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Research in Mathematics Education

STEM Academy for Teachers and Leaders: 2018-19 Coaching and PLC Evaluation

Technical Report 19-07

STEM Academy for Teachers and Leaders: 2018-19 Coaching and PLC Evaluation

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Executive Summary

Evidence suggests that pursuing a STEM career provides more financial and job security. However, not all subgroups are equally represented in STEM careers, including individuals who are Black or Hispanic, women, or from low socio-economic backgrounds (Tytler & Osborne, 2012; Miyake et al., 2010). Dallas Independent School District (ISD) is a large school system serving a majority percentage of students who identify as Black or Hispanic and are from low socio-economic backgrounds. In an effort to increase Dallas ISD's student interest and achievement in STEM, district leadership partnered with the Texas Instrument Foundation, Southern Methodist University (SMU), and the O'Donnell Foundation to develop and implement the *STEM Academy for Science Teachers and Leaders.* As part of the Academy, teachers and leaders engage in two primary components including: (a) intensive summer professional development on the SMU campus, and (b) one-on-one coaching with an SMU coach during the school year. Teachers participate in the STEM Academy for up to three years. This report focuses on the coaching component of the STEM Academy during the 2018-19 school year. The purpose of this report is to describe: (a) changes to the coaching model from previous years of implementation, (b) participating teachers and their school characteristics, (c) the fidelity of coaching implementation during the second year, and (d) teachers' perception of the coaching based on responses to the coaching evaluation survey.

The Coaching Model. The structure of the STEM Academy coaching includes a one-on-one pre-conference, observation, and post-conference, which is defined as the full cycle of coaching. Teachers also participated in a school leader or coach-led professional learning community (PLC) meeting during each cycle. During the second year of the Academy, forty teachers engaged in up to seven coaching cycles and PLC meetings with an instructional coach from SMU. The coaching model offered teachers support in understanding and implementing aspects that were learned during the summer professional development academy. These aspects included an emphasis on: (a) active learning, (b) scientific process standards, (c) deepened content knowledge, and (d) differentiation. In addition, during the STEM Academy summer professional development, teachers were encouraged to utilize community-based STEM education resources such as the Frontiers of Flight Museum and the Dallas Area Rapid Transit (DART).

Participating Teachers and their Schools. Forty teachers participated in STEM Academy coaching during the second year (2018-19). The majority of teachers identified as Black (55%) and female (70%). These teachers taught in 15 Dallas ISD middle schools. The schools in which the teachers taught tended to include more Black and Hispanic students, more economically disadvantaged students, and students identified as English learners.

Fidelity of Implementation. On average, teachers completed seven of the seven targeted coaching cycles, supporting that the STEM Academy coaching was implemented with strong fidelity. During the 2018-19 school year, SMU instructional coaches engaged in 790 coaching sessions (i.e., pre-conferences, observations, or post-conferences), resulting in a total of 257 complete coaching cycles across the school year. On average, the pre-conference occurred in 18 minutes, the observation occurred in 54 minutes, and the post-conference occurred in 20 minutes. Furthermore, SMU coaches engaged in 72 PLC meetings that multiple teachers attended across the school year for an average of 44 minutes.

Teachers' Perceptions of Coaching. Overall, 82% to 96% of teachers agreed or strongly agreed that coaching was a valuable professional learning development experience and supported their understanding and utilization of active learning strategies. When prompted about the ways coaching helped implement active strategies, one teacher stated, "The coaching supported me with becoming more of a facilitator for my students and allowing them to take responsibility for their own learning." For the pre-conference sessions, depending on cohort and time of survey, 86% to 100% of teachers agreed or strongly agreed the sessions helped with their implementation of active learning strategies. Similarly, for the post-conference session, 79% to 100% agreed or strongly agreed that the post-conference sessions were reflective, confidential, and encouraged the use of active learning strategies. Furthermore, 89% to 100% of teachers agreed or strongly agreed to confidence in implementing active learning strategies in their classroom after the coaching cycle.

Teachers responses to the survey indicated opportunities for improvement. With regard to the one-on-one coaching cycles, teachers were least likely to agree that the STEM Academy coaching provided sufficient support for the PLC meetings. In the fall 2018 survey administration, 91% to 100% of teachers across cohorts agreed or strongly agreed that the PLC meetings delivered high-quality information about active learning and differentiation strategies. After the spring 2019 survey, only 50% to 96% of teachers agreed or strongly agreed. When prompted to provide recommendations to improve the coaching overall, one teacher stated, "I think the PLCs could be structured a little differently."

These results support three key recommendations. First, the complete coaching cycles (i.e., pre-conference, observation, post-conference) were perceived favorably by teachers and should continue to be implemented with minor, if any, modifications. The model was implemented with strong fidelity and was perceived as an overall valuable experience by teachers. Second, the PLC meetings need modifications for teachers to find value in these meetings. This is evidenced by the drop across time in the perceived quality of information delivered at the PLCs. Lastly, variability was observed in the fidelity of implementation of coaching. At some schools, fidelity of implementation was as low as 71% for complete coaching cycles (i.e., pre-conference, observation, or post-conference). Based on contextual evidence, coaches made repeated efforts to reschedule components of the coaching cycle due to time constraints and variability in the perceived importance of the coaching cycle by teachers and leaders. It is critical that district and school leadership continue to emphasize the importance of the one-on-one coaching and PLC meetings and encourage teachers to make these sessions a priority.

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STEM Academy for Teachers and Leaders: 2018-19 Coaching and PLC Evaluation

Background Information

Fields in science, technology, engineering and math (STEM) represent a majority of the highest starting paid fields in the United States (National Association of Colleges and Employers, 2018). Some students, particularly female students, students of color, and students from low socio-economic backgrounds are hesitant to consider STEM careers (Tytler & Osborne, 2012; Mikaye et al., 2010). Dallas Independent School System (ISD) was concerned with similar trends reflected within their school system, especially considering the large metropolitan area of Dallas where many STEM careers exist (Dallas ISD, 2019; Perry, Reeder, Brattain, Hatfield, & Ketterlin-Geller, 2017).

To increase students' interest, motivation, and achievement in STEM, focusing primarily on science, Dallas ISD partnered with Southern Methodist University (SMU), the Texas Instruments Foundation, and the O'Donnell Foundation to develop, implement, and evaluate the *STEM Academy for Science Teachers and Leaders.* A full description of the STEM Academy and its intended goals can be found in the previous years' coaching evaluation report (Adams et al., 2018).

During the first year of implementation (2017-18), 15 science teachers and 6 instructional leaders (e.g., campus instructional coach or assistant principal) participated in the Academy. During the second year of implementation (2018-19) three teachers exited the program. In addition, a second cohort of teachers were recruited with 28 teachers. In total, 40 teachers participated in the Academy during the 2018-19 school year.

Coaching Evaluation Questions

The purpose of this report is to focus on the *teacher coaching component* of the STEM Academy. This report provides an overall description of the components of the STEM Academy coaching. In addition, this report focuses on two primary evaluation questions:

1. To what extent was coaching implemented with fidelity?

2. What are teachers' perceptions of coaching and PLC meetings?

Description of STEM Academy Teacher Coaching and PLC Meetings

Core components of the STEM Academy include instructional coaching and professional learning communities (PLC) meetings. A description of coaching and PLC meetings can be

found in the previous coaching report (Adams et al., 2018). During the first year of implementation, we selected schools where at least two-thirds of the science teachers agreed to participate. In subsequent years, we continued to follow the teachers within that transferred within the school. As a result of participation changes, six schools in the second year of implementation only had one teacher participating. To accommodate those teachers, we provided a virtual PLC facilitated by an instructional coach in which teachers discussed important topics in STEM education. Topics included STEM integration, instruction with English learners, and lesson reflections.

Structure of the STEM Academy Teacher Coaching and PLC Meetings

In the first year of implementation, one coach provided instructional coaching and led PLC meetings with the 15 teachers. In the second year of implementation, four additional coaches were added to serve the increased number of schools and teachers with the original coach serving as the lead coach. The lead coach was responsible for coach training and supporting problem solving with scheduling or challenges observed in classrooms. Similar to the first year of the STEM Academy, one-on-one coaching consisted of a pre-conference, observation, and post-conference. In addition, participating teachers received one hour of graduate credit for their participation in coaching and PLC meetings.

Coach 1

Coach 1 is the returning lead coach, whose title is STEM Development and Implementation Coordinator at RME. In this role, he supports campus leaders and science teachers in the delivery of classroom lessons that focus on the integration of STEM and active learning techniques through individualized coaching, co-planning and facilitating Professional Learning Communities, and feedback following classroom observations. This role is intended to increase student achievement in science, student interest in STEM and students' persistence in STEM coursework by supporting teachers' professional knowledge and skills, and campus administrators' instructional leadership skills.

Coach 2

Coach 2 was a teacher and then vice principal in Jamaica from 1996-2009. She left Jamaica for Washington, D.C. where she became involved in STEM and earned an M.A. in STEM Curriculum Development and Implementation from Concordia University, Portland, OR. She was a part of a team selected by Pearson to set the rubric for the mathematics component in Partnership for Assessment in Readiness in College and Careers (PARCC). She has experience in curriculum development focused on engineering using the Next Generation Science Standards (NGSS).

Coach 3

Coach 3 is an experienced regional administrator, assistant principal, and classroom teacher. She has a demonstrated history of working in the public education sector. Her skills include K-8 education, leadership, regional administration, STEM, coaching, data management, and state assessments. Prior to work in education she was an engineer and business consultant in the

healthcare industry for over 20 years. In addition to her engineering degree she has an MBA, a Master of Educational Leadership focused in Educational Leadership and Administration, and is currently a Ph.D. student in Education at SMU.

