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RESEARCH IN MATHEMATICS EDUCATION

STEM Academy for Science Teachers and Leaders: Student Survey Results

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Technical Report 20-03

STEM Academy for Science Teachers and Leaders: Student Survey Results

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Spring 2020

Published by
Southern Methodist University
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This research was supported by The Texas Instruments Foundation and the O'Donnell Foundation; GT00317. Opinions expressed herein do not necessarily reflect those of The Texas Instruments Foundation, the O'Donnell Foundation or individuals within.

Abstract

The STEM Academy for Science Teachers and Leaders is a professional development series, designed to support middle school science teachers and leaders in the Dallas Independent School District (ISD), with a goal of encouraging students' interest in science, technology, engineering, and mathematics (STEM) fields and ultimately STEM career pathways. This report focuses on students' science motivation in STEM Academy teachers' classrooms. Cohort 1 teachers began participation in 2017-18 and cohort 2 teachers began participation in 2018-19. As such, cohort 1 teachers participated for three years; cohort 2 teachers participated for two years. Each year of participation, teachers engaged in intensive summer professional development (PD) and coaching with a university instructional coach during the school year. The PD and coaching emphasized four main areas of focus including: (a) active learning, (b) scientific process standards, (c) deep pedagogical content knowledge (PCK), and (d) differentiated support for all learners.

Teachers taught different students across years. As such, this analysis includes different cohorts of students with the same students taking the survey twice within each year. Looking at change within years, students' science motivation in both cohort 1 and 2 teachers' classrooms either did not change or decreased slightly. In a follow up analysis, we focused on differential change in students' motivation based on student characteristics such as race, gender, special education (SPED) status, limited English proficient (LEP) status, prior ability in mathematics or reading based on STAAR tests, economic disadvantage (ED), and talented and gifted (TAG) status. Across both cohorts, we observed some consistent evidence of differential change across time for students. For example, students with higher STAAR reading scores tended to increase more in their science intrinsic motivation relative to other students.

In general, these results align with previous work showing that students' motivation tends to decrease in middle school (Elliot & McGregor, 1999; Maciver, Young, & Washburn, 2002; Wentzel, 1997; Wigfield & Eccles, 1994). This report extends existing work to show that these decreases are evident even within the context of an intensive professional development series like the STEM Academy. Existing work shows a connection between active learning and students' motivation (Bryan, Glynn, & Kittleson, 2011; Minner et al., 2010; Skinner, & Belmont, 1993), suggesting that teachers experienced unanticipated challenges in implementing the STEM Academy's main areas of focus in their classrooms.

We make three recommendations for others interested in implementing programs like the STEM Academy. First, we recommend that teachers teach the same grade levels across years. We observed evidence that teachers moved grade levels across years, which may have influenced their implementation of active learning. Second, school-based support and coaching should supplement external university coaching to ensure teachers implement innovative instructional strategies. Finally, school leadership and program staff should collaborate closely to ensure that the focus of the program aligns with the vision of the school and district leadership.

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STEM Academy for Science Teachers and Leaders: Student Survey Results

Background

The number of STEM-related jobs grew three times the rate of non-STEM jobs between 2000 and 2010, according to the Smithsonian Science Education Center. Both the American and global economies are requiring more individuals with STEM related degrees to fill professional positions in an increasingly high-tech job market (DeJarnette, 2012), and although the United States has experienced growth in this field, it has not seen the same growth in qualified STEM workers as its global competitors in Europe and Asia (National Science Board, 2010). Due to this increase in available STEM careers, leaders of STEM-related industries emphasize the critical need for more students interested in STEM, especially students from underrepresented subgroups (Smithsonian, 2018). In 2013, Texas House Bill 5 (HB 5) required that Grade 8 students select an endorsement area, including STEM, Business and Industry, Public Services, Arts & Humanities, or Multidisciplinary Studies. During the 2014-2015 school year, just 16.9% of Dallas Independent School District (ISD) students selected the STEM pathway (personal communication with district personnel, February 11, 2016), despite the fact that Dallas is home to a wide range of STEM industries.

In response to this evidence of a critical need, a partnership between the Texas Instruments Foundation, the O'Donnell Foundation, Southern Methodist University (SMU), and Dallas Independent School District (ISD) was established. A primary goal of this partnership was to improve students' motivation in STEM, ultimately affecting the STEM pipeline and equity in the technical fields. The leadership team specified desired outcomes including (a) an increase in teachers' implementation of active learning experiences, and (b) an increase in students' science achievement and motivation. To reach these outcomes, the project leadership identified four key areas of focus including:

- active learning consisting of project-based learning (PBL) (Bybee, 2010; Capraro, Capraro, & Morgan, 2013) and maker-based instruction (MBI) (Bevan, Gutwill, Petrich, & Wilkinson, 2014),
- scientific process standards (NRC, 2000),
- teacher pedagogical content knowledge (PCK) (van Driel, Verloop, & de Vos, 1998), and
- differentiated support for all learners, with an emphasis on social and emotional learning (SEL) (Bryan, Moore, Johnson, & Roehrig, 2015).

Overview of the Project

The STEM Academy for Science Teachers and Leaders project includes two primary components. First, university faculty and staff provided intensive summer academies, which included 90 hours of professional development focused on active learning, scientific process standards, teacher PCK, and differentiated support for all learners. Second, teachers received support during the school year including: (a) regular onsite coaching and observation with a university instructional coach aimed at emphasizing sustainability and implementation of the content of the summer academies, and (b) collaboration within a professional learning community (PLC). Participating teachers engaged in these two components of the program each year for up to three years. We summarized the structure and content of each academy, as well as teachers' perceptions of the summer academies, in existing external evaluation reports including:

- Academy 1 in 2017 (Perry, Reeder, Brattain, Hatfield, & Ketterlin-Geller, 2017) and in 2018 (Adams, Hatfield, Cox, & Ketterlin-Geller, 2018)

- Academy 2 in 2018 (Pierce, Adams, Rhone, Hatfield, & Ketterlin-Geller, 2019) and in 2019 (Sparks, Adams, Mota, Simon, Burton, Hatfield, & Ketterlin-Geller, 2019)

- Academy 3 in 2019 (Pierce, Cox, Hatfield, Adams, & Ketterlin-Geller, 2019)

In addition, we detail the structure and content, as well as teachers' perceptions of coaching in two external reports. We published one coaching evaluation report in 2017-18 (Adams, Hatfield, Cox, Mota, Sparks, & Ketterlin-Geller, 2018) and the other in 2018-19 (Sparks, Adams, Cox, Hatfield, Ketterlin-Geller, 2019). A third coaching evaluation report for 2019-20 is forthcoming.

The program follows a cohort model with new teachers entering during the second year of implementation. The first cohort of teachers (cohort 1) completed three years of participation, and a second cohort of teachers (cohort 2) completed two. Cohort 1 began participation in summer 2017 and cohort 2 began participation in summer 2018.

