THE GOVERNOR'S OFFICE OF STUDENT ACHIEVEMENT

APPLIED LEARNING STUDENT QUESTIONNAIRE: *OVERALL ANALYSIS*

Overall Results
May 2016

Executive Summary

Participants and Methods

In May 2016, 343 students across 4 Race to the Top programs completed the Applied Learning Student Questionnaire (ALSQ). The response rates displayed in Table 1 suggest that 74% of the total number of participating students responded to the survey. The response rates per program ranged from 65% (Real STEM Georgia Southern) to 100% (STE(A)M Truck). Although there is no agreed-upon standard for a minimum response rate, Martella, Nelson, Morgan, and Marchand-Martella (2013)[1] suggest that a response rate of 50% is *adequate* for analysis and reporting, 60% is *good*, and 75% or higher is considered *very good*. Overall, the response rate achieved across 4 Innovation Fund programs is considered *good* for reporting and analysis.

Table 1. Survey Response Rates

Program	# of Survey Respondents	Total # of Participating Students	Survey Response Rate
Real STEM Georgia Southern	212	328	65%
STE(A)M Truck	50	50	100%
Gwinnett Gear Up	72	75	96%
Grady County Mechatronics	9	11	82%
Total	**343**	**464**	**74%**

Note. The number of participating students represent approximations and may not reflect recent changes to the participant population (e.g., dropouts). Survey respondents who did not follow instructions and/or completed less than 20% of the survey items were not included in this report.

The ALSQ[2] is designed to measure pre and post gains related to student problem solving and communication skills, self-management and engagement. The ALSQ is a self-report questionnaire that includes 36 items to assess students' attitudes on the following survey constructs:

1. **Intrinsic Motivation**: motivation stemming from goals of mastery, learning and challenge. Example, "It is important for me to learn what is being taught in this program."
2. **Self-Management/Self-Regulation:** effortful and persistent behaviors that are used to guide, monitor, and direct the success of one's learning and performance. Example, "I turn all my assignments in on time."
3. **Intent to Persist:** aspirations, plans, and goals to pursue additional education and a career in STEM. Example, "I intend to get a college degree in STEM (Science, Technology, Engineering, and Math)."
4. **Problem Solving:** inquiry-based learning environment that provides higher-order cognitive tasks and real-world applications. Example, "I work out explanations on my own."

[1] Martella, R., Nelson, J., Morgan, R., & Marchand-Martella, N. (2013). *Understanding and Interpreting Education Research*. New York, NY: The Guilford Press.

[2] See Appendix A for information related to the construct reliabilities of the ALSQ.

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June 2016

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5. **Implementation Activities:** hands-on activities designed to increase exposure to STEM topics and real-world applications. Example, "We learn what scientists/technicians/engineers/ mathematicians or other STEM professionals do."

Results & Discussion

- **ALSQ Survey Constructs**

  Table 2 summarizes students' responses to the ALSQ survey constructs across all programs. In aggregate, students show statistically significant increases in *Intrinsic Motivation*, *Self-Management/Self-Regulation* skills, and *Intent to Persist*. In addition to assessing statistical significance from "before" to "now," effect sizes—a measure of the magnitude of an intervention on students' attitudes—were computed. Specifically, effect sizes were computed using Cohen's *d* and are intended to measure the practical importance of a significant finding.[3] Cohen (1988) classified effect sizes as small, *d*=0.2; medium, *d*=0.5; and large, *d*=0.8.[4] Table 2 suggests that medium effect sizes were found for *Intrinsic Motivation,* Self-*Management/Self-Regulation* skills*,* and *Intent to Persist*. Across all constructs, the largest effect size observed was for *Intrinsic Motivation* (*d*=0.79). This suggests that the programs were particularly effective at enhancing students' interests to learn and derive value from the material being taught. For example, AFTER participating in the programs, 73% of students said they prefer classwork that is challenging, compared to 48% before the program. See Table 4 for more information.

  To maximize impact, we would expect students' average scores to exceed 4.00 on a 5-point Likert scale (1, *Strongly Disagree* to 5, *Strongly Agree*). In light of this benchmark, it is important to note that the "now" scores for one construct— *Intent to Persist*— did *not* reach or exceed the optimal average of 4.00. Figure 1 suggests that additional work may be needed in the above mentioned area.

