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## The Impact of the Lawrence@MIT Program on Students' Desire to Attend College

### *Summary*

This study looks to measure the effect of participating in multiple science and technology workshops at MIT through the Lawrence@MIT (L@M) Program on students' inclination to attend college. Responses on pre-treatment surveys find students already aspire to attend college and believe science is important. Beside the fact that more students believe they will use science in their future career after participating in L@M, no other increase in response agreement shows statistical significance. Given the students' baseline beliefs future program evaluation surveys should ask more in-depth survey questions to assess if students understand the amount of work and preparation it requires to attend college in addition to whether they plan on attending higher education. If these additional surveys do not show L@M correlated with a greater understanding of what it takes to reach college, than maybe this program is better suited for one of the public schools, where students are further behind academically, than at the charter school, where college attendance is emphasized.

The pre and post surveys provide information to explore additional ideas. For instance, we can predict that participants most wanting to attend MIT are male, found the field trips to MIT met their expectations, and thought their MIT experience was significant.

### *Background*

As a research assistant with MIT@Lawrence, I coordinate the Lawrence@MIT (L@M) program, which brings forty-nine 8<sup>th</sup> grade students from the Lawrence Family Development Charter School (LFDCS) to MIT once a month to take part in science and technology workshops. The program has two goals. The first is to use the vast resources at MIT to improve student

understanding of science content being taught at their school. The second, and subject of this science, is to inspire students to attend college by exposing them to college subject matter and lifestyle. If students come to MIT and are engaged in science and technology topics, than they are likely to believe the subject matter important enough for further study, leading them to want to continue through college. In Lawrence, only 54% of students graduate from high school and even less attend college. In having students explore MIT, learn the types of research taking place here, and interact with college students, this program is one opportunity to change these trends.

It is a challenge to quantify whether participating in L@M encourages students to attend college, or particularly MIT, and if they have gained a new appreciation for science and its role in their future studies. Often achievement of these goals is described anecdotally, but in an era of budget cuts and data driven instruction, a program quantitatively showing it helps students set goals for continuing education can ensure school funding for the bus that brings the students to MIT. Quantitative results can also be used to make a case for replicating this program in other schools in the city and beyond.

### *Methodology*

This study can be approached as a straightforward experiment that follows the scientific method. The most basic hypothesis this assignment tests is: “if the LFDCS 8<sup>th</sup> grade students attend workshops at MIT, than they will be more likely to aspire to earning a college degree. The null hypothesis is than: “If the LFDCS 8<sup>th</sup> grade students attend workshops at MIT, than there will be no difference in their desire to attend college.” The independent variable is the MIT workshops and the dependent variable is their desire to attend college. Students answered a set of questions assessing their thoughts about science and college as part of a larger survey before

visiting MIT for the first time. These same key questions were also asked after their sixth and final visit to campus. These surveys can be found in appendix A.<sup>1</sup>

All of the eighth grade students at LFDCS participate in L@M so there is no self-selection bias regarding who chooses to attend the program. However findings from this study are not necessarily generalizable to the general Lawrence eighth grade population as LFDCS eighth grade students are most likely not a representative sample. Qualitatively the students at LFDCS are probably distinct from the greater population and probably more likely to want to attend college. Students must apply to LFDCS, signaling they may have a stronger investment in education and greater parental or guardian support for their education than students who attend neighborhood schools. Students graduating from LFDCS are also more likely to attend a private high school with financial assistance.<sup>2</sup>

This study has several threats to validity that should be noted up front. One limitation is the study lacks a control group. While beyond the scope of this project, this could have been remedied by having students similar to those attending LFDCS take the same pre and post survey without having the treatment of participating in L@M. As the study currently stands, it is possible that the difference between pre and post survey responses is due to some other variable that affected all Lawrence youth instead of differences being associated with participating in the L@M program. A talk at all middle schools by a college admission's office about the value of a college education or some other change in the greater world that all students might be responding

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<sup>1</sup> The common pre/post statements that have students ranking on a scale of one to five, with one being strongly disagree and five being strongly agree are: In my future I will use science and technology. I enjoy learning scientific information. Science is important in understanding everyday life. Science causes me to think differently about the world. One of my goals is to attend and graduate college. I would like to attend and graduate from MIT. These will be the focus of the bulk of this study.