During their time in the STEM Academy cohort 1 teachers participated in Academies 1, 2, and 3 (i.e., one academy each summer). Cohort 2 participated only in Academies 1 and 2. Project staff structured the content for all of the summer academies around four main areas of focus identified during the development of the STEM Academy as being especially influential in fostering teacher and student success in STEM. Figure 1 depicts these main areas of focus, also known as the foundational pillars.

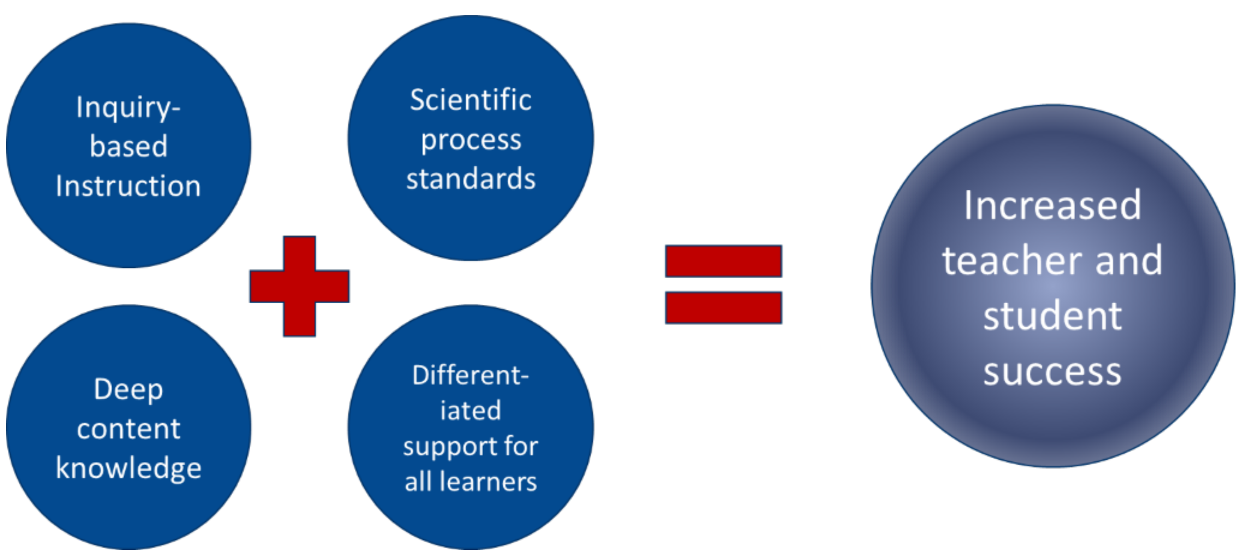


Figure 1. Foundational Pillars of the STEM Academy

As shown in Figure 1, the main outcome of the STEM Academy focuses on teacher and student success in STEM. An analysis of 138 studies conducted between 1984 and 2002 showed that active thinking in the science classroom improved students' conceptual understanding (Minner, Levy, & Century, 2010). A 2017 study identified sustained professional development (PD) in active learning for teachers as having a positive association with student growth in science mastery (Marshall, Smart, & Alston, 2017). In addition, active learning narrows STEM achievement gaps for under-represented student subgroups including females, students of color, and students from economically disadvantaged backgrounds (Marshall & Alston, 2014; Geier, Blumenfeld, Marx, Krajcik, Fishman, Soloway, & Clay-Chamber, 2008). The effective implementation of active learning necessitates teachers' understanding of the scientific process standards and PCK (NRC, 2000). Within the summer academies, differentiated support for all learners emphasized attending to students' SEL skills. Teachers who have higher social and emotional competence have better teacher-student relationships and better management of their classrooms through differentiated support structures, which leads to improved student learning (Jennings & Greenburg, 2009).

Additionally, the summer academies developed teachers' understanding and implementation of active learning and SEL within an inquiry framework called the 5E Instructional Model (5E) which has five components: Engage, Explore, Explain, Extend, and Evaluate. This framework is encouraged within the district by central administration. The ultimate goal is improving teachers' awareness and proficiency in implementing active learning, which existing research shows influences students' science motivation (Bryan, Glynn, & Kittleson, 2011). This report focuses specifically on the student outcomes of this project. For information about the teacher outcomes please see the teacher outcomes evaluation report (Pierce et al., 2020).

Purpose of this Report

The purpose of this report is to summarize trends in students' responses to the science motivation survey in cohort 1 and 2 teachers' classrooms.

Evaluation Questions

This report focuses on the following evaluation questions:

1. To what extent did students report positive science motivation? Did student motivation increase across time? Do we observe evidence of differential change across student subgroups?

Participating Teachers

Before examining student survey results, we provide a description of the participating teachers. Table 1 shows that in 2017-2018, 16 cohort 1 teachers participated in the STEM Academy. In 2018-2019, 29 cohort 2 teachers joined the STEM Academy. In both cohorts, teachers were majority female, Black, and non-Hispanic. Across the three years, 19 teachers exited the STEM Academy before the 2019-20 school year started. For more information about teachers' reasons for exiting the program, please request the internal teacher exit report (Cox, Adams, & Ketterlin-Geller, 2020).

Table 1
Cohort 1 Teacher Demographic Information

	Characteristic	2017-18	2018-19		2019-20	
		# of Cohort 1 Teachers	# of Cohort 1 Teachers	# of Cohort 2 Teachers	# of Cohort 1 Teachers	# of Cohort 2 Teachers
Gender	Male	4	3	9	2	5
	Female	12	9	20	7	12
Race	Alaska Native	0	0	0	0	1
	Asian	0	0	2	0	0
	Black	9	7	18	5	9
	Native Hawaiian	0	0	0	0	0
	Other Pacific Islander	0	0	1	0	1
	White	7	5	12	4	4
	Two or More Races	0	0	3	0	2
Ethnicity	Hispanic or Latino	4	3	2	2	2
	Not Hispanic or Latino	12	9	27	7	15
Total		16	12	29	9	17

Participating Students

For the student survey sample, we included students who met four criteria (Table 2). First, students needed to take a science motivation survey. Second, students needed to complete the survey in both fall and spring. The exception to this was in 2017-18 when we only collected the student survey in spring. Third, students needed to answer every item on the surveys (i.e., no skipped items). Fourth, students needed to provide a district identification number that matched Dallas ISD records, which allowed us to identify student demographic characteristics and grade level.

Table 2
Student Survey Sample Identification Criteria

Criteria for Inclusion	2017-18	2018-19	2019-20
Count of students who took the student survey	214	698	446
Count of students who took the survey in fall and spring	NA	580	342
Count of students who answered every item	198	428	261
Count of students whose identification number matched Dallas ISD record locator	197	424	254

Note: We only collected student surveys in the spring for 2017-18 students.