Table 2. Summary of Results by Constructs

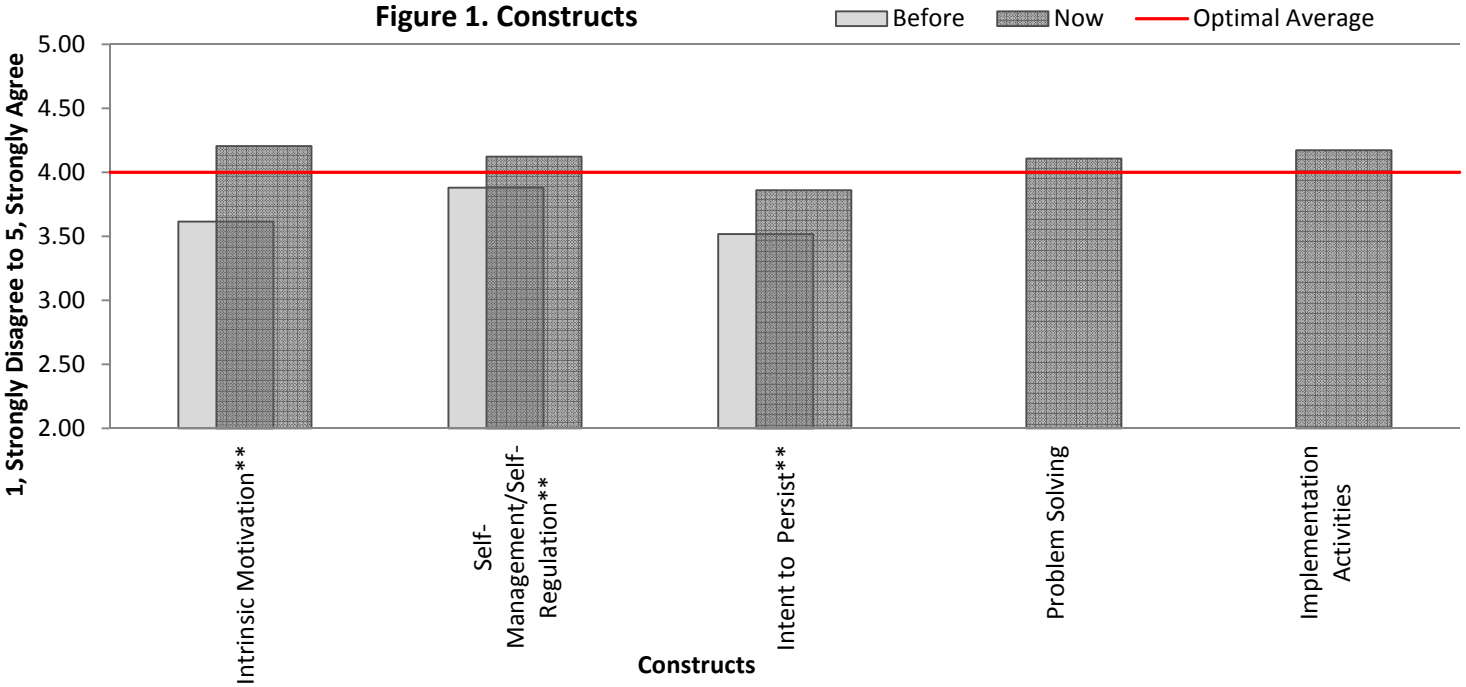
Overall- Constructs						
Constructs		**n**	**Mean[1]**		**Paired Samples t-test[2]**	**Effect Size (interpretation)[3]**
Intrinsic Motivation	Before	334		3.62	p<0.001**	.79[M]
	Now	334		4.20		
Self-Management/Self-Regulation	Before	334		3.88	p<0.001**	.53[M]
	Now	334		4.12		
Intent to Persist	Before	330		3.52	p<0.001**	.54[M]
	Now	330		3.86		
Problem Solving	Now	336		4.11	N/A	N/A
Implementation Activities	Now	335		4.17	N/A	N/A

Note. Scale; 1, *Strongly Disagree* to 5, *Strongly Agree*. [1] Reference lines are set at 3.5 and 4. [2]Please note that only students with matched Pre and Post data were assessed for significance. Desired statistically significant changes are highlighted in green. **p<0.001, *p<0.01, †p<0.05. Negatively worded statements were reverse coded for mean computations. [3]Effect size (Cohen's *d*): Small (<.2); Medium (.2 to .8); Large (>.8). Small effect sizes are highlighted in light red; medium effect sizes are highlighted in dark orange; large effect sizes are highlighted in dark green.