Coach 4

Coach 4 earned her bachelor's degree in biology and master's degree in teaching from Austin College. She then taught high school science in New Mexico for eight years. During that time, she taught a wide variety of courses including biology, physics, AP chemistry, genetics, microbiology, and pharmacology. Her academic interests include curriculum design and vertical alignment. She is currently working towards her Ed.D. in Higher Education from SMU.

Coach 5

Coach 5 holds a Bachelor's of Arts from the University of North Carolina at Greensboro with a concentration in secondary education. While teaching, he pursued his master's degree in education with a concentration in English as a second language. The coach completed his Ph.D. in Education in 2019 at SMU. His dissertation focused on reclassification policies of English learners. In addition, he completed a master's degree in statistics through Texas A&M in 2019. Prior to working with RME, the coach was a graduate research assistant with the Budd Center where he co-collaborated on research projects. His research interests include mathematics instruction of English learners and policies that impact English learners.

The Teacher Coaching Model

A complete description of the coaching model can be found in the previous coaching report (Adams et al., 2018). One notable change to the model includes the adoption of the STEM Teaching Observation Protocol (STEM TOP; see Appendix A) for classroom observations instead of the previously utilized teacher coaching checklist. The purpose of adopting the observation protocol was to standardize coaching procedures with coaches. Coaches participated in calibration sessions before the school year and routinely double-scored observations throughout the school year to ensure fairness of ratings. Coaches' calibration statistics will be reported in a forthcoming technical report.

PLC Meetings (Professional Learning Communities)

A complete description of the PLC model can be found in the previous coaching report (Adams et al., 2018). For the second year of implementation, we adopted a virtual PLC model to serve teachers who were the only Academy teachers at their campus. The virtual PLC was housed on Canvas (Canvas, 2018), a learning management system adopted by SMU. Teachers accessed content and discussions on their own time but were given deadlines to complete discussions. An instructional coach monitored the discussions and responded to teachers' comments throughout the year. The instructional coach facilitated seven different PLC discussions throughout the school year. Furthermore, in the spring semester, coaches at schools with more than one teacher delivered the content of the PLC meetings instead of facilitating the PLC with a school leader. The coaching team decided to implement this change due to scheduling challenges with school leaders. The content of the PLC meetings that the coaches delivered during the spring semester was similar to that of the virtual PLC.

Participating Teachers and Their Schools

This section of the report describes the participating teachers who engaged in coaching during the 2018-19 school year.

Participating Teachers

During the second year of the STEM Academy implementation (2018-19), forty teachers participated in STEM Academy teacher coaching. The descriptive information for the participating teachers by cohort is depicted in Table 1. Most teachers were female (70%), identified as Black (55%), and were non-Hispanic (88%).

Table 1. *Descriptive Information for 2018-19 Participating Teachers (n = 40)*

Characteristic	# (%) of Teachers Cohort 1	# (%) of Teachers Cohort 2	Total
Female	9 (23%)	19 (48%)	28 (70%)
Male	3 (7%)	9 (23%)	12 (30%)
White	5 (13%)	8 (20%)	13 (33%)
Black	7 (18%)	15 (37%)	22 (55%)
Asian	0 (0%)	2 (5%)	2 (5%)
Multi-racial	0 (0%)	3 (7%)	3 (7%)
Hispanic	3 (7%)	2 (5%)	5 (12%)
Non-Hispanic	9 (23%)	26 (65%)	35 (88%)
Total	**12 (100%)**	**28 (100%)**	**40 (100%)**

Table 2 shows participating teachers' average number of years teaching and in other professional careers by cohort. In particular, cohort 2 teachers had on average more overall experience teaching and experience teaching science than cohort 1 teachers. In contrast, cohort 1 teachers had on average more experience in other professions and years at their current school.

Table 2. *Participating Teachers' Average Number of Years in Teaching (n = 40).*

# of Years	Average # of Years (SD)	Min	Max
Cohort 1 (n = 12)			
Teaching	5.6 (3.4)	2	14
Teaching Science	5.2 (3.0)	2	12
In other professions	8.9 (6.1)	0	17
At current school	4.8 (3.4)	0	12
Cohort 2 (n = 28)			
Teaching	6.6 (5.8)	1	20
Teaching Science	6.1 (5.7)	1	20
In other professions	5.8 (5.8)	0	23
At current school	3.3 (3.0)	1	11

Participating Schools

The 40 participating teachers taught at 15 middle schools in Dallas ISD. Descriptive information for each school relative to the district and state overall are highlighted in Table 3. Thirteen of 15 (87%) participating schools enrolled a majority of students who identified as Hispanic. All fifteen participating schools enrolled a majority of students from economically disadvantaged backgrounds. Eight of 15 (53%) participating schools enrolled a majority of students who were identified as English learners.

Table 3. *Descriptive Information for Participating Schools*

School Name	% Hisp	% Black	% White	% Asian	% ED	% EL	% Male
School A	78.1	13	4.2	3.4	93.2	55.1	50.5
School B	79.5	19	0.5	0.0	96.0	55.1	52.1
School C	52.9	42	2.6	1.0	87.9	45.3	57.0
School D	29.4	69	0.6	0.0	79.3	20.7	57.0
School E	32.6	66	0.7	0.2	93.9	25.7	52.5
School F	92.3	6.0	1.0	0.1	91.8	56.6	54.7
School G	83.6	7.2	7.0	0.7	84.8	27.8	53.9
School H	85.4	14	0.5	0.0	97.0	60.9	56.8
School I	88.7	7.4	2.7	0.4	76.1	44.1	44.5
School J	72.0	17	9.0	0.1	83.8	50.4	53.3
School K	56.5	42	1.3	0.0	79.6	38.7	52.7
School L	65.5	6.3	25	0.8	66.2	33.0	53.2
School M	96.1	3.3	0.1	0.1	94.7	74.3	52.5
School N	91.1	4.4	3.5	0.4	90.8	70.2	53.6
School O	77.0	21	1.0	0.0	78.6	57.7	100
District	71.7	22	4.3	1.4	86.5	48.1	51.8

Note: ED indicates students who are identified as economically disadvantaged; EL indicates students who are English learners.
Source: Dallas ISD (2019)

Overall, students from participating schools were majority Hispanic, from economically disadvantaged backgrounds, and identified as English learners.

Method

To answer the evaluation questions specified in this report, fidelity of implementation data were tracked by the SMU coaches and project team. For teachers' perceptions of coaching, teachers completed a coaching evaluation near the end of fall 2018 and spring 2019. Data collection methods are summarized in this section.

Fidelity of Implementation

Across all coaching sessions, the SMU instructional coaches recorded the number of minutes for each coaching session (i.e., pre-conference, observation, and post-conference). The coaches

entered these data into an online survey platform called Qualtrics (Qualtrics, 2018). Completion was also tracked through the sharing of the post-conference form with the teacher through the online learning management system, Canvas.

Coaching Evaluation Survey

The participating teachers were invited to complete a coaching evaluation survey via email within Qualtrics in late fall 2018 and late spring 2019. By late fall 2018, one teacher had exited the program; by late spring 2019, another teacher exited the program.

The survey included items measuring teachers' perception of coaching overall (13 overall), the pre-conference session (4 items), the post-conference session (10 items), and the PLC meeting (4 items). The majority of the items were statements, and teachers rated their agreement on a four-point Likert scale (i.e., strongly disagree, disagree, agree, strongly agree). In addition, the survey included three open-ended items asking teachers about: (a) the aspects of coaching and PLCs that were most useful; (b) the aspects of coaching and PLCs that needed the most improvement; and (c) any other information they would like to share about coaching and PLCs. The coaching evaluation survey for spring 2019 is included in Appendix B.

Results

This section describes the results based on the two evaluation questions.

To what extent was coaching implemented with fidelity?

In this section, we summarize the number of coaching cycles teachers received and the number of minutes teachers engaged in those sessions. The frequency and duration of the teacher coaching sessions are summarized in Tables 4 and 5 respectively.

Table 4. *Number of Coaching Sessions by School*

School	**# of Teachers**	**# of Sessions at Each School**			**# of Coaching Cycles including Pre-Conference, Observation, and Post-Conference**			**Average # of Cycles per Teacher**
		Pre-Conference	*Observation*	*Post-Conference*	Complete	Goal	% of the Goal Complete	
School A	6	38	42	42	38	42	90%	6
School B	6	40	42	42	40	42	95%	7
School C	4	28	28	28	28	28	100%	7
School D	3	20	20	20	20	21	95%	7
School E	3	20	20	20	20	21	95%	7
School F	3	21	21	21	21	21	100%	7
School G	3	21	21	21	21	21	100%	7
School H	3	15	21	15	15	21	71%	5
School I	2	14	14	14	14	14	100%	7
School J	2	14	14	14	14	14	100%	7
School K	1	7	7	7	7	7	100%	7
School L	1	6	6	6	6	7	86%	6
School M	1	6	7	6	6	7	86%	6
School N*	1	5	5	5	5	7	71%	5
School O*	1	2	2	2	2	7	29%	2
All	**40**	**257**	**270**	**263**	**257**	**280**	**92%**	**6**

Note: * Designates schools where the teacher left the program before the end of the school year.

A primary goal of the project was for the 40 participating teachers to engage in seven coaching cycles, each of which included a pre-conference, observation, and a post-conference. Constraints such as teachers' schedules and absences, testing, and coaches' availability kept teachers from engaging in all seven full coaching cycles. If all teachers engaged in the all seven cycles, 280 complete coaching cycles would have occurred in the 2018-19 school year. Table 5 shows that coaches engaged in a total of 257 of the targeted 280 complete coaching cycles with teachers; therefore 92% of the targeted coaching cycles were completed. In total, the coaches engaged in 790 coaching sessions including 257 pre-conferences, 270 observations, and 263 post-conferences with the 40 participating teachers.