<sup>2</sup> Talk by LFDCS Superintendent Ralph Corroero, May 1<sup>st</sup>, 2009.

to is also known as the history effect. The maturity effect also challenges the study's validity. Maybe students have grown to think more about college over the year irrespective of the program. Ideally we want students to be inspired to attend college because of the academic opportunities. In this study, however, there is uncontrolled noise in that students may want to come to college because they find the food good or that they do not have a curfew. These elements cannot be separated from the academic reasons for attending college.

A separate challenge that merits some discussion is that none of the data is technically at an interval level. This is a common problem for social scientists.<sup>3</sup> I plan to treat the 1-5 and 1-10 ranked items as if they are on an interval scale. The argument for this being that each number is approximately the same amount apart from the numbers it is next to. There is a range between agree and strongly agree, but this distance approximates the distance between agree and no opinion or strongly disagree and disagree.

### *Key Findings*

Thirty-eight of the forty-nine eighth grade students completed the pretreatment survey and forty-three completed the post survey. Five of the forty-nine students did not complete either the pre or post surveys. Thirty-seven students conducted both pre and post surveys, which allows for the use of more statistically powerful matched tests. However, before completing these inferential tests, it is helpful to review some of the descriptive information listed in Table 1 and Table 2 in Appendix B. On the pre surveys, students tended to be more in agreement with the statements presented than in disagreement. This is seen through the high mean and median scores. Also the 3<sup>rd</sup> quartile on many of the measures is often at 5, the strongly agree

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<sup>3</sup> For more information regarding the ordinal-interval debate see Kenneth J. Meier, Jeffrey L. Brudney, and John Bohte. *Applied Statistics for Public and Nonprofit Administration*. Thomson Wadsworth, 7<sup>th</sup> edition, 2009, pgs 89-90.

category. In particular, the statement of “One of my goals is to attend and graduate college” shows a ceiling effect. While the mean student score increases from 4.68 on the pre survey to 4.74 on the post survey, this is on the extremely high side of the spectrum. The median in both cases remains at 5. Figure 1 and Figure 2 in Appendix B illustrate the student responses to this statement about college. Responses to other statements like “Coming to MIT met my expectations” had much more variance. This is illustrated in Figure 3 of Appendix B. However, here too we find students tend to be more on the agreement side of the spectrum.

Paired t-tests measure the effect of the L@M program on students’ different attitudes about science and college as asked on both surveys. We can tell from the previous tables that students were more agreement with the survey measures on the post test than on the pre test, however a t-test will help show whether this increase is outside the realm of chance and potentially due to the L@M program. Table 3 in Appendix B shows there to be a statistically significant increase in students believing they will use science and technology in their future careers at the end of the L@M program. None of the other differences between the pre and post-surveys appear statistically significant.

### *Conclusions*

Survey result analysis shows many of the LFDCS students wanted to attend college before participating in L@M. Students might have a greater understanding of college and the role of science in careers than initially assumed by the pre survey. This idea can be investigated by considering the types of careers students plan to enter and how strongly they agree with the statement that their future career will use science and technology. On their first survey, students were asked their future career goals (see Appendix A). These were then coded for whether these

careers utilize science.<sup>4</sup> Figure 4 in Appendix B shows a chi square test between scientific and unscientific careers and the pre-treatment statement of whether a future career needs science and technology. This measure is statistically significant suggesting there is a relationship between the types of careers the students will pursue and if they feel they will use science in their profession. Before participating in L@M the students already had a base understanding of both what a career entails and the field of science. An effective evaluation needs to ask more specific questions to address if and to what extent L@M strengthens this prior knowledge.