Student Survey Sample

The overall student survey sample included 875 students. Table 3 shows the student characteristics overall, as well as disaggregated by year and by cohort. In general, the majority of students were Hispanic, economically disadvantaged (ED), and identified as Limited English Proficient (LEP).

Table 3

Cohort 1 Student Survey Sample

Student Characteristic	Overall		Overall by Year						Cohort 1				Cohort 2			
	All Years		17-18*		18-19		19-20		18-19		19-20		18-19		19-20	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Asian	10	1.1	0	0.0	8	1.9	2	0.8	1	0.9	1	0.9	7	2.3	1	0.7
Black	117	14.3	36	18.3	47	11.1	34	13.4	10	8.8	8	7.1	37	11.9	26	18.4
Hispanic	678	77.5	147	74.6	342	80.7	189	74.4	99	86.8	88	77.9	243	78.4	101	71.6
Two or More Races	19	2.2	1	0.5	11	1.7	7	2.8	1	0.9	1	0.9	10	3.2	6	4.3
White	13	1.5	3	1.5	7	1.7	3	1.2	1	0.9	3	2.7	6	1.9	0	0.0
Pacific Islander	1	0.1	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	1	0.3	0	0.0
American Indian	1	0.1	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	1	0.3	0	0.0
Unknown Race	36	4.1	10	5.1	7	1.7	19	7.5	2	1.8	12	10.6	5	1.6	7	5.0
Male	382	43.7	85	43.2	187	44.1	110	43.3	59	51.8	44	38.9	128	41.3	66	46.8
Female	457	52.2	102	51.8	230	54.3	125	49.2	53	46.5	57	50.4	177	57.1	68	48.2
Unknown Gender	36	4.1	10	5.1	7	1.7	19	7.5	2	1.8	12	10.6	5	1.6	7	5.0
Economically Disadvantaged	729	86.9	148	79.1	365	87.5	216	91.9	104	92.9	90	89.1	261	85.6	126	94.0
Limited English Proficient	441	52.6	77	41.2	215	51.6	149	63.4	72	64.3	66	65.4	143	46.9	83	61.9
Gifted and Talented	188	22.4	41	21.9	104	24.9	43	18.3	9	8.0	17	16.8	95	31.2	26	19.4
Special Education	39	4.5	6	3.1	19	4.5	14	5.5	8	7.0	7	6.2	11	3.6	7	5.0
Grade 6	186	22.2	0	0.0	105	25.2	81	34.5	0	0.0	0	0.0	105	34.4	81	50.5
Grade 7	278	33.1	54	28.9	123	29.5	101	43.0	46	41.1	74	73.3	77	25.3	27	20.2
Grade 8	375	44.7	133	71.1	189	45.3	53	22.6	66	58.9	27	26.7	123	40.3	26	19.4
Total	875	100	197	100	424	100	254	100	114	100	113	100	310	100	141	100

* 2017-18 includes only Cohort 1 students. As such, we did not disaggregate 2017-18 by cohort.

Measures

We collected science motivation data for the students in participating teachers' classrooms. This section describes the student survey and provides evidence supporting the appropriateness of the survey.

Student Survey

Project staff invited students in participating teachers' classrooms to complete a student survey called the Science Motivation Questionnaire II (SMQ-II). Developers of the survey designed the SMQ-II to determine students' motivation to learn science (Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011). The version of the SMQ-II used in this study is available from the University of Georgia via https://coe.uga.edu/assets/downloads/mse/smqii-glynn.pdf. The SMQ-II includes 25 items divided into five dimensions measuring:

- intrinsic motivation, defined as the inherent satisfaction in learning science for its own sake,

- career motivation, defined as the learning of science in order to attain a tangible goal specific to a science career,

- self-determination, defined as the level of control that students believe they have over their individual learning of science,

- self-efficacy, defined as students' belief that they can achieve in science, and

- grade motivation, defined as the learning of science in order to attain a tangible goal specific to science coursework.

Each of the five dimensions of science motivation has five associated items on the SMQ-II and all response options are on a Likert-type scale with responses ranging from never to always. Existing validity evidence supports the use of the SMQ-II. According to Glynn et al. (2011), the relationship between students' science motivation and college science GPA was significant ($p < .001$). The correlations between the components and GPA are as follows: self-efficacy (0.58), self-determination (0.41), grade motivation (0.35), career motivation (0.34), and intrinsic motivation (0.29). Additionally, empirical studies support the five-factor internal structure of the SMQ-II (Bryan, Glynn, & Kittleson, 2011; Glynn et al., 2011). Finally, Glynn et al. (2011) found the following internal consistencies: career motivation (0.92), intrinsic motivation (0.89), self-determination (0.88), self-efficacy (0.83), and grade motivation (0.81).

Within the STEM Academy, students in STEM Academy teachers' classrooms were invited to participate in SMQ-II at two timepoints, including near the beginning (i.e., October) and near the end of the school year (i.e., February or early March). For more detail about classroom sampling and student survey administration, please request in internal report focused on student survey data collection (Sparks, Hatfield, Adams, and Ketterlin-Geller, 2020). The logic model for the STEM Academy specified student motivation as a long-term outcome of the program; as such, we did not expect to observe changes in student achievement and motivation until teachers' third year of the program.

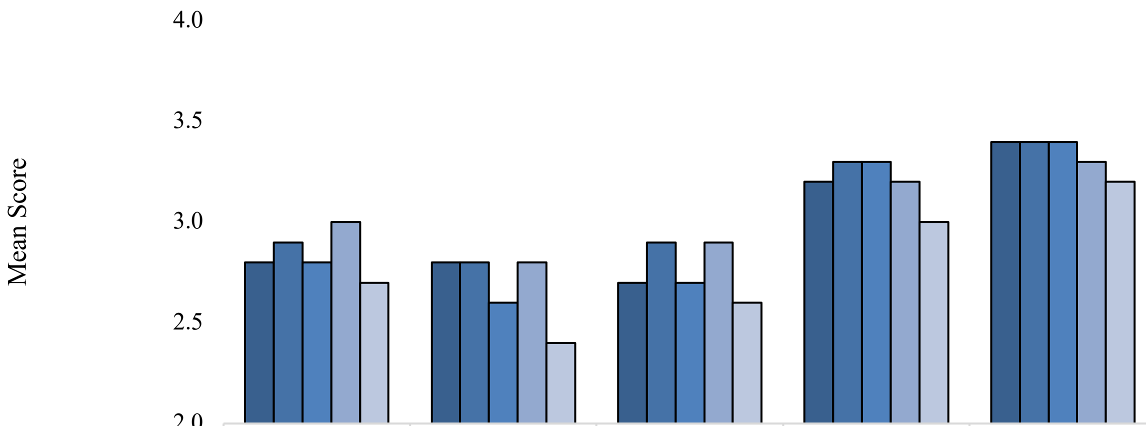
Results

To what extent did students report positive science motivation? Did student motivation increase across time?