On average, each teacher engaged in six of seven coaching cycles. In some instances, the teacher was no longer available for coaching. For example, the teachers in Schools N and O exited the program before the end of the school year. Teachers left the program due to personal commitments and career changes. A forthcoming technical report will detail reasons for teachers' exits from the Academy. For the thirteen schools that did not have a teacher exit during the year we observed variation across schools with a range between 86% to 100% in the percentage of completed coaching cycles.

Table 5. *Average Number of Minutes Teachers Engaged in Coaching Sessions by School*

School	***# of teachers***	**Average # of Minutes**		
		Pre-conference	*Observation*	*Post-conference*
School A	6	18.0	46.1	18.3
School B	6	17.4	47.5	18.0
School C	4	15.0	46.1	15.2
School D	3	26.8	49.3	25.5
School E	3	14.0	53.0	16.0
School F	3	21.0	46.4	20.5
School G	3	18.8	98.1	18.6
School H	3	14.7	45.5	17.7
School I	2	22.9	72.5	25.4
School J	2	16.8	47.5	30.0
School K	1	14.3	85.0	16.4
School L	1	16.7	48.3	25.0
School M	1	12.5	46.4	13.3
School N	1	19.0	56.0	26.0
School O	1	15.0	52.5	12.5
All	**40**	**18.0**	**53.8**	**19.5**

Source: STEM TOP Coaching Logs
Note: The STEM TOP Coaching Log recorded minutes in intervals of five minutes ranging from "5 minutes or less" to "60 minutes or more"

On average, the coaches met with teachers 18 minutes during the pre-conference, observed teachers for 54 minutes, and met with teachers for 20 minutes during the post-conference. Lengths for these activities varied due to teacher availability and school schedules. For example, observations at School G were longer due to longer class periods.

In addition to individual coaching activities, the coaches engaged with the PLCs at each campus. For campuses with only one teacher, a coach engaged virtually with these teachers. Table 6 shows the number of PLCs provided to each campus and the average time of the PLCs. Overall, teachers engaged between five and seven PLCs with their SMU coach. The variability in the number of PLC sessions can be attributed scheduling difficulties. In total, coaches facilitated 72 PLCs, which were led by either the campus leadership or an SMU coach. The average number of minutes of PLC engagement ranged from 33 and 60 minutes.

Table 6. *PLC Implementation Summary*

School	# of teachers	PLCs Completed	Average # of Minutes
School A	6	7	45.7
School B	6	7	49.3
School C	4	7	45.0
School D	3	6	40.8
School E	3	6	32.5
School F	3	7	36.4
School G	3	7	60.0
School H	3	6	40.8
School I	2	5	39.0
School J	2	7	42.1
Virtual PLC	5	7	NA
All	**40**	**72**	**43.5**

Note: Number of minutes was not recorded for virtual PLCs.

Overall, coaches co-facilitated or facilitated PLCs with high fidelity throughout the school year, as evidenced by the number of PLCs completed out of the goal number (seven total) and average number of minutes conducting PLCs.

What are teachers' perceptions of coaching?

The results of the 2018-19 fall and spring teacher coaching evaluation surveys are summarized in this section. The quantitative and qualitative results are summarized in four sections focused on teachers' perceptions: (a) overall, (b) focused on the pre-conference, (c) focused on the post-conference, and (d) focused on the PLC. We present the results by cohort. Cohort 1 teachers were in their second year of participation; cohort 2 teachers were in the first year of participation.

Overall. Figure 1 shows that from fall 2018 to spring 2019, the percentage of cohort 1 teachers who agree or strongly agreed that coaching was valuable for their professional development remained consistent (82%) with the number of teachers who strongly agree increasing from 55% to 64% between the two time points. The percentage of cohort 2 teachers who strongly agreed or agreed that coaching was valuable in their professional development decreased slightly from 96% in the fall to 92% in the spring. In general, 80% or more of teachers agreed or strongly agreed that coaching was valuable.

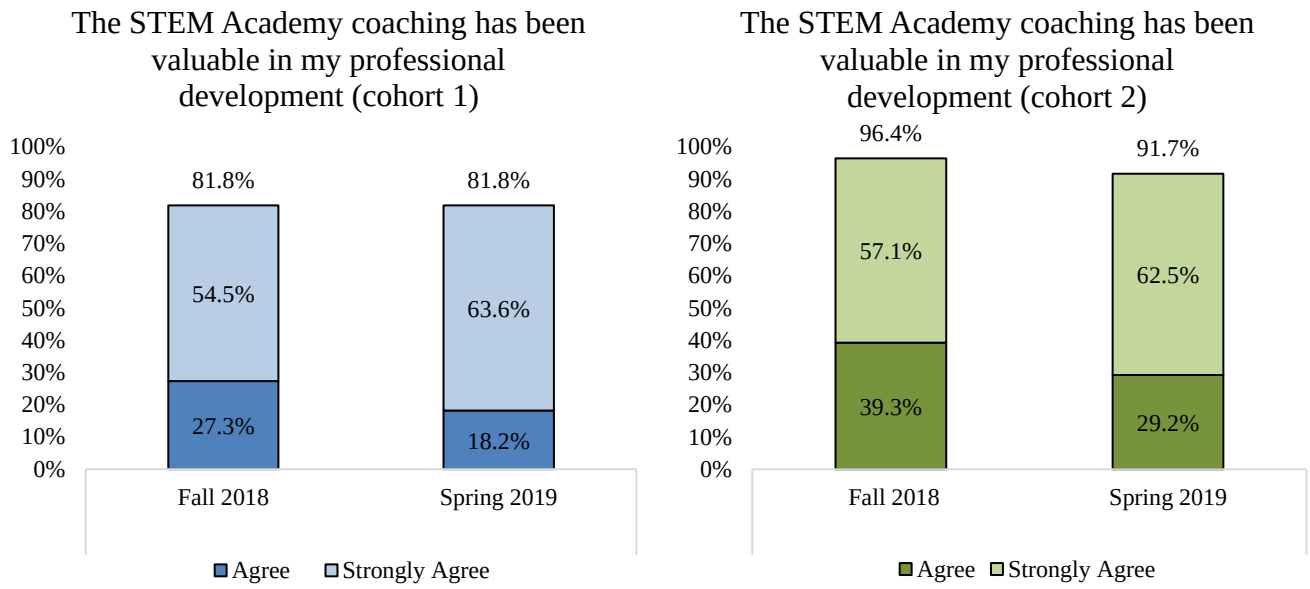


Figure 1. Teachers' perception of value of coaching towards professional development (c1 n = 11; c2 Fall n = 28, Spring n = 26)

Coaching deepened understanding. Figures 2 and 3 show change over time in teachers' perceptions of coaching for deepening their understanding of different aspects of STEM education, disaggregated by cohort. For cohort 1, the percentage of teachers who strongly agreed or agreed that coaching deepened their understanding of aspects of STEM education was high, with slight decreases between the two time points. For example, the percentage of teachers who strongly agreed or agreed that STEM academy coaching deepened their understanding of project-based learning decreased from 100% in fall to 91% in spring. One aspect, the scientific process standards, stayed consistent across time points. Figure 3 shows the change in time in cohort 2 teachers' perception of STEM Academy coaching deepening different aspects of STEM education. Cohort 2 teachers' perceptions increased in four out of six aspects: project-based learning, maker-based instruction, science content knowledge, and scientific process standards. Overall, the high percentages of agreement across cohorts suggest teachers received a deepened understanding of active learning strategies, community-based resources, content knowledge, and process standards. However, the varying trends between cohorts from fall to spring suggests differences in the needs of teachers who have been in the program longer.