[3] To compute effect sizes, the formulas derived from Daniel & Kostic (2015) were utilized. Source: Daniel, T. & Kostic, B. (2015). *RStats effect size calculator*. Available online: http://www.missouristate.edu/rstats/Tables-and-Calculators.htm.

[4] Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed). Hillsdale, NJ: Lawrence Earlbaum Associates.

Figure 1. Constructs



Note. **p<0.001, *p<0.01, †p<0.05; Scale is truncated for visual clarity.

- **ALSQ Survey Constructs by Program**

Examining the ALSQ results by individual program, it is evident that all of the programs show statistically significant increases in *Intrinsic Motivation, Self-Management/Self-Regulation* skills, and *Intent to Persist*. Examining effect sizes, all of the programs exhibit either medium or large effect sizes across all constructs. This suggests that the individual programs were *effective* at enhancing students' motivations to succeed, their ability to direct their own learning, and their intent to persist in STEM education and careers. While the effect sizes were consistently large (*d*>.8) across all constructs for the Grady County Mechatronics program, caution should be employed when interpreting the results given the small sample size (n=9).[5]

[5] According to deWinter (2013), the t-test can be applied to a small sample size, as long as the effect size is expected to be large. Source: deWinter, J.C.F. (2013). Using the Student's t-test with extremely small sample sizes. *Practice Assessment, Research and Evaluation, 18 (10).* Available online: http://pareonline.net/getvn.asp?v=18&n=10.

Table 3. Summary of Results by Constructs per Program

Overall- Constructs per Program													
Constructs		**Real STEM Georgia Southern (n=212)**			**STE(A)M Truck (n=50)**			**Gwinnett Gear Up (n=72)**			**Grady County Mechatronics (n=9)**		
		Mean	*t-test*	Effect Size	Mean	*t-test*	Effect Size	Mean	*t-test*	Effect Size	Mean	*t-test*	Effect Size
Intrinsic Motivation	Before	3.65	$p<0.001^{**}$	$.81^{L}$	3.88	$p<0.001^{**}$	$.58^{M}$	3.34	$p<0.001^{**}$	$.88^{L}$	3.51	$p=0.015^{\dagger}$	1.13^{L}
	Now	4.28			4.15			4.01			4.24		
Self-Management/ Self-Regulation	Before	3.97	$p<0.001^{**}$	$.39^{M}$	3.88	$p=0.004^{*}$	$.44^{M}$	3.63	$p<0.001^{**}$	1.03^{L}	3.91	$p=0.045^{\dagger}$	$.87^{L}$
	Now	4.14			4.09			4.09			4.13		
Intent to Persist	Before	3.58	$p<0.001^{**}$	$.57^{M}$	3.39	$p=0.007^{*}$	$.40^{M}$	3.44	$p<0.001^{**}$	$.50^{M}$	3.25	$p=0.025^{\dagger}$	1.00^{L}
	Now	3.95			3.62			3.78			3.65		
Problem Solving	Now	4.27	N/A	N/A	3.93	N/A	N/A	3.78	N/A	N/A	3.95	N/A	N/A
Implementation Activities	Now	4.30			3.98			3.97			3.96		

Note. Scale= 1, *Strongly Disagree* to 5, *Strongly Agree*. Desired statistically significant changes are highlighted in green and undesired statistically significant changes are highlighted in red. **p<0.001, *p<0.01, †p<0.05. Effect size (Cohen's d): Small (<.2); Medium (.2 to .8); Large (>.8). Small effect sizes are highlighted in light red; medium effect sizes are highlighted in dark orange; large effect sizes are highlighted in dark green.

In order for programs to maximize their effectiveness, we would expect "now" scores to reach or exceed the optimal average of 4.00 on a 5-point Likert scale (1, *Strongly Disagree* to 5, *Strongly Agree*). Figures 2 – 6 display "now" scores for each program and construct. For example, Figure 3 indicates that all of the programs met or exceeded the optimal average for *Self-Management/Self-Regulation*. In general, programs not reaching or exceeding the red horizontal line may need additional attention. For instance, 4 out of 4 programs did not reach the optimal average for *Intent to Persist* (Figure 4).

