate in the program?*

Methodology. This study utilized propensity score matching to create treatment (students who participated in *Science from Scientists* programming, all from the same school) and control (students who did not participate in programming from different schools within the same school district) groups that were balanced on a set of covariates[1] that are reasonably thought to influence the outcome of interest. For this study, the outcome of interest is performance on the grade 5 Minnesota Comprehensive Assessment (MCA) in Science—which students took in the spring of fifth grade, toward the end of their participation in *Science from Scientists* programming. Propensity score matching uses a probability model to create a set of control students matched to the treatment, resulting in two groups of students for comparison that have similar characteristics prior to the treatment group's participation in programming.

The covariates used in this study included two academic and five demographic variables. Academic variables included (1) attendance during the school years under study,[2] and (2) prior achievement on the grade 3 MCA in math. Since students in Minnesota do not take the MCA in science until grade 5, the grade 3 math scores were used as a proxy for prior science achievement. Demographic variables included: (3) gender, (4) race/ethnicity, (5) free/reduced lunch (FRL) status, (6) Special Ed status, and (7) English learner (EL) status.

Treatment Group. Two cohorts of students from the same school received *Science from Scientist* programming during both fourth and fifth grade. Sixty-two students in the first cohort participated in the 2016-17 (fourth grade) and 2017-18 (fifth grade) school years. In addition, 50 students participated in the second cohort during 2017-18 (fourth grade) and 2018-19 (fifth grade), for a combined treatment group of 112 students. Each cohort received nine classroom visits per school year, for a total of 18 hours of *Science from Scientists* programming over two years.

Control Group. During the two-year time period of interest (2016-17 and 2017-18 school years), there were 979 fifth graders in the district who did not participate in *Science from Scientists* programming. Using a 1:1 ratio, propensity score matching was used to create a set of 112 non-participants matched with the treatment group based on the covariates listed above. Analysis of the differences between treatment and control groups indicated that from a statistical standpoint the two groups are identical in terms of the seven covariates used for propensity score matching.

Student demographics for the treatment and control group can be seen in Table 1.

[1] *A covariate is a variable that is not of direct interest, but which needs to be accounted for as part of the study because it has the potential to influence the outcome.*

[2] *Attendance was measured by enrollment at both the beginning and end of the school years under study.*

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Table 1: Treatment and control groups have similar demographic characteristics.

	Treatment		Control**	
	N	%	N	N
MALE	56	50%	55	50%
FEMALE	56	50%	56	50%
WHITE	72	64%	72	65%
SOC*	40	36%	39	35%
NON EL	99	88%	98	88%
EL	13	12%	13	12%
NON FRL	75	67%	71	64%
FRL	37	33%	40	36%
NON SPEC ED	95	85%	95	86%
SPEC ED	17	15%	16	14%

**SOC is an abbreviation for students of color.*
***Note that Science MCA data was missing for one student in the control group. This does not impact analysis nor interpretation of findings.*

Analysis. Once treatment and control groups were established, the impact of the *Science from Scientists* program on students' grade 5 MCA Science achievement was evaluated statistically using regression analysis. Science achievement was considered in two ways: (1) Science scores and (2) Science proficiency.[3]

RESULTS

Findings. Students in the study who received the *Science from Scientists* program had significantly higher grade 5 MCA Science scores and were more likely to be proficient than their matched sample peers. The effect size for these results were somewhat modest, therefore results should be interpreted with appropriate caution.[4]

Considered in greater detail, the average grade 5 MCA Science score was 51.3 for the treatment group compared to 48.7 for the control. Linear regression indicated that the treatment condition, i.e. participation in *Science from Scientists* programming over two years, was a significant individual predictor (p=0.006), with a small to moderate effect size (d=0.25).[5] Logistic regression was then used to estimate treatment effects on grade 5 MCA Science proficiency. On this measure, the treatment group had a proficiency rate of 0.66 compared to 0.56 for the control group. The treatment condition was also a

[3] *Proficiency indicates the percentage of students who are considered to be performing at or above grade level.*
[4] *Effect size is a measure of the difference between the mean scores for the treatment and control groups relative to the standard deviation of scores.*
[5] *A p-value of less than 0.05 is typically used for the threshold for statistical significance in similar studies. A p-value of 0.05 means that there is a 5% chance that the findings are due to random sampling error.*

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significant predictor in this model (p=0.041), with a small to moderate effect size (d=0.21).[6] A summary of these findings can be found in Table 2.