Cohort 1

Contrary to our hypothesis, we did not observe increases across time in students' science motivation based on the student survey. In general, we observed slight decreases or little change across time. We collected data from the same students within year, but different students across years. Because change across time includes different cohorts of students, we depict the results using bar graphs. In 2017-18, we only collected student survey data in spring 2018. Therefore, we were not able to examine change within year for students in 2017-18. Based on matched-pair *t*-tests comparing change within year for the same students in 2018-19 and 2019-20, the decreases were statistically significant for:

- intrinsic motivation in both years ($p < .05$ for fall 2018 to spring 2019; $p < .001$ for fall 2019 to spring 2020),
- career motivation in both years ($p < .01$ for fall 2018 to spring 2019; $p < .001$ for fall 2019 to spring 2020),
- self-determination in both years ($p < .05$ for fall 2018 to spring 2019; $p < .001$ for fall 2019 to spring 2020),
- self-efficacy for fall 2019 to spring 2020 only ($p < .01$), and
- grade motivation in fall 2019 to spring 2020 only ($p < .05$).



	Intrinsic motivation	Career motivation	Self-determination	Self-efficacy	Grade motivation
Spring 18 (n=197)	2.8	2.8	2.7	3.2	3.4
Fall 18 (n=114)	2.9	2.8	2.9	3.3	3.4
Spring 19 (n=114)	2.8	2.6	2.7	3.3	3.4
Fall 19 (n=113)	3.0	2.8	2.9	3.2	3.3
Spring 20 (n=113)	2.7	2.4	2.6	3.0	3.2

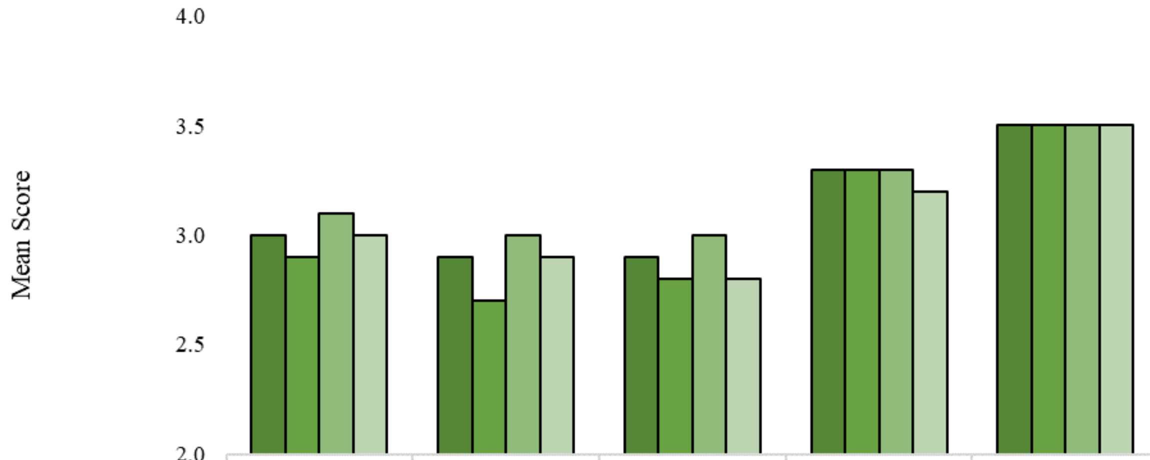
Figure 2. Cohort 1 Teachers' Students' Average Science Motivation Across Time

Note: We did not collect cohort 1 fall 2017 student survey data because SMU was awaiting research review board approval from Dallas ISD.

Cohort 2

Similar to students in cohort 1 teachers' classrooms, we did not observe increases in students' science motivation in cohort 2 teachers' classrooms. These teachers engaged in the STEM Academy for two years; whereas, cohort 1 teachers engaged for three years. We observed consistent results across both cohorts with slight decreases or little change across time. Based on matched-pair *t*-tests comparing change within year for the same students in 2018-19 and 2019-20, the decreases were statistically significant for:

- intrinsic motivation in both years ($p < .05$ for fall 2018 to spring 2019; $p < .05$ for fall 2019 to spring 2020),
- career motivation in both years ($p < .001$ for fall 2018 to spring 2019; $p < .05$ for fall 2019 to spring 2020),
- self-determination in both years ($p < .01$ for fall 2018 to spring 2019; $p < .01$ for fall 2019 to spring 2020),
- self-efficacy for fall 2019 to spring 2020 only ($p < .05$), and
- grade motivation in neither year.



	Intrinsic motivation	Career motivation	Self-determination	Self-efficacy	Grade motivation
Fall 18 (n=310)	3.0	2.9	2.9	3.3	3.5
Spring 19 (n=310)	2.9	2.7	2.8	3.3	3.5
Fall 19 (n=141)	3.1	3.0	3.0	3.3	3.5
Spring 20 (n=141)	3.0	2.9	2.8	3.2	3.5

Figure 3. Cohort 2 Teachers' Students' Average Science Motivation Across Time

For students in both cohort 1 and 2 teachers' classrooms, grade motivation was more stable across time relative to other dimensions of motivation. In addition, students tended to rate their self-efficacy and grade motivation higher than the other dimensions of science motivation.

Based on the student survey, do we observe evidence of differential change across student subgroups?

To test if differential change existed by student subgroup, we fit a series of hierarchical linear models (HLMs) including interaction terms testing the relationship between students fall and spring science motivation after controlling for a wide range of characteristics including:

- student characteristics [i.e., prior year STAAR reading and mathematics scores, ethnicity, gender, special education (SPED) status, ED status, grade],
- teacher characteristics (i.e., level of education, ethnicity, gender, year of participation), and
- school characteristics in the prior year (i.e., percent of Black students, percent of at risk students based on a district measure including students' ED status and prior achievement, percent of teachers retained, percent of students meeting science proficiency, percent of teachers rating the campus culture positively, and the percept of teachers rating the campus expectations for students positively).

We fit a separate model for each of the five dimensions of science motivation. We included student, teacher, and school characteristics to more precisely isolate the relationship between student characteristics and science motivation. We tested differential change by fitting the full model including an interaction term for students' fall motivation and the student characteristic. We tested each interaction term separately from the other interaction terms. The coefficient for each interaction term tested for differential change in dimensions of science motivation based on specific student characteristics, after controlling for student, teacher, and school characteristics. See Appendix B for the full model specification and results.