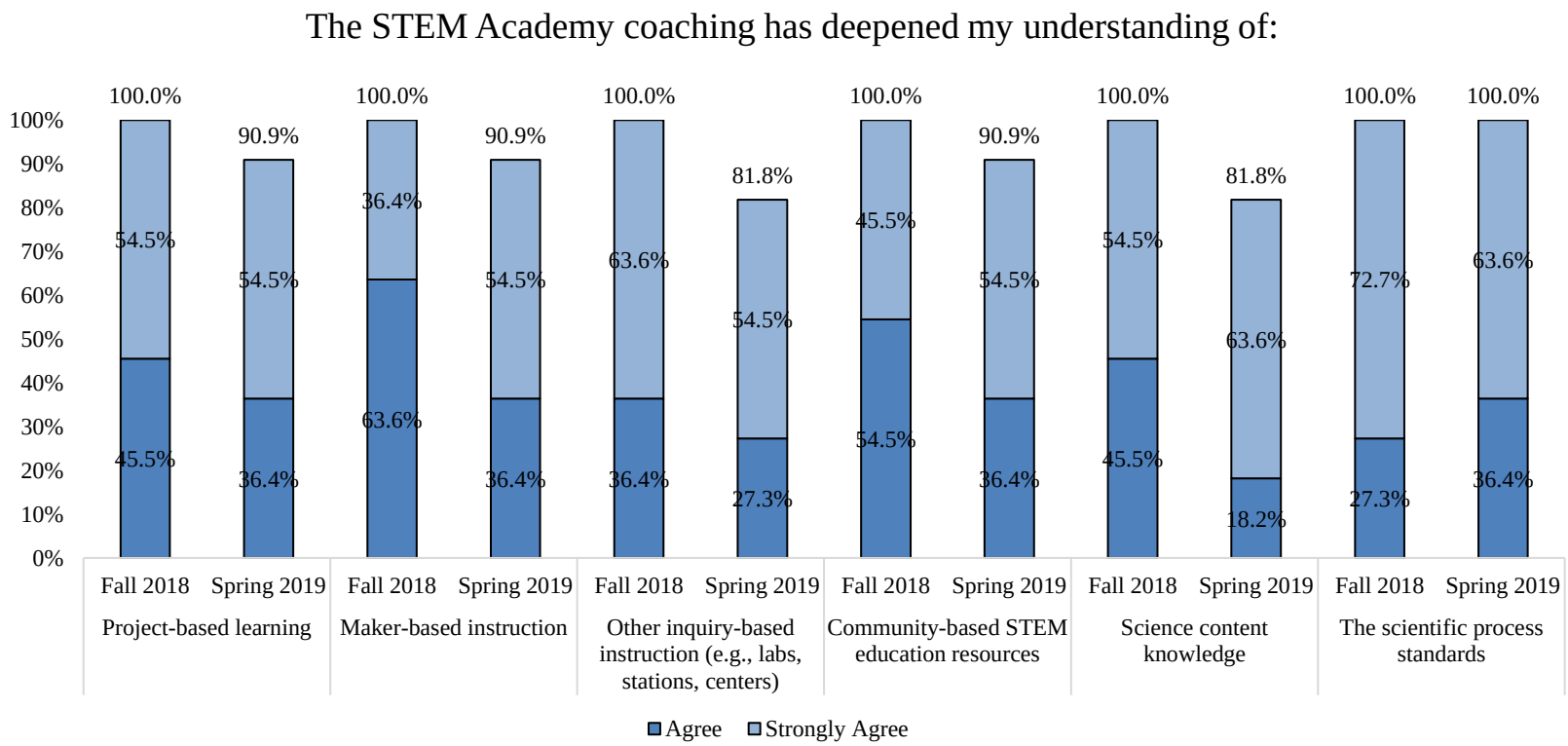


Figure 2. Cohort 1 teachers' perceptions of the influence of STEM Academy coaching on aspects of STEM education (n = 11)

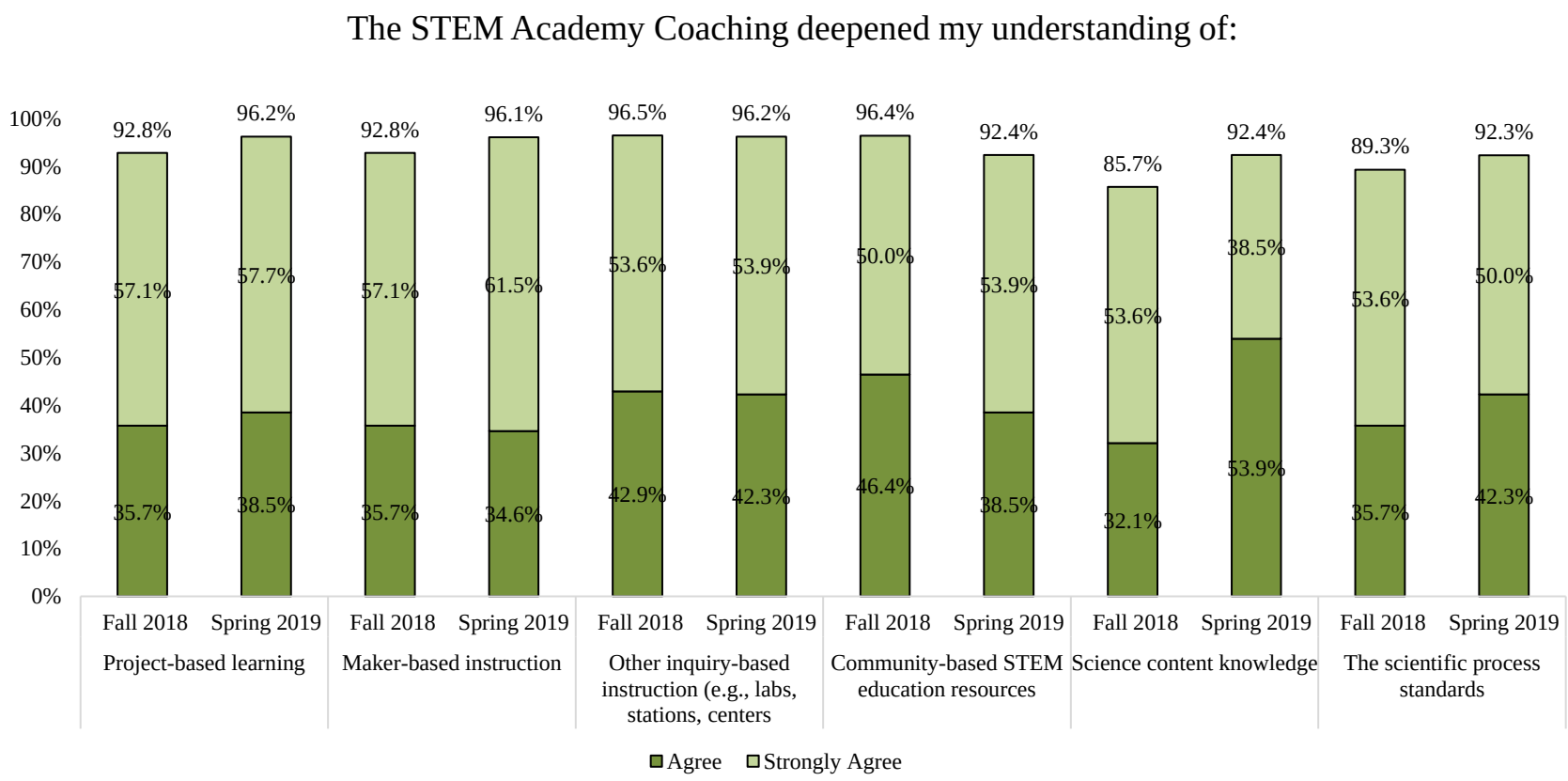


Figure 3. Cohort 2 teachers' perceptions of the influence of STEM Academy coaching on aspects of STEM education (Fall n = 28, Spring n = 26)

Coaching provided tools. Figures 4 and 5 show the change across time in teachers' perceptions of STEM Academy coaching providing tools to implement different aspects of STEM education, disaggregated by cohort. For most aspects, the percentage of teachers who strongly agree or agree was high, with slight decreases across the two time points. For example, cohort 1 teachers' perceptions of STEM Academy coaching providing tools to implement differentiation strategies to support all learning decreased from 91% to 82%. Teachers' open responses also provide insight into the impacts of STEM Academy coaching. For example, when teachers were asked how coaching supported the utilization of active learning strategies, one cohort 1 teacher stated, "My coach would help me rethink activities often, making them more engaging and student-driven" Observed decreases between fall and spring may be attributed to proximity of the evaluation to the summer professional development. Teachers may feel more comfortable in the fall with strategies because they learned about the strategies in the prior summer. When teachers were asked about how coaching could better support their understanding and utilization of active learning strategies, one cohort 1 teacher stated, "Continue to provide great feedback and helpful tips."

Figure 5 shows the change in time in cohort 2 teachers' perception of STEM Academy coaching providing tools to apply different aspects of STEM education. We observed increases in two out of the six aspects of teachers who strongly agreed or agreed between fall and spring: project-based learning, and maker-based instruction. We observed decreases in the remaining four aspects but the decreases were small, with the biggest decrease of four percentage points. Teachers' opened-ended responses provided additional support for coaching provided by SMU. One cohort 2 teacher stated, "My coaching was invaluable. I learned so much from SMU. I have been able to use everything that has been presented to me." Overall, across cohorts and timepoints, teachers felt coaching provided them the tools necessary to implement active learning strategies, community-based resources, scientific process standards, and differentiation strategies in the classroom. This is evidenced by the high percentages of agreement across cohorts and timepoints. However, similar to the deepened understanding, variation exists between cohorts in their agreement between fall and spring. Again, this may indicate that the needs of cohort 1 teachers may differ from those in cohort 2.