Table 2: Grade 5 MCA Science scores and proficiency levels were higher for students who had participated in *Science from Scientists* programming than for a control group.

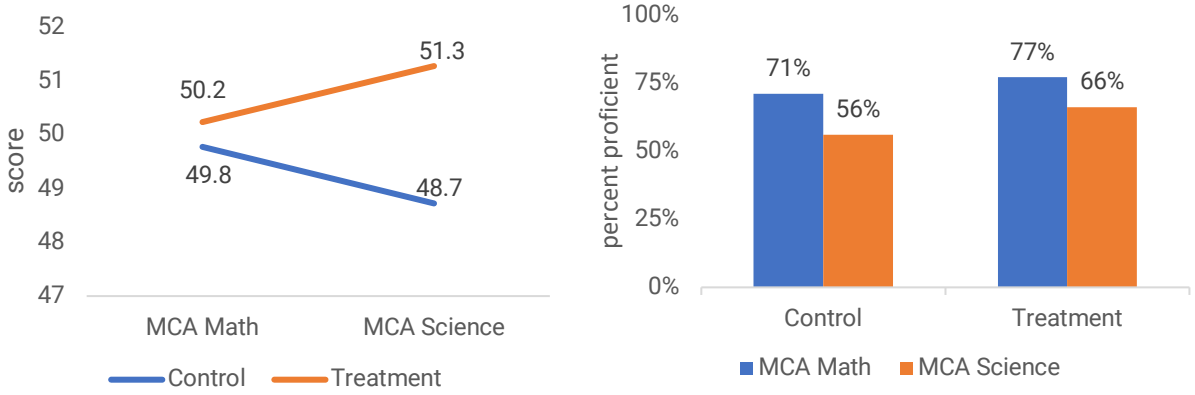
	Treatment (N)	Control (N)		
Outcome	Mean	Mean	P-value	effect size (Cohen's *d*)
Science score	51.27 (112)	48.72 (111)	0.006	0.25
Science Proficient	0.660 (112)	0.560 (111)	0.041	0.21

Note that Science MCA data was missing for one student in the control group. This does not impact analysis nor interpretation of findings.

Another useful measure to consider is the "risk difference" which considers the difference in probability of an event between two groups. Analysis shows that there is a 7% chance that *Science from Scientists* programming would result in improved Science scores and an 18% chance of improved Science proficiency.

Comparisons for treatment and control groups in terms of pre to post change in science scores and proficiency can be seen in Figure 1. Figure 2 shows the difference in Science scores for the two groups in terms of demographic subgroups.

Figure 1. While treatment and control groups had similar pre scores and proficiency, students participating in *Science from Scientists* programming showed larger pre to post change.



While not a component of the statistical analysis, it is of interest to investigate what if any impacts the program had on different student sub-groups. Figure 2 shows that difference scores were consistently in the expected direction for all subgroups suggesting that the program's effects were generalized across all student groups.

[6] *Effect sizes of 0.25 for science scores and 0.21 for science proficiency indicate that differences in mean values were 25% and 21% of a standard deviation higher for the treatment group when compared to the control group.*