Cohort 1

Table 4 shows the coefficients for the interaction terms, which were individually tested in the full model for cohort 1 teachers. We identified significant interactions for six subgroups. Relative to other students, students with higher prior reading test scores demonstrated larger increases in science intrinsic motivation ($p < .05$). Relative to non-Hispanic students, Hispanic students demonstrated larger increases in science self-efficacy ($p < .05$). Relative to male students, female students demonstrated larger increases in science intrinsic motivation ($p < .01$) and career motivation ($p < .05$). Relative to other students, ED students demonstrated larger increases in intrinsic motivation ($p < .05$) and career motivation ($p < .05$). Relative to other students, students in cohort 1 teachers' classrooms during their third year of the program (2019-20) demonstrated larger decreases in intrinsic motivation ($p < .05$).

Table 4
Cohort 1 HLM Coefficients for the Interaction Terms

Variable	Dimensions				
	Intrinsic Motivation	Career Motivation	Self-Determination	Self-Efficacy	Grade Motivation
Prior Reading Score	.00*	.00	.00	-.00	-.00
Prior Math Score	-.00	-.00	.00	.00	-.00
Black	.03	.08	-.45	-.73	-.50
Hispanic	-.08	.18	.25	.61*	.10
Female	.34**	.25	.07	.25*	.16
Special Education	.40*	.51**	-.05	.28	-.32
Economic Disadvantage	.36*	.46*	-.37	.14	.23
Talented and Gifted	.02	-.13	.04	.07	.18
Grade 7	.22	-.14	-.07	-.16	-.07
Year	-.30*	-.05	-.11	-.09	-.02

Note: * p<0.05, ** p<0.01, *** p<0.001
We specified Grade 8 White students as the reference group. We did not test interaction effects for students in the reference group. The cohort 1 sample did not include students in Grade 6. Year indicates whether student was in cohort 1 teachers' classroom during 2018-19 or 2019-20.

Cohort 2

Table 5 shows the coefficients for the interaction terms, which were individually tested in the full model for cohort 2 teachers. We observe evidence of differential change for students in cohort 2 teachers' classrooms who have higher prior reading and mathematics scores on the state test. Relative to other students, students with higher prior test scores demonstrated larger increases in science intrinsic motivation ($p < .05$ for prior reading scores), self-determination ($p < .01$ for reading scores), and grade motivation ($p < .01$ for prior reading scores and $p < .001$ for prior mathematics scores). Relative to other students, ED students demonstrated larger decreases in science grade motivation ($p < .01$). Relative to other students, talented and gifted (TAG) students demonstrated larger increases in grade motivation ($p < .001$).

Table 5
Cohort 2 Coefficients for the Interaction Terms

Variable	Dimensions				
	Intrinsic Motivation	Career Motivation	Self-Determination	Self-Efficacy	Grade Motivation
Prior Reading Score	.00*	.00	.00**	.00	.00**
Prior Math Score	.00	.00	.00	.00*	.00***
Black	-.02	.14	-.13	-.06	-.05
Hispanic	-.02	-.10	.04	-.09	-.13
Female	-.04	.00	.14	-.13	-.02
Special Education	-.27	-.25	-.27	-.10	-.09
Economic Disadvantage	-.19	-.01	-.06	-.14	-.43**
Talented and Gifted	.10	.07	.10	.10	.42***
Grade 6	.10	.02	.09	.07	.10
Grade 7	-.10	.04	-.06	-.05	-.19
Year	.02	-.02	-.08	-.09	-.07

Note: * p<0.05, ** p<0.01, *** p<0.001
We specified Grade 8 White students as the reference group. We did not test interaction effects for our reference group. Year indicates whether student was in cohort 2 teachers' classroom during 2018-19 or 2019-20.

In summary, we observed little to no change in students' science motivation as measured by the student survey. We observed evidence of differential change across time for student subgroups. Across both cohorts of teachers, students with higher prior reading scores tended to increase more in their intrinsic motivation relative to other students. We also observed inconsistent evidence of differential change across teacher cohorts. For example, in cohort 1 teachers' classrooms only, we observed larger increases in dimensions of science motivation for Hispanic students, female students, ED students, and SPED students. However, in cohort 2 teachers' classrooms, we did not observe increases for these subgroups, and ED students decreased more in their grade motivation relative to other students.

Conclusions

We expected that students' motivation would increase in STEM Academy teachers' classrooms given the intensive nature of the intervention (i.e., summer PD and year-round coaching). However, we observed evidence that middle school students' science motivation decreased across the school year. This finding aligns with previous work showing that students' motivation in general decreases in middle school (Wigfield & Eccles, 1994). We specified student motivation as a long-term outcome of the program. Therefore, we expected to see changes in students' science motivation in teachers' third year of the program. However, we did not observe evidence that students' motivation increased more in cohort 2 teachers' second year or cohort 1 teachers' third year of the program. This is contrary to existing research, which finds a strong relationship between exposure to active learning and positive student motivation (e.g., Bryan, Glynn, & Kittleson, 2011; Minner et al., 2010; Skinner, & Belmont, 1993).

There are several possible explanations for why we did not observe the hypothesized increases within year. These explanations include factors related to the students and the implementation of the program. The decreases within year in science motivation could be due to a number of student factors including anxiety about approaching standardized testing (Elliot & McGregor, 1999), middle school students' cognitive and emotional development (Wentzel, 1997), or teachers' instructional decisions in anticipation of standardized testing (Maciver, Young, & Washburn, 2002). In addition, the finding that science motivation decreased within the context of an intensive teacher intervention like the STEM Academy points to the need to understand what is happening within the schools during program implementation. We hypothesized that intensive teacher professional development and coaching would encourage teachers to implement high quality active learning experiences, which would increase student motivation. However, teachers experienced a number of hurdles in implementing active learning as evidenced by external observations of teachers' implementation of active learning and teacher focus groups (Adams, Ketterlin-Geller, & Hatfield, 2020). In addition, STEM Academy teachers' STEM beliefs did not increase consistently across the course of the STEM Academy, which may have contributed to hesitation in implementing active learning. Qualitative interviews with teachers pointed to differential patterns in implementation across teachers, which may explain the conditions under which teachers were more successful in implementing active learning (Adams, Knox, & Ketterlin-Geller, 2020). This work is ongoing and may highlight differential patterns in student motivation based on the frequency and quality of teachers' implementation of active learning.

We observed evidence that teachers changed grade levels across the academy. For example, cohort 1 teachers taught majority Grade 8 students in both 2017-18 (71%) and 2018-19 (59%) and then majority Grade 7 students in 2019-20 (73%). Cohort 2 teachers taught majority Grade 8 students in 2018-19 (40%), but then majority Grade 6 students in 2019-20 (51%). Based on existing research (Kelly, Gningue, & Qian, 2015), this teacher movement across grades may have created setbacks for teachers in terms of implementing active learning and influencing students' motivation.