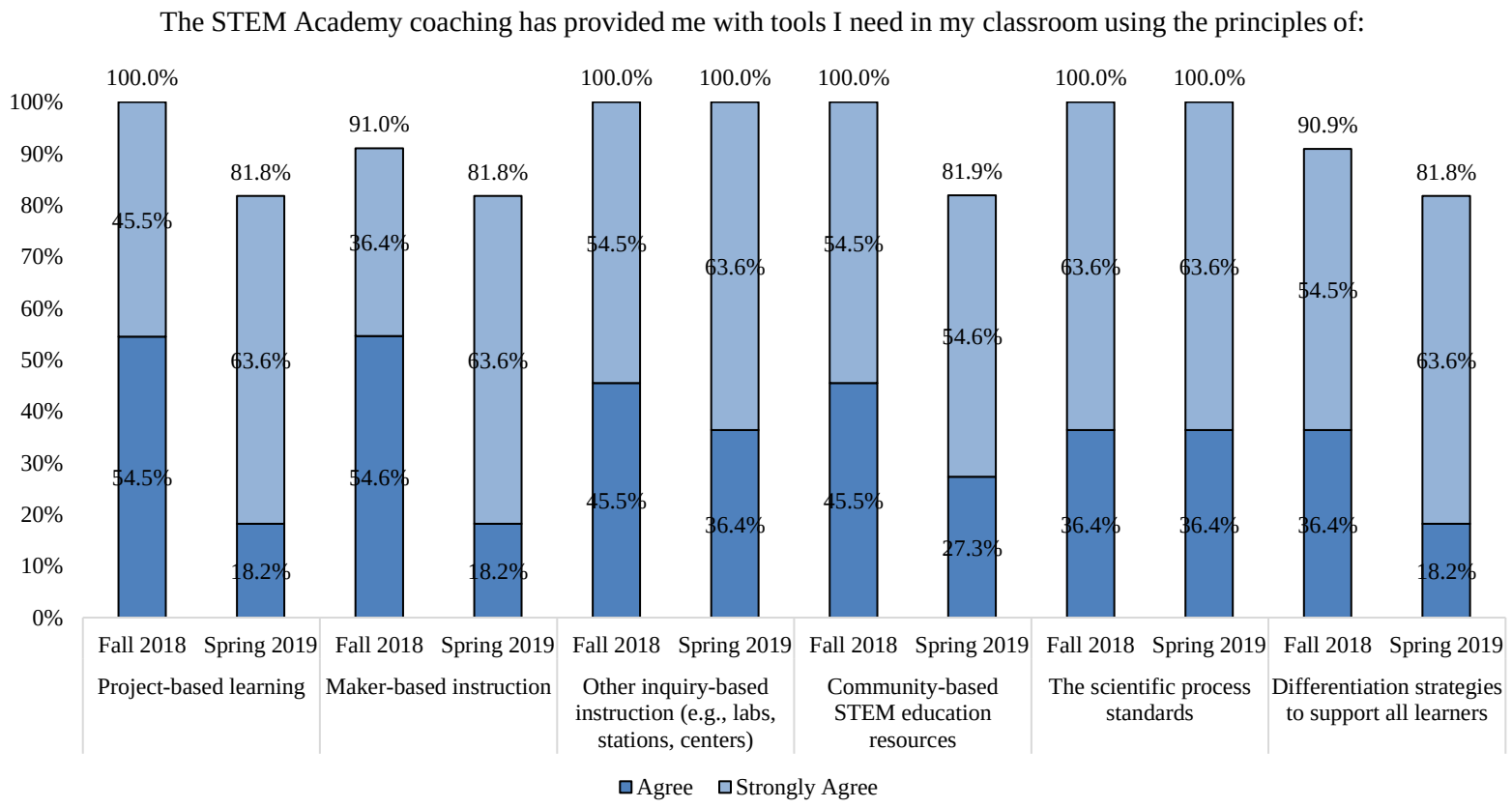


Figure 4. Cohort 1 teachers' perception of STEM Academy coaching providing tools for aspects of STEM education (n = 11)

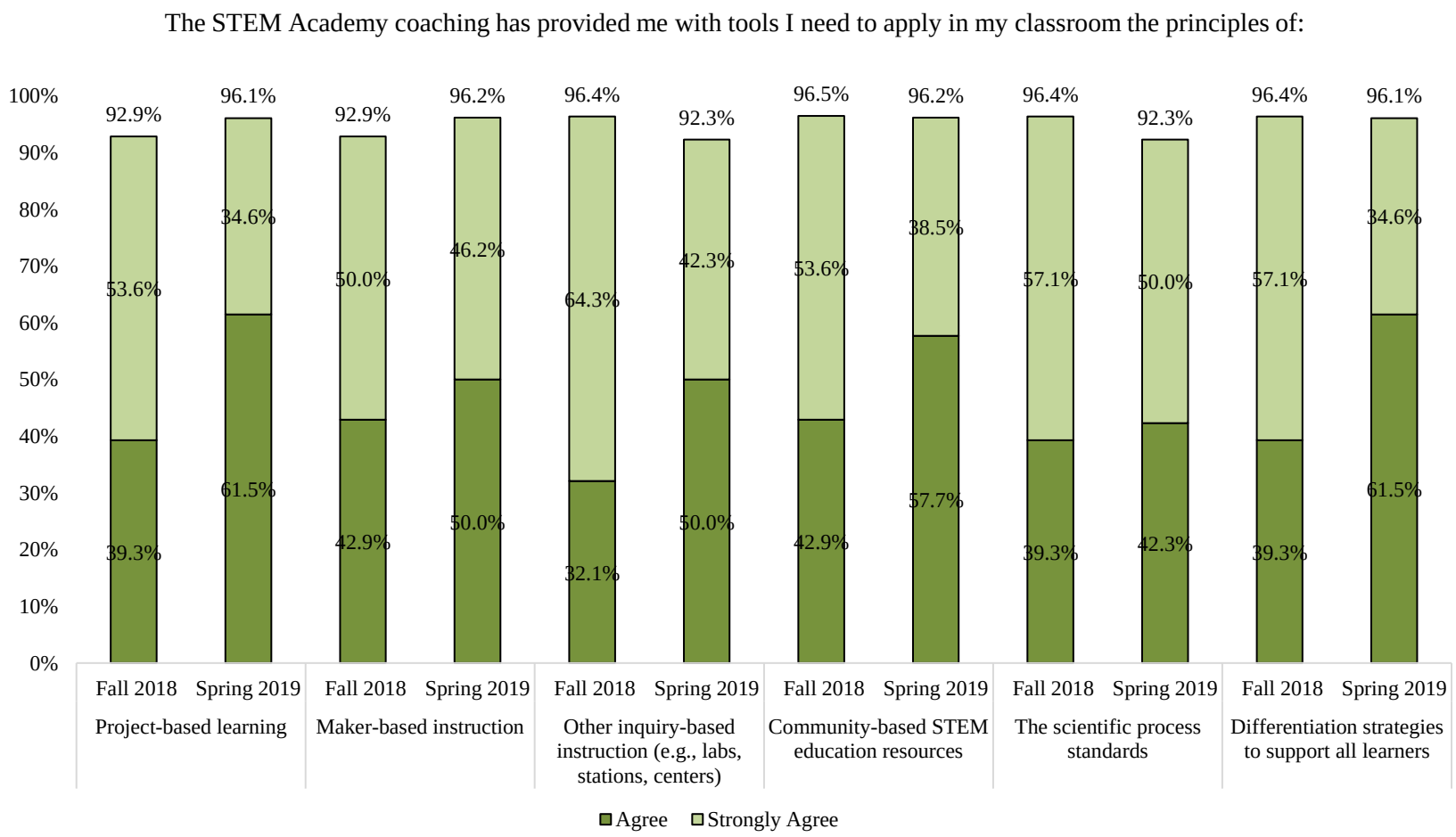


Figure 5. Cohort 2 teachers' perception of STEM Academy coaching providing tools for aspects of STEM education (Fall n = 28, Spring n = 26)

Pre-Conference. Figure 8 shows the change over time in cohort 1 and 2 teachers' perception of the pre-planning sessions with their coaches. Teachers' opinions of the pre-planning sessions remained consistently high. For example, 100% of cohort 1 teachers agreed that the pre-conference increased active learning in both fall and spring. Similar to cohort 1, teachers' perceptions of the pre-planning sessions were consistently high over time. One notable growth is teachers' perceptions includes "Increase my personal content knowledge", with 86% of teachers rating strongly agree or agree in fall and increasing to 96% in the spring. Overall, across timepoints and cohorts, teachers perceived the pre-conference sessions as helpful for increasing their use of active learning strategies, incorporating the scientific process standards, including differentiation strategies in their classrooms, and increasing their science content knowledge. This is evidenced by the high percentage of agreement towards statements about the pre-conference.

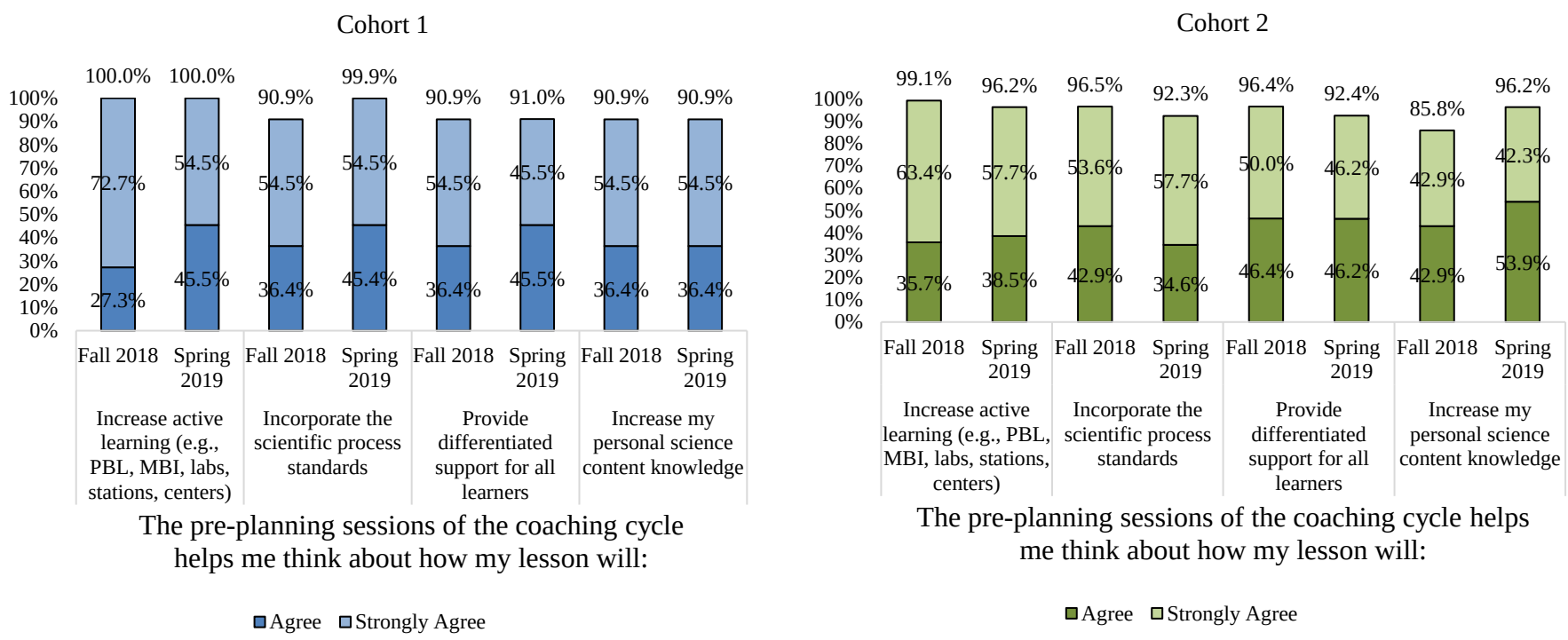


Figure 8. Teachers' perceptions of the pre-planning sessions (c1 n = 11; c2 Fall n = 28, Spring n = 26)

Post-Conference. Figures 9 and 10 show the change in teachers' perception in the post-conference session over time for cohort 1 and 2 teachers. In most instances, cohort 1 and 2 teachers rated that they strongly agree or agree. One notable decrease in cohort 1 teachers' perception was in "Increases my personal science content knowledge." In fall, 91% of cohort 1 teachers strongly agreed or agreed to the statement but this percentage decreased to 82% in the spring. On the other hand, cohort 2 teachers' perceptions increased related to this item, "increases my personal science content knowledge." In the fall, 79% of cohort 2 teachers rated that they strongly agree or agree and in spring 96% rated strongly agree or agree. Overall, the coaching cycle was beneficial for teachers in both cohorts across time. One notable exception was the decrease in perceived benefit towards content knowledge for cohort 1 but increase for cohort 2, furthering the need to differentiate the support by cohort.