Figure 2. Intrinsic Motivation ("Now" Scores)

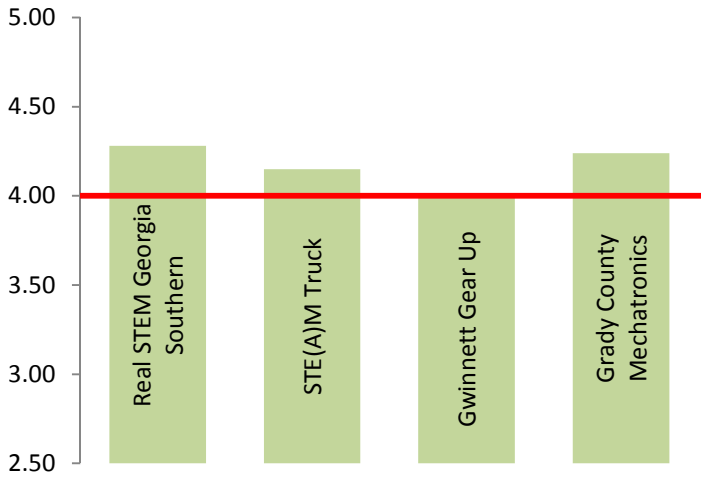
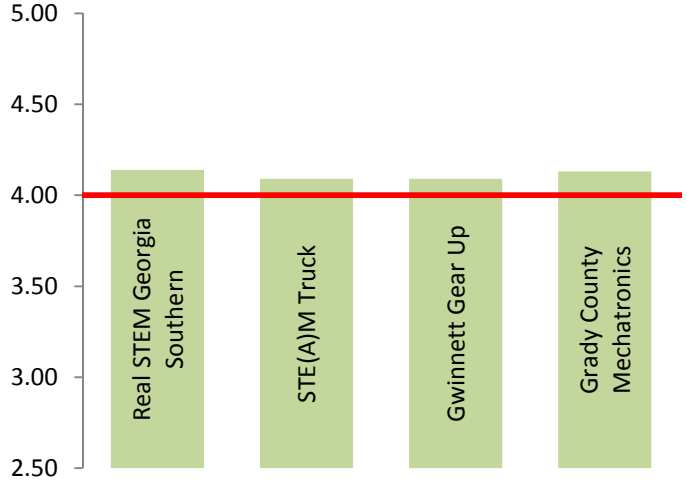


Figure 3. Self-Management/Self-Regulation ("Now" Scores)



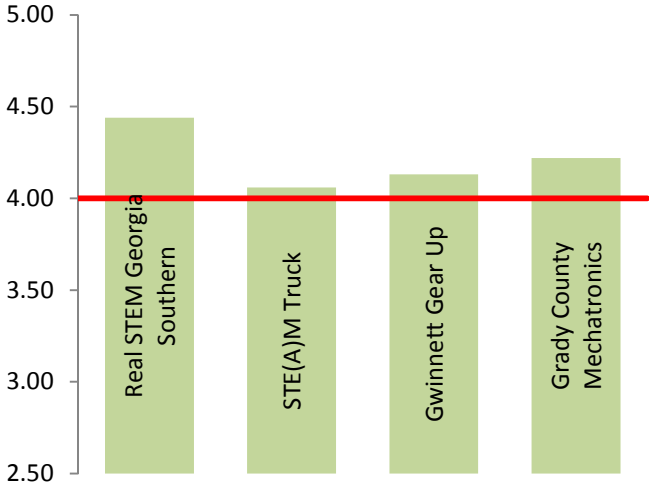
Scale= 1, Strongly Disagree to 5, Strongly Agree. Scale was truncated for visual clarity. Programs that met or exceeded the optimal average of 4.00 are reflected in green; programs that fell below the optimal average are reflected in red.

Figure 4. Intent to Persist ("Now" Scores)

Figure 5. Problem Solving ("Now" Scores)

Figure 6. Implementation Activities ("Now" Scores)

Figure 7. Overall Program Ratings



Scale= 1, *Strongly Disagree* to 5, *Strongly Agree*. Scale was truncated for visual clarity. Programs that met or exceeded the optimal average of 4.00 are reflected in green; programs that fell below the optimal average are reflected in red.