For students in cohort 1 and 2 teachers' classrooms, we did not observe consistent evidence of differential change in science motivation for students in under-represented subgroups. Students with higher reading scores reported larger increases in science intrinsic motivation in both cohort 1 and 2 teachers' classrooms. Students may recognize the disadvantage presented by lower reading ability for achieving proficiency in science (Isreal, Wang, & Marino, 2015). Relative to other students, we observed larger increases in motivation for under-represented students (i.e., female, Hispanic, SPED, and ED) in cohort 1 teachers' classrooms, but not in cohort 2 teachers' classrooms. This finding warrants further investigation and may support differential patterns of teachers' implementation across teacher cohorts.

A limitation to this report is that we did not include a comparison group. As such, we cannot make conclusions about what would have happened to student motivation outside of the context of the STEM Academy. A second limitation is that we collected the fall motivation survey after STEM Academy teachers taught these students for up to two months (i.e., the survey was first given in October each year). As such, the fall survey is not a true baseline.

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Appendix A – Science Motivation Questionnaire II

SCIENCE MOTIVATION QUESTIONNAIRE II (SMQ-II)

In order to better understand what you think and how you feel about your science courses, please respond to each of the following statements from the perspective of "When I am in a science course…"

Statements	Never 0	Rarely 1	Sometimes 2	Often 3	Always 4
01. The science I learn is relevant to my life.					
02. I like to do better than other students on science tests.					
03. Learning science is interesting.					
04. Getting a good science grade is important to me.					
05. I put enough effort into learning science.					
06. I use strategies to learn science well.					
07. Learning science will help me get a good job.					
08. It is important that I get an "A" in science.					
09. I am confident I will do well on science tests.					
10. Knowing science will give me a career advantage.					
11. I spend a lot of time learning science.					
12. Learning science makes my life more meaningful.					
13. Understanding science will benefit me in my career.					
14. I am confident I will do well on science labs and projects.					
15. I believe I can master science knowledge and skills.					
16. I prepare well for science tests and labs.					
17. I am curious about discoveries in science.					
18. I believe I can earn a grade of "A" in science.					
19. I enjoy learning science.					
20. I think about the grade I will get in science.					
21. I am sure I can understand science.					
22. I study hard to learn science.					
23. My career will involve science.					
24. Scoring high on science tests and labs matters to me.					
25. I will use science problem-solving skills in my career.					

Note. The SMQ-II is copyrighted and registered. Go to **http://www.coe.uga.edu/smq/** for permission and directions to use it and its discipline-specific versions such as the Biology Motivation Questionnaire II (BMQ-II), Chemistry Motivation Questionnaire II (CMQ-II), and Physics Motivation Questionnaire II (PMQ-II) in which the words *biology*, *chemistry*, and *physics* are respectively substituted for the word *science*. Versions in other languages are also available.

Appendix B – Student Survey Model Full Results

Table 1B

Full HLM Results for Students in Cohort 1 Teachers' Classrooms

	Variables	Intrinsic Motivation Model 1	Career Motivation Model 2	Self-Determination Model 3	Self-Efficacy Model 4	Grade Motivation Model 5
Student Characteristics	Outcome	0.62***	0.61***	0.56***	0.56***	0.65***
		(0.06)	(0.07)	(0.06)	(0.06)	(0.07)
	Prior Year STAAR Reading	0.00	0.00	0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	Prior Year STAAR Math	0.00	0.00	0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	Black	-0.39	0.05	0.27	-0.03	0.06
		(0.27)	(0.35)	(0.28)	(0.24)	(0.23)
	Hispanic	-0.40	0.00	0.07	-0.21	-0.08
		(0.23)	(0.30)	(0.23)	(0.21)	(0.20)
	Female	-0.07	0.12	0.01	-0.03	-0.03
		(0.08)	(0.11)	(0.09)	(0.08)	(0.07)
	Special Education	-0.18	0.23	-0.17	-0.06	-0.12
		(0.17)	(0.23)	(0.18)	(0.16)	(0.15)
	Economic Disadvantage	-0.02	-0.42	-0.14	-0.05	-0.23
		(0.16)	(0.22)	(0.17)	(0.15)	(0.14)
	Talented and Gifted	0.12	-0.06	-0.04	-0.05	-0.01
		(0.14)	(0.19)	(0.14)	(0.13)	(0.12)
	Grade 6	0.00	0.00	0.00	0.00	0.00
		(.00)	(.00)	(.00)	(.00)	(.00)
	Grade 7	-0.27	-0.12	-0.19	0.05	0.06
		(0.18)	(0.23)	(0.18)	(0.16)	(0.15)
Teacher Characteristics	Teacher State Experience	-0.05	-0.11*	-0.05	-0.06	0.06
		(0.04)	(0.06)	(0.04)	(0.04)	(0.04)
	Master's or Higher	0.09	0.29	0.10	0.03	-0.24
		(0.29)	(0.38)	(0.30)	(0.26)	(0.25)
	Teacher Black	-0.37	0.06	-0.32	-0.01	0.18
		(0.24)	(0.31)	(0.24)	(0.21)	(0.20)
	Teacher Hispanic	-0.64*	-1.29**	-0.68*	-0.51	0.09
		(0.32)	(0.43)	(0.33)	(0.29)	(0.28)

	Teacher Female	0.26	0.33	0.24	-0.06	0.02
		(0.20)	(0.26)	(0.20)	(0.18)	(0.17)
	Year	-0.05	-0.23	-0.13	-0.15	-0.05
		(0.17)	(0.22)	(0.17)	(0.15)	(0.15)
School Characteristics	Percent Black Students	0.01	0.01	0.01	0.01	0.00
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	Percent Students at Risk	-0.01	-0.04	0.00	-0.01	0.01
		(0.03)	(0.04)	(0.03)	(0.03)	(0.03)
	Percent Teachers Retained	0.02	0.02	0.02	0.02*	0.01
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	Percent Students Met Grade Level Science	0.01	-0.02	0.00	0.00	0.00
		(0.03)	(0.04)	(0.03)	(0.03)	(0.03)
	Percent Teachers Rating the Campus Culture Positively	0.01	-0.03	0.02	0.00	0.00
		(0.03)	(0.04)	(0.03)	(0.03)	(0.03)
	Percent Teachers Rating the Campus Expectations Positively	-0.03	-0.03	-0.05	-0.02	-0.01
		(0.04)	(0.06)	(0.04)	(0.04)	(0.04)
	Constant	3.38	8.01*	2.38	3.38	-0.05
		(3.09)	(4.04)	(3.15)	(2.77)	(2.69)
	AIC	404.77	516.65	410.36	360.67	340.47
	BIC	487.96	599.85	493.56	443.87	423.66
	N	206	206	206	206	206

Note: * p<0.05, ** p<0.01, *** p<0.001
We were missing student demographic characteristics for 10 students in Cohort 1. These students were not included in this analysis.