The next group of students participating in L@M need to be asked more in-depth survey questions aimed at understanding specifics about their college aspirations. The pre and post comparison t-tests might than show the program makes a statistically significant impact on student thinking. For instance, this study finds students want to go to college, but not necessarily MIT (See Table 1, Appendix B). More needs to be done to determine the type of college these students want to attend and why comparatively they are less interested in an MIT education. A more pointed survey will also better assess whether students understand the work it requires to attend, remain in, and graduate from college. Initial findings from this study suggest there may be a disconnect between students' desire and their ability to attend college. Table 1 in Appendix B shows most students strongly agree that they want to attend and graduate college, but on average students are earning grades in the low B / high C range. If students continue to earn these types of grades, which are a measure of student effort and achievement, in high school they will not be admitted into strong four-year universities.

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<sup>4</sup> Whether science is used in a career is a subjective categorization. Careers using science include computer engineer, video game tester, mechanical engineer, pediatrician, doctor, veterinarian, surgeon, engineer, psychologist, forensic scientist, scientist. Those not using science include reporter, photographer, performer, manager, business owner, actress, cosmetologist, athlete

Improved survey questions might include some of the following. Asking the students pre and post the L@M experience how many hours they believe a college student spends studying each day. This question looks to measure disconnect between the desire to attend college and knowing what college is really like. If the L@M program is successful, students will more accurately answer this question after the field trip series. A question attempting to address this same concept might ask what grade point average high school seniors need to be admitted to college. Again the increase in question accuracy from the pre survey to the post survey would be measured. Questions for the next L@M class also have to ensure they are not leading students to “socially desirable” responses. For instance, this study asked if attending college is a goal of the students. Few eighth grade students will say they do not want to attend college with the knowledge they will be taking monthly field trips to MIT. This question might be rephrased to ask whether students *plan* to attend college or allowing students to select several options regarding their post high school plans.

If results from this new revised survey still find L@M does not significantly improve or clarify student thoughts about college and further science education, maybe this program is not the best fit for LFDCS, which is different from the other public schools in Lawrence at a statistically significant level. The chi square test shown in Table 5 in Appendix B shows the number of eighth grades students scoring in the proficient and above category, needs improvement category, and warning level category on the 2007-2008 MCAS science test in the public schools is statistically significant from the number of students in each of these categories from LFDCS.<sup>5</sup> To be part of a charter school students and their families must make the effort to complete an application and often agree to a more rigorous academic experience. At LFDCS, for

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<sup>5</sup> Data obtained from Massachusetts Department of Elementary and Secondary Education (<http://profiles.doe.mass.edu/>), part of the Massachusetts Department of Education.

instance, students attend Saturday school and have individualized academic plans that target gaps in their understanding. While untested, these could be reasons why the charter school student scores are different from those in the public school. At the same time, very few students are scoring at or above the proficient level. The greatest variation in these scores is between the needs improvement and warning level. Even though the LFDCS students are different from those in the public schools, leading some to believe they are less in need of a program like L@M, the fact that only about 7% are achieving on grade level, suggests they should still benefit from the science and technology workshops at MIT. Before giving up on this program for this school, we should first rethink our assessment questions.

Even though there are questions regarding the depth of the survey questions and if this program serves the most needed student population, it is important to acknowledge that it is statistically significant that more students believe they will use science and technology in their careers after having attended the workshops MIT. In one particular measure it appears that this program could be having an impact on student thinking about future scientific study and use.

### *Other Interesting Results*

The surveys completed by the students gathered additional information that can be analyzed. For instance, it can be used to predict the characteristics of the students most likely to want to attend MIT. Both the pre and the post survey responses varied a lot in the amount students agreed on wanting to attend MIT in the future. The scatter plot of post survey data, Figure 4 in Appendix B, shows the variables that might be correlated with wanting to attend MIT. Regressions show the strongest statistical correlation at the .001 level between wanting to attend MIT and having the field trips meet ones expectations. This relationship explains 33% of the variance in the wanting to attend MIT data. Gender is also strongly correlated with wanting

to attend MIT. Males are more likely to agree to wanting to attend MIT than girls. Independent of other variables, gender explains 31% of the variance in the wanting to attend MIT variable. These findings are shown in Table 6 in Appendix B. When several variables are combined in a multivariate regression, 58% of the variation in deciding the degree to which students want to attend MIT can be explained. These results are shown in Table 7. Overall, the students most wanting to attend MIT are male, strongly believe the field trips met their expectations, think the field trip series was a significant experience, and plan to use science and technology in their future careers.