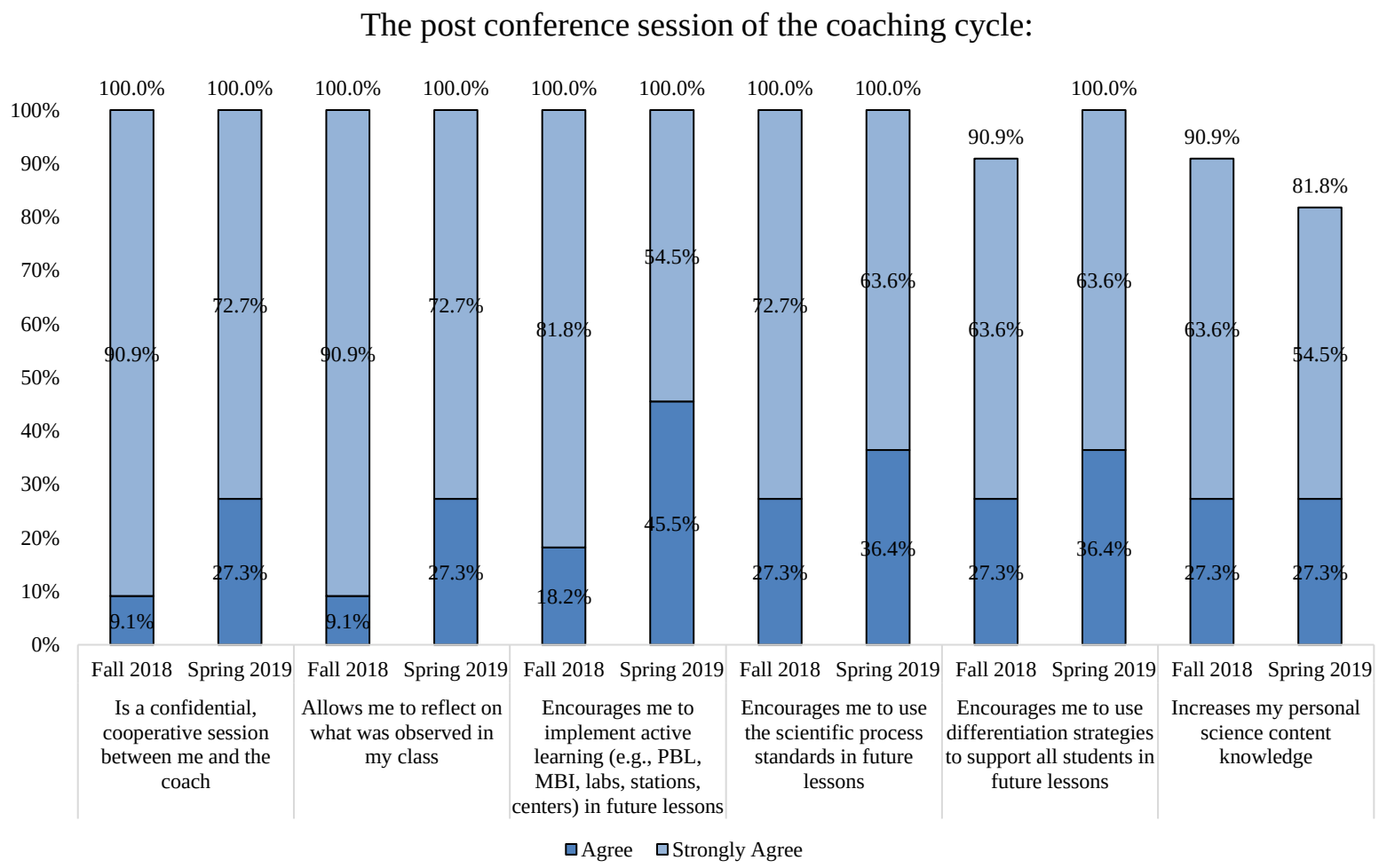


Figure 9. Cohort 1 teachers' perceptions of the post-conference session (n = 11)

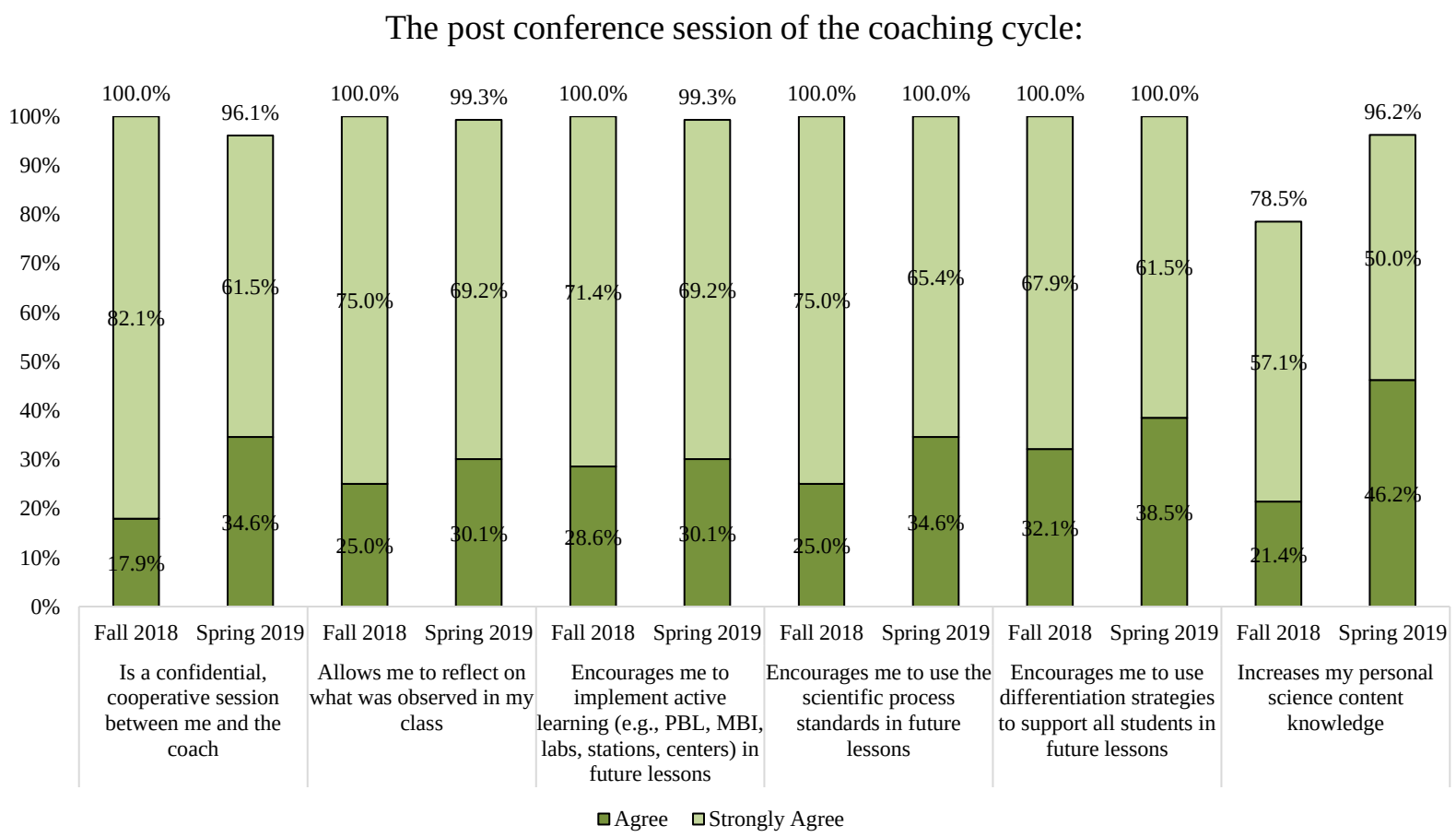
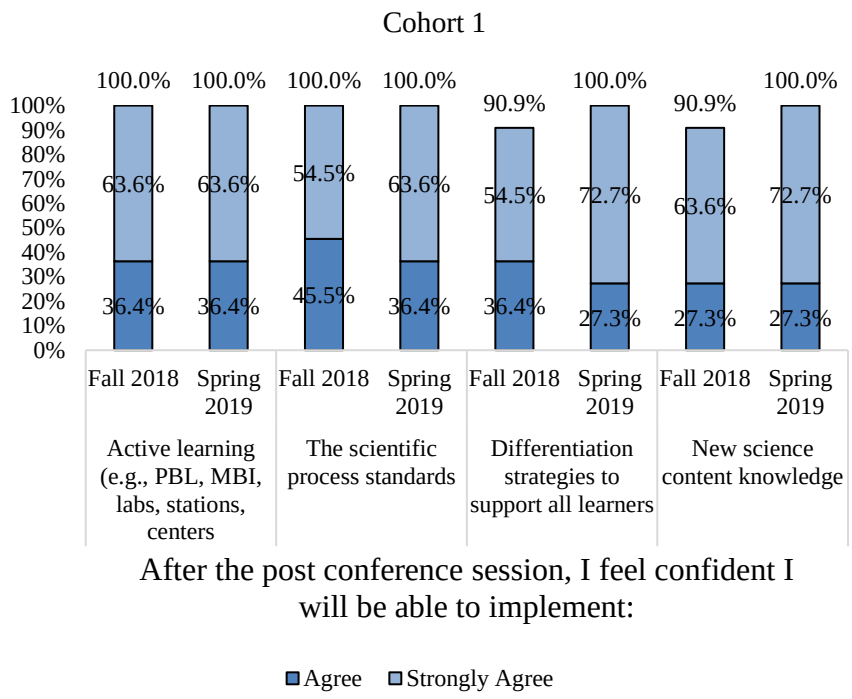