Table 2B

Full HLM Results for Students in Cohort 2 Teachers' Classrooms

	Variable	Intrinsic Motivation Model 1	Career Motivation Model 2	Self-Determination Model 3	Self-Efficacy Model 4	Grade Motivation Model 5
Student Characteristics	Outcome	0.72***	0.78***	0.72***	0.60***	0.56***
		(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
	Prior Year STAAR Reading	0.00	0.00	0.00	0.00	**0.00****
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	Prior Year STAAR Math	0.00	0.00	0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	Black	-0.02	-0.05	0.06	0.05	-0.01
		(0.12)	(0.15)	(0.12)	(0.11)	(0.11)
	Hispanic	-0.05	0.02	0.06	0.02	-0.06
		(0.11)	(0.13)	(0.10)	(0.10)	(0.09)
	Female	0.02	-0.04	-0.07	-0.08	0.02
		(0.06)	(0.07)	(0.05)	(0.05)	(0.05)
	Special Education	0.07	-0.05	-0.06	-0.07	-0.01
		(0.14)	(0.17)	(0.14)	(0.13)	(0.13)
	Economic Disadvantage	-0.01	-0.08	0.03	0.08	0.10
		(0.08)	(0.10)	(0.08)	(0.08)	(0.07)
	Talented and Gifted	-0.14	-0.05	-0.11	-0.11	**-0.18****
		(0.08)	(0.09)	(0.07)	(0.07)	(0.07)
	Grade 6	0.07	0.09	-0.01	-0.11	0.03
		(0.09)	(0.11)	(0.09)	(0.08)	(0.08)
	Grade 7	**0.27****	0.16	0.07	0.07	0.12
		(0.08)	(0.10)	(0.08)	(0.08)	(0.07)
Teacher Characteristics	Teacher State Experience	0.00	0.02*	0.00	-0.01	0.00
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	Master's or Higher	-0.06	-0.09	0.03	0.06	-0.03
		(0.09)	(0.11)	(0.09)	(0.08)	(0.08)
	Teacher Black	-0.07	0.01	0.03	0.04	0.00
		(0.07)	(0.09)	(0.07)	(0.07)	(0.06)
	Teacher Hispanic	0.06	-0.07	-0.02	0.14	0.07
		(0.18)	(0.22)	(0.18)	(0.17)	(0.16)

	Teacher Female	0.13	0.09	0.01	0.13	-0.04
		(0.10)	(0.12)	(0.09)	(0.09)	(0.08)
	Year	-0.03	0.13	-0.11	-0.14	-0.02
		(0.12)	(0.14)	(0.11)	(0.11)	(0.10)
School Characteristics	Percent Black Students	0.00	-0.01	0.00	0.01*	0.00
		(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
	Percent Students at Risk	0.00	0.01	-0.01	0.00	0.00
		(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
	Percent Teachers Retained	0.01	0.01	0.01	0.00	0.00
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	Percent Students Met Grade Level Science	0.00	0.01	-0.01	-0.01	0.00
		(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
	Percent Teachers Rating the Campus Culture Positively	-0.01	0.02	0.00	-0.03	0.00
		(0.02)	(0.02)	(0.02)	(0.02)	(0.01)
	Percent Teachers Rating the Campus Expectations Positively	0.02	0.00	0.00	0.03*	0.01
		(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
	Constant	-2.26	-3.46	-0.24	-0.46	-0.71
		(1.95)	(2.34)	(1.87)	(1.78)	(1.70)
	AIC	726.96	878.14	693.15	646.34	607.47
	BIC	831.76	982.94	797.95	751.13	712.27
	N	416	416	416	416	416

Note: * p<0.05, ** p<0.01, *** p<0.001
We were missing student demographic characteristics for 18 students in Cohort 2. These students were not included in this analysis.

Appendix C – Student Survey Item Results

Table 1C

Item Descriptive Statistics for Students in Cohort 1 and 2 Teachers' Classrooms across Time including the Full Sample

Scale	*Item*	*Statistic*	***Students in Cohort 1 Teachers' Classrooms*** *Spr 18 (n=214)*	*Fall 18 (n=228)*	*Spr 19 (n=169)*	*Fall 19 (n=205)*	*Spr 20 (n=149)*	***Students in Cohort 2 Teachers' Classrooms*** *Fall 18 (n=470)*	*Spr 19 (n=411)*	*Fall 19 (n=241)*	*Spr 20 (n=193)*
Intrinsic motivation	Learning science is interesting	Mean	3.2	3.2	3.1	3.2	3.1	3.2	3.1	3.3	3.2
		SD	.84	.90	.94	.92	.86	.89	.92	.93	.86
		Min	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	1	4	1	0	2	3	2	0
	I am curious about discoveries in science	Mean	3.1	3.2	3.0	3.1	2.9	3.2	3.0	3.2	3.0
		SD	1.0	.96	1.0	1.00	1.1	.97	1.0	1.04	1.0
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	15	3	4	2	24	7	10	2
	The science I learn is relevant to my life	Mean	2.6	2.6	2.5	2.6	2.4	2.6	2.7	2.8	2.8
		SD	.88	1.0	1.1	.96	.91	.97	.95	.96	1.0
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	0	0	1	0	1	1	1	0
	Learning science makes my life more meaningful	Mean	2.4	2.5	2.1	2.3	2.1	2.5	2.3	2.6	2.5
		SD	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	0	0	1	0	0	1	0	0
		Mean	3.2	3.1	3.1	3.2	2.9	3.3	3.1	3.3	3.0

Scale	*Item*	*Statistic*	***Students in Cohort 1 Teachers' Classrooms*** *Spr 18 (n=214)*	*Fall 18 (n=228)*	*Spr 19 (n=169)*	*Fall 19 (n=205)*	*Spr 20 (n=149)*	***Students in Cohort 2 Teachers' Classrooms*** *Fall 18 (n=470)*	*Spr 19 (n=411)*	*Fall 19 (n=241)*	*Spr 20 (n=193)*
	I enjoy learning science	SD	.89	1.0	.92	.95	1.0	.90	1.0	.97	1.1
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	11	4	2	2	24	8	10	0
Career motivation	Learning science will help me get a good job	Mean	3.0	3.0	2.7	2.9	2.6	3.0	2.9	3.1	3.1
		SD	.98	1.0	1.1	1.11	1.1	.96	1.1	1.03	1.0
		Min	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	1	0	2	0	0	3	5	1	0
	Understanding science will benefit me in my career	Mean	3.0	3.0	2.6	2.8	2.5	3.0	2.7	3.0	2.9
		SD	1.1	.99	1.2	1.09	1.2	.98	1.1	1.01	1.0
		Min	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	11	3	1	0	23	7	7	0
	Knowing science will give me a career advantage	Mean	3.1	3.0	2.8	2.8	2.6	3.1	3.0	3.2	3.0
		SD	.94	.91	1.0	1.1	1.1	.95	1.0	.98	1.0
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	2	7	1	1	7	1	1	2
	I will use science problem-solving skills in my career	Mean	2.6	2.7	2.4	2.6	2.3	2.9	2.5	2.8	2.7
		SD	1.1	1.1	1.2	1.2	1.2	1.1	1.2	1.1	1.2
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	11	3	3	0	23	6	8	1
		Mean	2.4	2.2	2.2	2.3	2.0	2.5	2.2	2.6	2.4