- **Program Rating**
  Collapsing across all programs, students' ratings of their programs exceeded the optimal average of 4.00. On a 5-point Likert scale where 1 signifies *Very Poor* and 5 signifies *Excellent*, the average score was a 4.31. See Table 12. Looking at Figure 7, it is evident that all of the programs were rated above the optimal average. The high ratings for each of the programs speak to students' enjoyment.

- **Areas for Further Improvement**
  Across all programs, further enhancing students' intentions to persist may be warranted. Likewise, students' ratings suggest that the inquiry-based learning environment may be improved by allowing students more opportunity to choose their own topics, work out explanations on their own, and interact with STEM professionals. Providing increased opportunities for interactions with STEM professionals and providing additional hands-on activities may enhance students' intentions to persist in STEM education and careers.

Table 4. Intrinsic Motivation

Intrinsic Motivation		n	Mean[1]		Paired Samples t-test[2]		1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
1. I prefer class work that is challenging so I can learn new things.	Before	329		3.40	p<0.001**		5%	12%	35%	33%	15%
	Now	329		3.94			2%	4%	21%	43%	30%
2. It is important to me to learn what is being taught in this program.	Before	330		3.79	p<0.001**		2%	6%	27%	39%	25%
	Now	330		4.32			1%	1%	11%	40%	47%
3. I like what I am learning in this program.	Before	331		3.66	p<0.001**		4%	6%	33%	33%	24%
	Now	331		4.17			2%	4%	16%	34%	45%
4. I think I will be able to use what I learn in this program in other classes.	Before	327		3.55	p<0.001**		4%	12%	32%	31%	21%
	Now	327		4.17			1%	6%	15%	33%	46%
5. Even when I do poorly on a test, I try to learn from my mistakes.	Before	332		3.89	p<0.001**		2%	5%	24%	39%	30%
	Now	332		4.44			--	--	10%	35%	55%
6. I think that what I am learning in this program is useful for me to know.	Before	329		3.56	p<0.001**		6%	8%	29%	38%	19%
	Now	329		4.19			2%	3%	14%	38%	43%
7. I think that what we are learning in this program is interesting.	Before	329		3.61	p<0.001**		6%	9%	27%	33%	25%
	Now	329		4.23			2%	2%	15%	33%	48%
8. Understanding STEM (Science, Technology, Engineering, and Math) is important to me.	Before	330		3.54	p<0.001**		5%	11%	31%	31%	22%
	Now	330		4.20			1%	5%	14%	34%	46%
9. I enjoy STEM (Science, Technology, Engineering, and Math) in general.	Before	329		3.50	p<0.001**		9%	9%	29%	29%	24%
	Now	329		4.19			2%	4%	16%	31%	48%

Note. [1] Reference lines are set at 3.5 and 4. [2]Please note that only students with matched Pre and Post data were assessed for significance. Desired statistically significant changes are highlighted in green and undesired statistically significant changes are highlighted in red. **p<0.001, *p<0.01, †p<0.05.

Table 5. Self-Management/Self-Regulation

Self-Management/Self-Regulation		n	Mean[1]	Paired Samples t-test[2]	1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
10. I turn all my assignments in on time.	Before	330	3.62	p<0.001**	4%	12%	29%	29%	26%
	Now	330	3.94		3%	4%	25%	34%	35%
11. I miss class often. (n)	Before	331	1.73	p=0.780	59%	22%	11%	5%	4%
	Now	331	1.74		61%	21%	8%	4%	6%
12. I am often late for class. (n)	Before	328	1.67	p=0.385	63%	20%	9%	5%	4%
	Now	328	1.71		65%	17%	7%	6%	6%
13. I set aside time to do my homework and study.	Before	330	3.22	p<0.001**	8%	16%	36%	28%	12%
	Now	330	3.68		5%	7%	29%	35%	24%
14. When I say I'm going to do something, I do it.	Before	330	3.78	p<0.001**	2%	7%	29%	35%	27%
	Now	330	4.13		1%	2%	18%	42%	37%
15. I am a hard worker.	Before	330	4.05	p<0.001**	1%	4%	19%	40%	35%
	Now	330	4.36		--	1%	10%	39%	49%
16. I finish whatever I begin.	Before	330	3.87	p<0.001**	1%	6%	29%	32%	32%
	Now	330	4.19		1%	2%	20%	34%	44%

Note. [1] Reference lines are set at 3.5 and 4. [2]Please note that only students with matched Pre and Post data were assessed for significance. Desired statistically significant changes are highlighted in green and undesired statistically significant changes are highlighted in red. **p<0.001, *p<0.01, †p<0.05; (n) negatively worded statement.