Figure 10. Cohort 2 teachers' perceptions of post-conference sessions (Fall n = 28, Spring n = 26)

Teacher confidence. We also asked teachers about their perceptions of their confidence after the post-conference. Figure 11 shows the change in time for cohort 1 and 2 teachers. Teachers consistently rated high in agreement to aspects such as "After the post-conference session, I feel confident I will be able to implement active learning." Teachers also increased in their agreement to statements such as "After the post-conference session, I feel confident I will be able to implement differentiation strategies to support all learners." The percent of cohort 1 teachers who agreed or strongly agreed increased from 91% in the fall to 100% in the spring.

In the fall, 100% of cohort 2 teachers strongly agreed or agreed with the statement "After the post-conference, I feel confident I will be able to implement active learning." Their opinions decreased slightly to 96% in the spring. Other aspects of STEM education saw increases from fall to spring. For example, 89% of cohort 2 teachers in the fall rated strongly agree or agree to the statement "After the post-conference, I feel confident I will be able to implement new science content knowledge." This percentage increased to 96% in the spring. Overall, post-coaching confidence across cohorts and timepoints suggest teachers felt confident in implementing active learning strategies, integrating scientific process standards, including differentiation strategies for all learners, and implementing new science content. This is evidenced by the high percentage of agreement to statements about teachers' perceptions of post-coaching confidence.



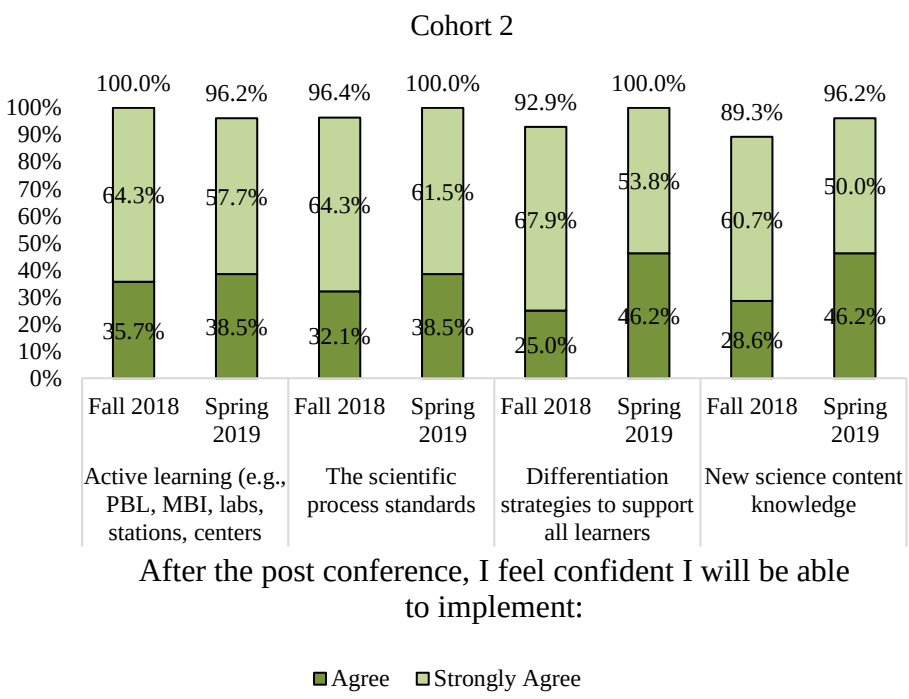


Figure 11. Teachers' perception of confidence after the post-conference session

PLCs. Figure 12 shows the change in time in cohort 1 teachers' perception of the professional learning communities (PLCs). We observe decreases in the percentage of teachers who strongly agree or agree to five out of the six aspects of the PLCs. One hundred percent of cohort 1 teachers rated strongly agree or agree that the PLC delivered "high-quality information about maker-based instruction" in the fall, which decreased to 73% in the spring. Teachers responded most favorably toward "differentiation strategies to support all learners," with 91% of teachers rating strongly agree or agree at both time points. In open-ended responses, teachers provided suggestions about what could be different about the PLCs. One teacher stated, "I believe PLCs need more improvement. I think surveys should be done to each campus, to see what are their exact needs of the professional development."

Figure 13 shows the change in time in cohort 2 teachers' perception of their PLCs. Similar to cohort 1 teachers, we observe decreases in teachers' rating of the PLCs in five out of the six aspects between time points. For example, 96% of cohort 2 teachers strongly agreed or agreed that the PLC delivered high-quality information about maker-based instruction in the fall, which decreased to 50% in the spring. This could be attributed to a change in the questions made mid-year. For the spring survey, we included the words "at my school", which may have influenced survey responses. One increase was observed related to science content, which increased with 89% of teachers rating strongly agree or agree in the fall and 96% in the spring. Open-ended responses from the teachers also provide context for the decreases in the perception of PLCs. One teacher stated, "I would recommend that some topics of PLC be relevant and on a needs basis."

Overall, teachers perceived the PLC as beneficial for improving instruction in their individual classrooms in the fall, which decreased substantially for some aspects in the spring. It is important to note that the item language was revised slightly between fall and spring. More specifically, in the fall, the item read, "*The STEM Academy Professional Learning Community delivers high-quality information about*…" In the spring, this was revised slightly to "*The STEM Academy Professional Learning Community at my school delivers high-quality information about*…" The spring survey included the words "at my school" which may have influenced survey responses. Alternatively, changes across time could have been attributable to changes made to the PLC delivery. In the spring, the PLCs were led by the SMU coaches instead of the STEM Academy campus instructional leader. This change was made because campus instructional leaders were not consistently available to engage in the STEM Academy activities given the other demands on their time. A small number of teachers received a virtual PLC via Canvas throughout the year because they were the only teacher at their campus. Out of the three virtual PLC teachers who completed the coaching evaluation, only one teacher disagreed or strongly disagreed with statements about the content delivered in the virtual PLC.

Because the item changed slightly from fall to spring, it is not completely clear if changes in teachers perceptions were attributable to the change in the item language or the changes that were made to the PLCs (i.e., to move from PLC co-led by the coach and school leader to a PLC led by the coach), but we see evidence that teachers' overall perceptions of the PLC decreased from fall to spring.