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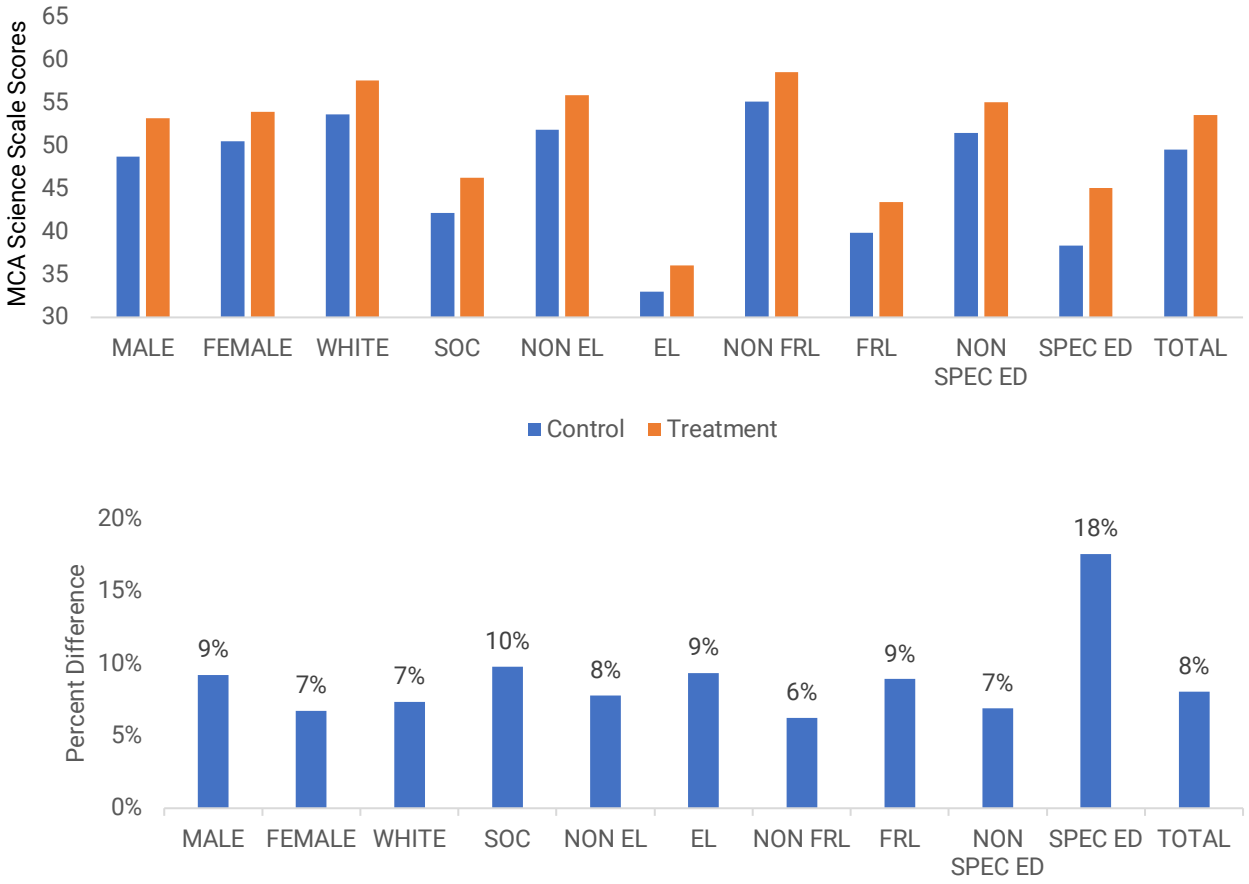
Figure 2. Grade 5 MCA Science scores were consistently higher for students who participated in *Science from Scientists* programming across all demographic subgroups, viewed in terms of scores and percent difference.



Limitations & Further Research. Possible caveats include the fact that prior Science achievement could not be included as a covariate, as statewide MCA Science testing in Minnesota starts in grade 5, and thus statewide MCA math performance was used as a proxy for this study. Future study designs could benefit from using a more direct measure of prior Science achievement, possibly MAP or FAST.

As with any quasi-experimental design such as propensity score matching, it is never known exactly how well the model specifies or if all important covariates were included. However, balance statistics showed no indication of residual confounding, meaning that from a statistical standpoint there was no difference between treatment and comparison groups prior to treatment in this study.

Finally, given that there was an overall treatment effect found, it would be of interest in the future to investigate program impacts on special populations who are considered underrepresented and/or underserved in STEM—including girls, low-income students, and students of color. Results of the current evaluation regarding these sub-groups were encouraging but require replication and further study.