Table 6. Intent to Persist

Intent to Persist		n	Mean[1]		Paired Samples t-test[2]		1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
17. I am considering a career in STEM (Science, Technology, Engineering, and Math).	Before	330		3.18	p<0.001**		11%	17%	34%	19%	19%
	Now	330		3.58			9%	11%	25%	24%	31%
18. I intend to get a college degree in STEM (Science, Technology, Engineering, and Math).	Before	329		3.16	p<0.001**		12%	16%	33%	21%	17%
	Now	329		3.55			8%	12%	27%	24%	30%
19. I can see myself working in STEM (Science, Technology, Engineering, and Math).	Before	329		3.25	p<0.001**		10%	16%	32%	24%	18%
	Now	329		3.68			7%	9%	24%	28%	32%
20. Someday, I would like to have a career in STEM (Science, Technology, Engineering, and Math).	Before	328		3.20	p<0.001**		12%	16%	32%	19%	20%
	Now	328		3.63			8%	9%	28%	22%	33%
21. I intend to graduate from high school.	Before	328		4.83	p=0.081		1%	1%	2%	8%	89%
	Now	328		4.88			1%	--	1%	5%	93%

Note. [1] Reference lines are set at 3.5 and 4. [2]Please note that only students with matched Pre and Post data were assessed for significance. Desired statistically significant changes are highlighted in green and undesired statistically significant changes are highlighted in red. **p<0.001, *p<0.01, †p<0.05.

Table 7. Problem Solving, Now Only

Problem Solving	n	Mean[1]	Assessment		1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
22. In this program, my teacher(s) tells me how to improve my work.	335	4.24	Good ☺		1%	2%	14%	36%	47%
23. In this program, my teacher(s) lets us choose our own topics or projects to investigate.	334	3.61	Attention ✓		6%	11%	25%	32%	26%
24. In this program, I work out explanations on my own.	336	3.85	Attention ✓		1%	4%	26%	47%	22%
25. In this program, I have opportunities to explain my ideas.	335	4.09	Good ☺		1%	4%	16%	43%	36%
26. In this program, we plan and do our own projects and/or experiments.	336	3.93	Attention ✓		2%	7%	21%	35%	35%
27. In this program, we work on real-world problems.	335	4.08	Good ☺		1%	5%	17%	36%	40%
28. In this program, we have class discussions.	334	4.20	Good ☺		1%	2%	13%	41%	42%
29. In this program, we investigate to see if our ideas are right.	336	4.25	Good ☺		1%	1%	14%	43%	42%
30. In this program, we need to be able to think and ask questions.	331	4.46	Good ☺		1%	--	7%	37%	56%
31. In this program, we are expected to understand and explain ideas.	333	4.36	Good ☺		1%	1%	9%	41%	49%

Note. [1] Reference lines are set at 3.5 and 4. Assessment: Good=Above 4.0; Attention=Below 4.0; Action=Below 3.5.

Table 8. Implementation Activities, Now Only

Implementation Activities	n	Mean[1]		Assessment		1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
32. In this program, my teacher(s) takes notice of students' ideas.	335		4.09	Good ☺		3%	3%	17%	35%	42%
33. In this program, my teacher(s) shows us how new information relates to what we have already learned.	334		4.30	Good ☺		--	1%	11%	42%	45%
34. In this program, we learn what scientists/ technicians/ engineers/ mathematicians or other STEM professionals do.	334		4.16	Good ☺		2%	2%	14%	43%	40%
35. In this program, we do our work in groups.	335		4.37	Good ☺		--	--	13%	36%	51%
36. In this program, we interact with scientists/ technicians/ engineers/ mathematicians or other STEM professionals.	334		3.94	Attention ✓		2%	6%	23%	35%	34%

Note. [1] Reference lines are set at 3.5 and 4. Assessment: Good=Above 4.0; Attention=Below 4.0; Action=Below 3.5.