Appendix A  
Pre and Post Surveys

**Lawrence@MIT Student Survey**



*Welcome to MIT! We are happy to have you on campus and look forward to working with you throughout the year. We want to learn a little bit more about you. Please use the lines below to answer each of the following questions.*

1. What do you like most about science? \_\_\_\_\_  
\_\_\_\_\_
2. What do you find most difficult about science? \_\_\_\_\_  
\_\_\_\_\_
3. In your opinion, what do scientists do? \_\_\_\_\_  
\_\_\_\_\_
4. (Circle) On average, what grade do you earn in science?    A    B    C    D    Below
5. Give an example of a recent technology: \_\_\_\_\_
6. Have you ever used digital media? If so, describe your experience: \_\_\_\_\_  
\_\_\_\_\_
7. What are your future career goals? \_\_\_\_\_
8. Have you ever been to MIT before? If so, for what purpose? \_\_\_\_\_  
\_\_\_\_\_
9. What do you want to learn while at MIT this year? \_\_\_\_\_  
\_\_\_\_\_
10. What is one question you currently have about MIT? \_\_\_\_\_  
\_\_\_\_\_

11. List three things you know about college:

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

12. List three things you want to know about college:

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

13. Write one other piece of information we should know about you. \_\_\_\_\_

\_\_\_\_\_

*For the following questions please circle the number that most accurately matches your opinion. Values range from 1 (strongly disagree) to 5 (strongly agree)*

14. In my future career I will use science and technology.

1      2      3      4      5

15. I enjoy learning scientific information.

16. Science is important in understanding everyday life.

1      2      3      4      5

17. Science causes me to think differently about the world.

1      2      3      4      5

18. One of my goals is to attend and graduate college.

1      2      3      4      5

19. I would like to attend and graduate MIT.

1      2      3      4      5

**Lawrence@MIT Student Survey  
End of Year**



*We have had a great time having you at MIT this year! Please answer the questions below so we can learn a little bit more about your Lawrence@MIT experience so we can make it even better for the students next year.*

20. What was the best part of visiting MIT? \_\_\_\_\_

\_\_\_\_\_

21. What was your FAVORITE workshop? What did you like about this workshop?

\_\_\_\_\_

\_\_\_\_\_

22. What workshop should we NOT offer next year? Why? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

23. If you could change anything about your visits, what would it be and why? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

24. What did you learn about college this year? \_\_\_\_\_

\_\_\_\_\_

25. In particular, what did you learn about MIT? \_\_\_\_\_

\_\_\_\_\_

26. List three things you know about college:

• \_\_\_\_\_

• \_\_\_\_\_

•

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*For the following questions please circle the number that most accurately matches your opinion. Values range from 1 (strongly disagree) to 10 (strongly agree). In this instance, a 5 would mean no or neutral opinion.*

27. Coming to MIT was a significant experience.

1      2      3      4      5      6      7      8      9      10

28. Coming to MIT helped me learn more about science.

1      2      3      4      5      6      7      8      9      10

29. Coming to MIT met my expectations.

1      2      3      4      5      6      7      8      9      10

*For the following questions please circle the number that most accurately matches your opinion. Values range from 1 (strongly disagree) to 5 (strongly agree)*

30. In my future career I will use science and technology.      1      2      3      4      5

31. I enjoy learning scientific information.      1      2      3      4      5

32. Science is important in understanding everyday life.      1      2      3      4      5

33. Science causes me to think differently about the world.      1      2      3      4      5

34. One of my goals is to attend and graduate college.      1      2      3      4      5

35. I would like to attend and graduate from MIT.      1      2      3      4      5

36. Write 3 – 5 sentences explaining Lawrence@MIT to next year's students. What should these students know? What should they look forward to?