Scale	*Item*	*Statistic*	***Students in Cohort 1 Teachers' Classrooms*** *Spr 18 (n=214)*	*Fall 18 (n=228)*	*Spr 19 (n=169)*	*Fall 19 (n=205)*	*Spr 20 (n=149)*	***Students in Cohort 2 Teachers' Classrooms*** *Fall 18 (n=470)*	*Spr 19 (n=411)*	*Fall 19 (n=241)*	*Spr 20 (n=193)*
	My career will involve science	SD	1.3	1.3	1.3	1.3	1.2	1.3	1.3	1.1	1.3
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	14	4	5	1	26	16	10	2
Self-determination	I study hard to learn science	Mean	2.5	2.6	2.5	2.6	2.3	2.7	2.7	2.7	2.6
		SD	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.0	1.1
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	3	13	7	3	1	26	9	12	4
	I prepare well for science tests and labs	Mean	2.8	3.2	2.9	3.0	2.8	3.0	2.9	3.1	2.9
		SD	1.0	.86	1.0	.92	1.0	.97	1.0	.94	1.1
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	2	13	7	2	2	24	9	9	0
	I put enough effort into learning science	Mean	3.3	3.3	3.3	3.2	3.1	3.3	3.2	3.3	3.2
		SD	.76	.79	.78	.88	.82	.82	.85	.81	.87
		Min	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	3	2	0	1	5	0	0	2
	I spend a lot of time learning science	Mean	2.4	2.3	2.1	2.4	2.1	2.5	2.3	2.6	2.5
		SD	.96	1.0	1.0	1.1	.95	.96	1.0	1.0	1.0
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	2	1	2	1	2	4	6	2	2
		Mean	2.6	2.8	2.7	2.7	2.5	2.8	2.7	3.0	2.8
		SD	.95	1.0	.96	1.1	1.0	.98	.98	.93	.98

Scale	*Item*	*Statistic*	***Students in Cohort 1 Teachers' Classrooms*** *Spr 18 (n=214)*	*Fall 18 (n=228)*	*Spr 19 (n=169)*	*Fall 19 (n=205)*	*Spr 20 (n=149)*	***Students in Cohort 2 Teachers' Classrooms*** *Fall 18 (n=470)*	*Spr 19 (n=411)*	*Fall 19 (n=241)*	*Spr 20 (n=193)*
	I use strategies to learn science well	Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	1	2	0	0	1	3	1	2	1
Self-efficacy	I believe I can earn a grade of "A" in science	Mean	3.4	3.4	3.4	3.3	3.1	3.4	3.4	3.4	3.3
		SD	.92	.88	.94	.90	.94	.91	.96	.87	.87
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	12	3	4	0	24	10	8	1
	I am confident I will do well on science tests	Mean	3.3	3.5	3.3	3.1	3.1	3.3	3.2	3.3	3.2
		SD	.79	.79	.78	.88	.93	.84	.87	.83	.88
		Min	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	12	5	0	3	23	9	0	0
	I believe I can master science knowledge and skills	Mean	3.0	3.2	3.0	3.0	2.9	3.1	3.0	3.1	3.0
		SD	.96	.88	1.0	.95	.96	.95	.98	.89	.97
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	12	3	2	2	24	8	8	0
	I am sure I can understand science	Mean	3.2	3.1	3.2	3.1	3.0	3.1	3.1	3.1	3.1
		SD	.85	.82	.80	.90	.93	.89	.89	.86	.93
		Min	0.0	0.0	1.0	0.0	0.0	0.0	0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4	4.0	4.0
		No Response	3	13	4	3	0	26	8	12	4
	I am confident I will do well	Mean	3.1	3.2	3.1	3.3	3.0	3.1	3.1	3.2	3.1
		SD	.92	.89	1.0	.79	.90	.91	.93	.93	.85

Scale	Item	Statistic	Students in Cohort 1 Teachers' Classrooms					Students in Cohort 2 Teachers' Classrooms			
			Spr 18 (n=214)	*Fall 18 (n=228)*	*Spr 19 (n=169)*	*Fall 19 (n=205)*	*Spr 20 (n=149)*	*Fall 18 (n=470)*	*Spr 19 (n=411)*	*Fall 19 (n=241)*	*Spr 20 (n=193)*
	on science labs and projects	Min	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	1	1	1	2	0	3	4	1	3
Grade motivation	Scoring high on science tests and labs matters to me	Mean	3.5	3.6	3.5	3.4	3.2	3.5	3.5	3.5	3.5
		SD	.89	.76	.84	.84	1.0	.84	.89	.80	.83
		Min	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	2	13	3	5	1	25	8	10	3
	It is important that I get an "A" in science	Mean	3.5	3.5	3.4	3.5	3.4	3.6	3.5	3.6	3.6
		SD	.72	.79	.86	.77	.84	.74	.86	.77	.75
		Min	0.0	0.0	0.0	1.0	1.0	1.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	2	2	2	0	1	7	0	1
	I think about the grade I will get in science	Mean	3.2	3.1	3.2	3.1	3.1	3.3	3.3	3.4	3.3
		SD	1.0	.93	.96	.98	1.1	.88	.90	.83	.88
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	1	11	5	2	2	24	7	9	3
	Getting a good science grade is important to me	Mean	3.7	3.7	3.7	3.6	3.6	3.7	3.6	3.7	3.7
		SD	.58	.63	.67	.67	.71	.61	.71	.68	.65
		Min	1.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	1.0
		Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	0	1	3	2	0	2	1	0	3
	I like to do better than other students	Mean	3.1	3.0	2.9	2.9	2.7	3.0	3.0	3.0	3.0
		SD	.98	1.0	1.0	1.1	1.1	1.1	1.0	1.1	1.1
		Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Scale	*Item*	*Statistic*	***Students in Cohort 1 Teachers' Classrooms*** *Spr 18 (n=214)*	*Fall 18 (n=228)*	*Spr 19 (n=169)*	*Fall 19 (n=205)*	*Spr 20 (n=149)*	***Students in Cohort 2 Teachers' Classrooms*** *Fall 18 (n=470)*	*Spr 19 (n=411)*	*Fall 19 (n=241)*	*Spr 20 (n=193)*
	on science tests	Max	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
		No Response	1	1	0	1	0	2	0	1	1

Note: Table 1C includes the full sample of students, including students who did not complete all items on the survey (i.e., No Response) and/or did not complete surveys in the fall and spring.