Table 9. Educational Plans

What is the highest level of education you plan to achieve?	Before		Now		*Change*[1]	
	n	%	n	%	*n*	*%*
High School	36	11%	21	6%	-15	-5%
2-year college	34	10%	16	5%	-18	-6%
4-year college	102	31%	71	22%	-31	-9%
Graduate School	93	28%	100	31%	+7	+2%
Professional School	62	19%	119	36%	+57	+17%
Total	**327**	**100%**	**327**	**100%**		
Average[2]	**3.15**		**3.49**		**p<0.001**(significant)[3]**	

Note. [1] Change from Before to Now. Increases are highlighted in green; decreases are highlighted in red.
[2]To compute averages, the following codes were applied: High School (1), 2-year college (2), 4-year college (3), Graduate School (4), Professional School (4).
[3]Paired samples t-test, p-value: **p<0.001, *p<0.01, †p<0.05.

Table 10. Demographics

Gender	n	%
Female	137	41%
Male	195	59%
Total	**332**	**100%**

Ethnicity	n	%
Asian	16	5%
Black	115	35%
Hispanic	68	20%
Native American	3	1%
White	102	31%
Multiracial	16	5%
Other	12	4%
Total	**332**	**100%**

Grade	n	%
6th	2	1%
7th	50	15%
8th	142	43%
9th	20	6%
10th	7	2%
11th	49	15%
12th	63	19%
Other	1	<1%
Total	**334**	**100%**

Table 11. Participation

How long have you participated in this program?		n	%
Dosage	0 semesters	2	1%
	1 semester	95	29%
	2 semesters	198	59%
	3 semesters	9	3%
	4 or more semesters	14	4%
	Summer Only	1	<1%
	Don't Know	13	4%
	Total	**332**	**100%**
Did you participate in this program during the summer?		**n**	**%**
Summer Participation	No	313	94%
	Yes	11	3%
	Don't Know	9	3%
	Total	**333**	**100%**

Table 12. Program Rating

Program Rating: How would you rate this program?	n	Mean[1]	Assessment	1 (Very Poor)	2 (Poor)	3 (Average)	4 (Good)	5 (Excellent)
	333	4.31	Good ☺	1%	1%	15%	32%	51%

Note. [1] Reference lines are set at 3.5 and 4. Assessment: Good=Above 4.0; Attention=Below 4.0; Action=Below 3.5.

Appendix A. Construct Reliabilities

Table A1. Construct Reliabilities (Omnibus, May 2016)

Constructs		Cronbach's alpha	*Reliability Interpretation*
Intrinsic Motivation (9-items)	Before	0.895	*Very good*
	Now	0.891	*Very good*
Self-Management/Self-Regulation (7-items)	Before	0.729	*Good*
	Now	0.714	*Good*
Intent to Persist (5-items)	Before	0.894	*Very good*
	Now	0.904	*Excellent*
Problem Solving (10-items)	Now	0.878	*Very good*
Implementation Activities (5-items)	Now	0.784	*Good*

Cronbach's Alpha Reliability Key: Cronbach's alpha is a measure of the internal consistency of items in a construct. This statistic ranges from 0 to 1.00; the higher the value the better. An alpha of .80 or higher is considered to have achieved very good measurement reliability; an alpha of .65 is considered acceptable (Field, 2009).

Reliability	Interpretation
.90 and above	Excellent reliability; at the level of the best measures
.80 - .90	Very good
.70 - .80	Good; in the range of most. There are probably a few items which could be improved.
.60 - .70	Somewhat low. This measure needs to be supplemented by other measures (e.g., more surveys) to determine outcomes. There are probably some items which could be improved.
.50 - .60	Suggests need for revision of measure, unless it is quite short (ten or fewer items). The test definitely needs to be supplemented by other measures (e.g., more tests).
.50 or below	Questionable reliability. This measure should not contribute heavily to the outcomes and needs revision.

From: J. C. Nunnally, Psychometric Theory. New York: McGraw-Hill, 1967, pp. 172-235.

Reference:

Field, A. (2009). *Discovering Statistics Using SPSS, 3rd Edition*. Thousand Oaks, CA: Sage Publications.