Appendix B  
Tables and Graphs

Table 1: Descriptive Statistics for Pre and Post Measures

	Average Grade Earned in Science	In my future career I will use science and technology		I enjoy learning scientific information		I need science to understand everyday life		Science causes me to think differently about the world		One of my goals is to attend and graduate college		I would like to attend and graduate from MIT	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Minimum	2	1	1	2	1	2	2	2	1	2	2	1	1
1st Quartile	2	3	3	3	3	3	3	3	4	5	5	2	2
Median	3	3	4	4	4	4	5	4	4	5	5	3	3
Mean	2.84	3.18	3.58	3.84	3.93	3.92	4.16	3.97	4.14	4.68	4.74	2.84	3.16
3rd Quartile	3	4	5	4	5	5	5	5	5	5	5	5	4
Maximum	4	5	5	5	5	5	5	5	5	5	5	5	5

Note: Self-reported grades measured on a scale of 1-4 with 4 as an A, 3 as a B, 2 as a C, and 1 below a C. Other variables measured on a 1-5 scale with 5 being strongly agree and 1 being strongly disagree.

Table 2: Descriptive Statistics for Post Measures

	Coming to MIT was a significant experience	Coming to MIT helped me learn more about science	Coming to MIT met my expectations
	Post	Post	Post
Minimum	5	6	4
1st Quartile	7	7.5	7
Median	8	9	8
Mean	8	8.5	7.8
3rd Quartile	9	10	9
Maximum	10	10	10

Note: Measured on a 1-10 scale with 10 being strongly agree and 1 being strongly disagree.

Figure 1:

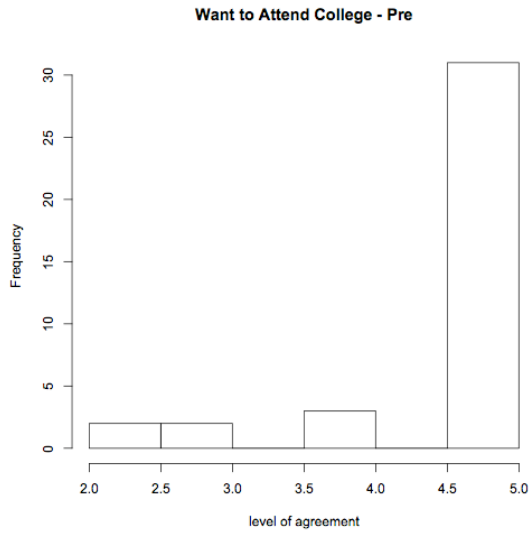


Figure 2:

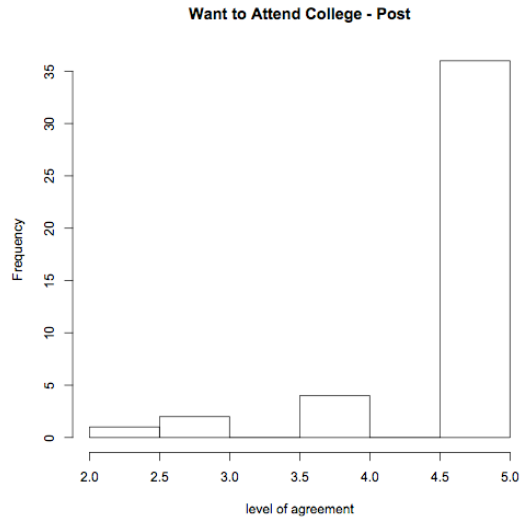


Figure 3:

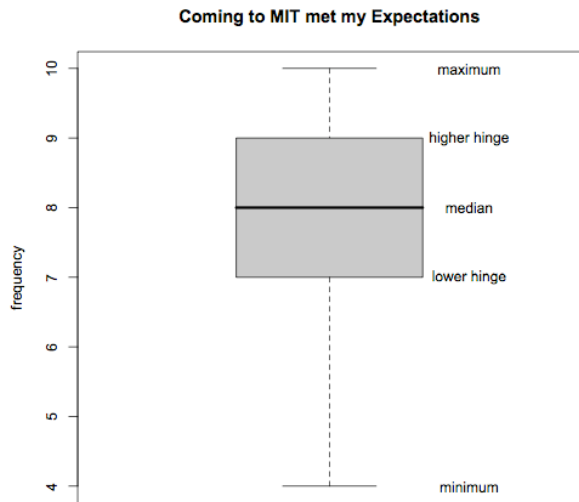


Table 3: T-Test Results

	t-value	p-value	mean of differences
In my future career I will use science and technology	-2.4084	0.02145*	-0.27
I enjoy learning scientific information	-0.9613	0.3428	-0.14
I need science to understand everyday life	-1.7632	0.08636	-0.27
Science causes me to think differently about the world	-1.3896	0.1732	-0.24
One of my goals is to attend and graduate college	-0.4423	0.6609	-0.05
I would like to attend and graduate from MIT	-1.2675	0.2131	-0.19

degrees of freedom = 36

\* significant at a 95% confidence level

Table 4: Chi Square Scientific Career and Opinion on Whether Future Career Uses Science

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
Future Career Uses Science	1	1	4	9	2
Future Career Does Not Use Science	3	3	11	2	2

Chi Square: 9.4004

Degrees of Freedom: 4

p-value: .050

Table 5: Number of 8<sup>th</sup> grade students in each scoring category on 2007-2008 MCAS Science Test

	2007-2008 8th Grade MCAS Science Scores		
	Proficient and Above	Needs Improvement	Warning Level
Lawrence Public School 8th Grade Students	42.63	210.62	405.75
LFDCS 8th Grade Students	3.43	27.93	17.15

Number of students do not appear as integers because this information is calculated from the percent in each category and the total number of students in the public schools and LFDCS.

Chi Square: 14.0138  
 Degrees of Freedom: 2  
 p-value: .0009

Figure 4:

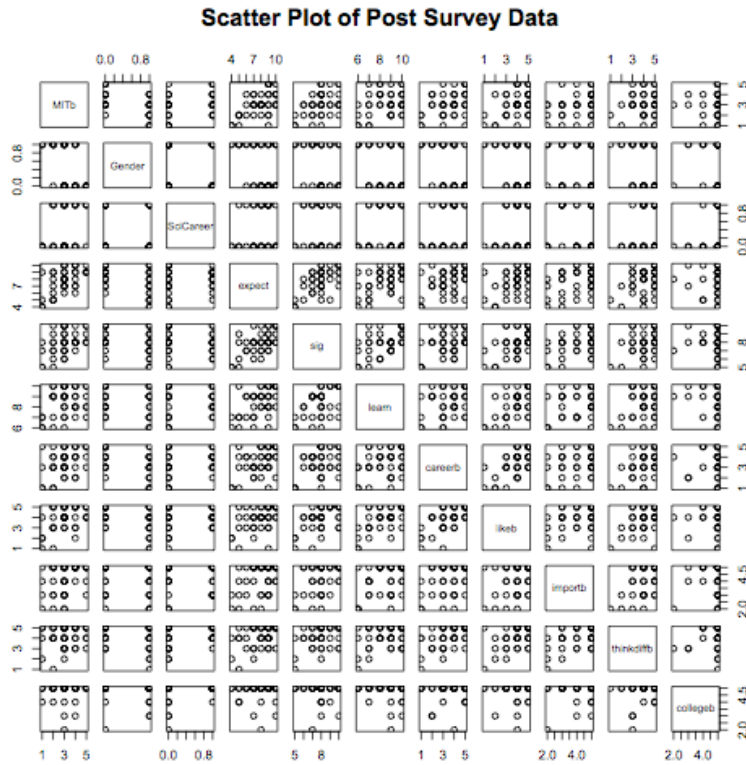


Table 6: Linear Regression with wanting to attend MIT (as measured in post survey)

	Estimate	Standard Error	t-value	Pr(> t )	R Squared
MIT met expectations	0.38784	0.08523	4.55	.000047***	0.3356
Gender	-1.2783	0.298	-4.29	.000106***	0.3098
MIT as significant experience	0.3629	0.1156	3.139	.00314**	0.1937
MIT visits helped learning about science	0.2673	0.1311	2.039	.0479*	0.0921
My future career will use science	0.3935	0.1299	3.028	.00424**	0.1828
Like learning about science	0.4612	0.1445	3.192	.00271**	0.1991
Believe science is important	0.3747	0.163	2.299	.0267*	0.1142

Significance Levels \*\*\* = .001, \*\* = .01, \* = .05

Table 7: Multivariate Regression with wanting to attend MIT

	Estimate	Standard Error	t-value	Pr(> t )
MIT met expectations	0.21591	0.10241	2.108	.04346*
Gender	-0.864	0.30428	-2.839	.00804**
MIT as significant experience	0.05816	0.12492	0.466	0.64488
My future career will use science	-0.0342	0.1425	-0.249	0.81197
Like learning about science	0.16626	0.16912	0.983	0.3345

Significance Levels      \*\*\* = .001,    \*\* = .01,    \* = .05

Multiple R-Squared: .5827

## Appendix C Data and Metadata

**Sources:** Data comes from original surveys (see Appendix A) written by the author. Pre-surveys were completed September 24, 2008 and post surveys were completed May 1, 2009. Information about the public school testing comes from the Massachusetts Department of Education (see footnote 5). The number of public school students results from adding the following middle schools together: South Lawrence East Middle School, School for Exceptional Studies, Robert Frost Middle School, James F Leonard Middle School, Gerald A Guilmette Middle School, Edward F Parthum Middle School, and Arlington Middle School.

**Data Shape:** 38 of the 49 students completed the pretreatment survey. 43 of these same students completed the post survey. 18 different variables were included in this study. The MCAS data, obtained May 11, 2009 has an additional 5 variables. Survey data imported into R has the name “merged” and data from the MCAS scores is named “schools”.

### Variables:

- “Gender,” coded 0 for male and 1 for female. Nominal data.
- “SciCareer,” variable created from students listing their future career coded 0 for a career without science and 1 for a career with science (see footnote 4).
- “Grades” are coded 4 for A, 3 for B, 2 for C, and 1 for below. This is a nominal category.
- The following variables are on a 1-5 ordinal scale that in social science is often treated as interval level data (see footnote 1 and Appendix A). An “a” at the end of the variable name refers to the pre-survey, while a variable ending in a “b” refers to the post-survey.
  - “career,”: “In my future career I will use science and technology”
  - “like”: “I enjoy learning scientific information”
  - “import”: “Science is important in understanding everyday life”
  - “thinkdiff”: “Science causes me to think differently about the world”
  - “college”: “One of my goals is to attend and graduate college”
  - “MIT”: “I would like to attend and graduate from MIT”
- The following variables are on a 1-10 ordinal scale that in social science is often treated as interval data (see footnote 1 and Appendix A). These measures were only part of the post-survey.
  - “sig”: “Coming to MIT was a significant experience”
  - “learn”: “Coming to MIT helped me learn more about science”
  - “expect”: “Coming to MIT met my expectations”
- “lfdcs,” variable referring to the Lawrence Family Development Charter School. It is a nominal measure.
- “public,” refers to the combination of public school described above. It is a nominal measure.
- “p,” variable standing for proficient or above. None of the students in any of the schools measured have students scoring in the advanced proficient range. This variable is a nominal measure.
- “ni,” variable standing for needs improvement. It is a nominal category.
- “w,” variable standing for warning level. It is a nominal category.

**Missing Values:** As explained in the findings section, 37 students took both the pre and the post surveys. “NA” was placed in the columns for the students who did not have both and they were not included in any of the paired tests.