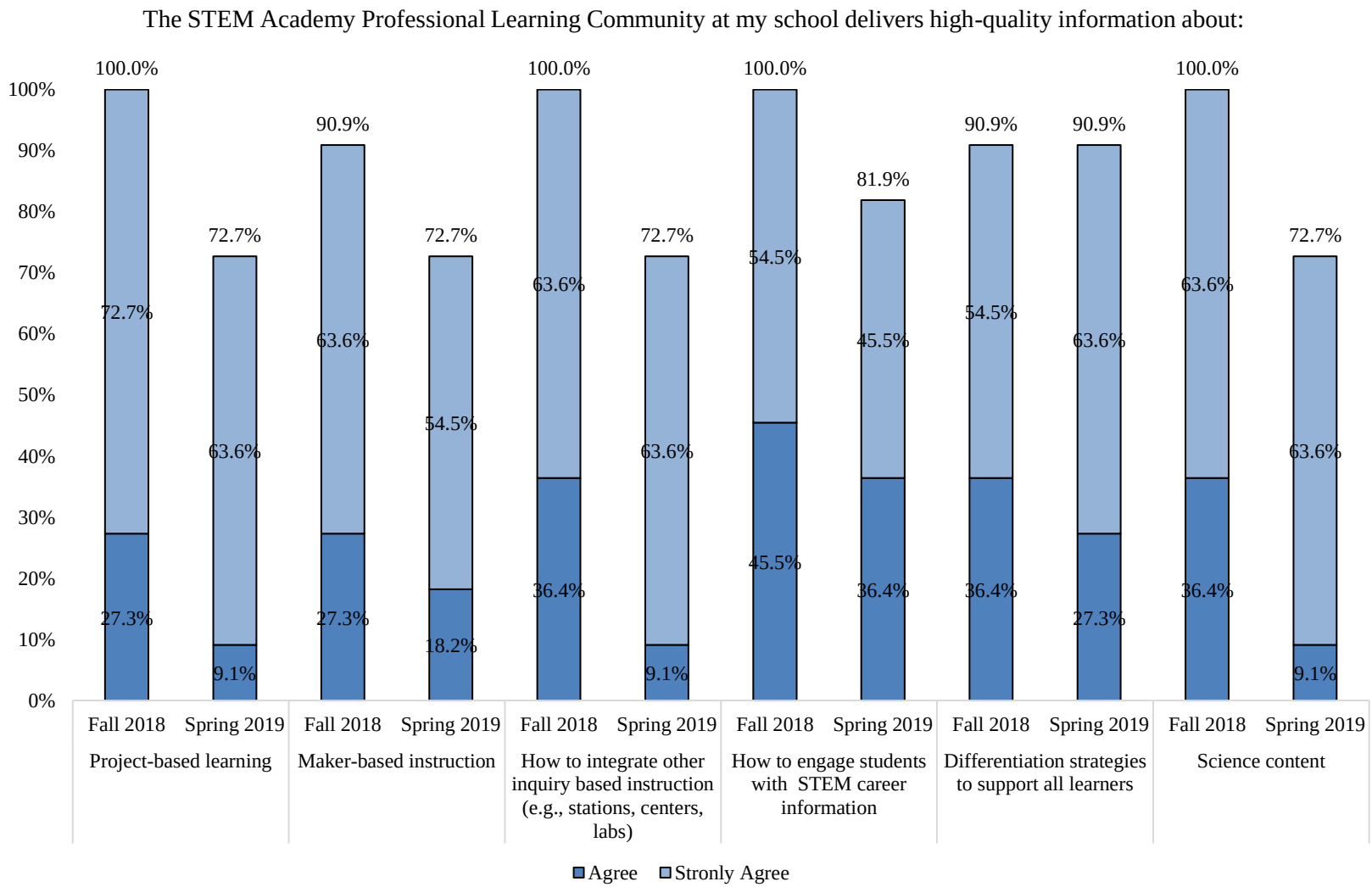


Figure 12. Cohort 1 teachers' perception of PLC practices (n = 11)
Note: Fall 2018 administration asked "The STEM Academy Professional Learning Community delivers high-quality information about:"
Spring 2019 administration asked "The STEM Academy Professional Learning Community at my school delivers high-quality information about:"

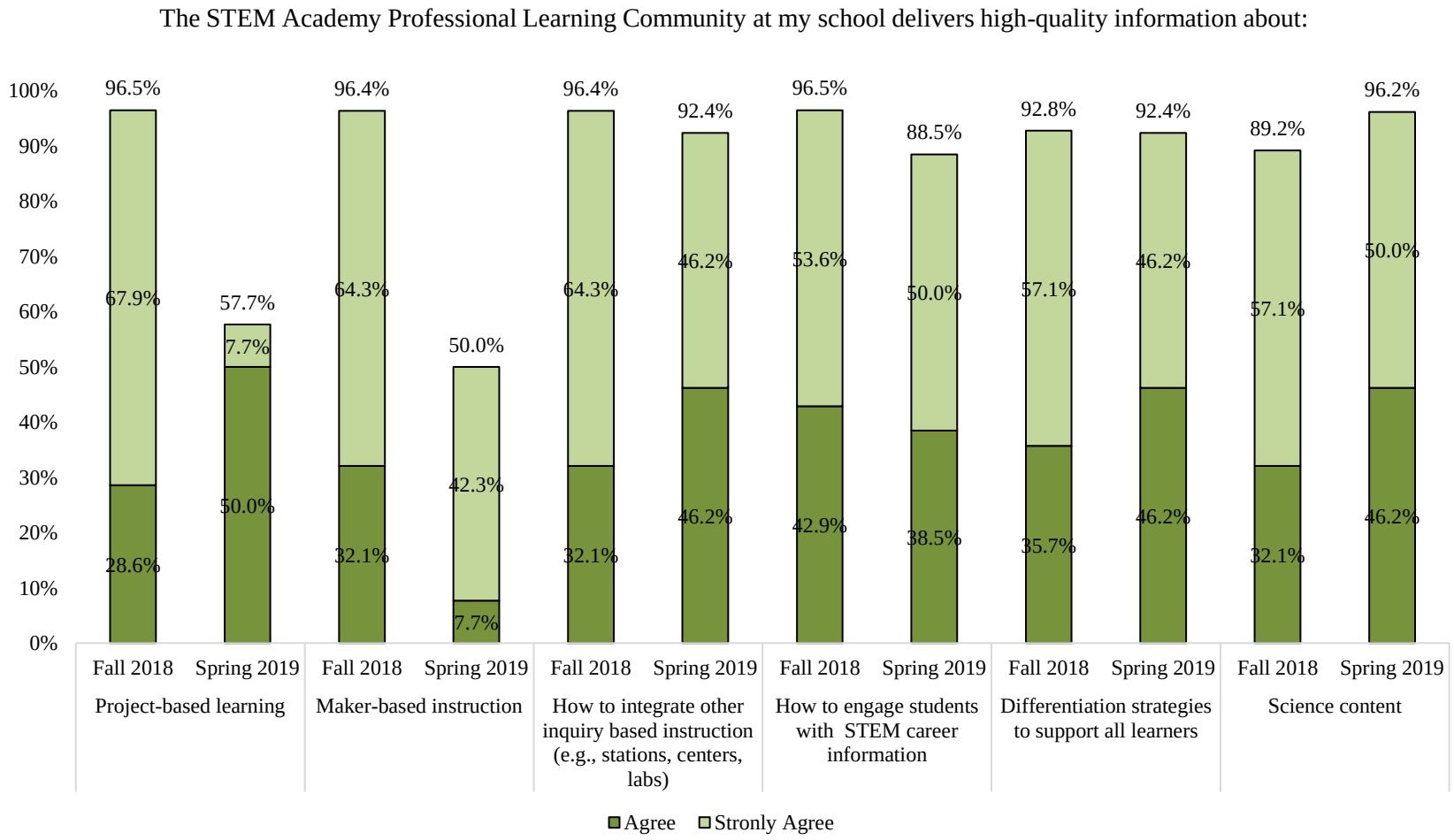


Figure 13. Cohort 2 teachers' perceptions of PLC practices (Fall n = 28, Spring n = 26)
Note: Fall 2018 administration asked "The STEM Academy Professional Learning Community delivers high-quality information about:"
Spring 2019 administration asked "The STEM Academy Professional Learning Community at my school delivers high-quality information about:"

Summary

The STEM Academy coaching and PLC meetings during the 2018-19 school year were designed to reinforce active learning instructional strategies. Teachers worked individually with a SMU instructional coaching for up to seven coaching cycles and PLC meetings. Each cycle included a pre-conference, observation, and post-conference. The coaching cycles, coupled with the PLC meetings, were designed to affect long-term change in teachers' instructional practices, guided by the four foundational pillars of the STEM Academy, which included (a) active learning strategies, (b) scientific process standards, (c) deepened content knowledge, and (d) differentiation across students' needs.

Participating teachers and schools. Forty teachers participated in the STEM Academy teacher coaching during the 2018-19 school year. Teachers taught in 15 Dallas ISD middle schools. Participating middle schools included high percentages of students who belong to subgroups who have been historically underrepresented in STEM. These schools had higher numbers of Black and Hispanic students, more ED students, and more EL students, supporting the need to intervene with students' STEM outcomes.

Fidelity of implementation. A goal of the STEM Academy was for participating teachers to receive up to seven coaching cycles, which included a pre-conference, observation, and post-conference. During the second year, 790 coaching sessions including 257 pre-conferences, 270 observations, and 263 post-conferences were completed. Overall, SMU coaches facilitated 257 complete coaching cycles with the 40 teachers, with an average of six complete cycles per teacher. Implementation was similar across schools with a few notable exceptions. The majority of schools participated in between 86% and 100% of goal number of complete coaching cycles. School N and School O participated in fewer coaching cycles due to teacher attrition from the program. School H also engaged in fewer (71%) of the goal number of complete coaching cycles. On average, the coaches pre-conferenced with teachers for 18 minutes, observed teachers for 54 minutes, and engaged in post-conferences for 20 minutes. Furthermore, coaches engaged with teachers and leaders in 72 PLC meetings an average of 44 minutes. The evidence of implementation is strong supporting that participating teachers received on average six of seven complete cycles designed to support and increase their utilization of active learning strategies, content knowledge, and differentiation across students' needs.

Teachers' perception overall. Overall, between 82% and 96% of teachers agreed that coaching was a valuable aspect of their professional development and supported their utilization of STEM education practices across fall 2018 and spring 2019 timepoints.

Teachers' perceptions of the pre-conference. Between 86% and 100% of teachers across timepoints and cohorts agreed of strongly agreed that the pre-conference helped them increase their use of active learning, incorporate scientific process standards, provided differentiated support for all learners, and increase their personal science content knowledge.

Teachers' perceptions of the post-conference. Between 79% and 100% of teachers across timepoints and cohorts agreed or strongly agreed that the post conference was confidential and reflective; encouraged the implementation of active strategies, the scientific process standards, differentiations strategies, and increased their content knowledge.

Furthermore, teachers reported high confidence in implementing STEM instruction after the post-conference sessions including active learning strategies, scientific process standards, differentiation strategies, and new science content knowledge. Between 89% and 100% of teachers agreed or strongly agreed to confidence in implementing these different aspects of STEM education.

Teachers' perceptions of the PLC. Teachers' perceptions of PLC practices at the beginning of the school year were relatively high, with 91% to 100% of teachers agreeing about the value of PLCs for implementing STEM education practices. However, their rating dropped by the end of the school year with 50% to 96% of teachers in agreement.

Overall, teachers felt that coaching supported their implementation and confidence with STEM education practices. Teachers felt most supported through aspects of the complete coaching cycle (i.e., pre-conference, observation, post-conference) and less supported through the PLCs in the spring semester.

Recommendations

As the coaching model continues into the third year, we hope this report will highlight areas of strength and opportunity. As such, the evidence presented in this report supports three key recommendations including:

1. The coaching model as a whole should continue to be implemented. Teachers were supportive of the full coaching cycle (i.e., pre-conference, observation, post-conference). One cohort 2 teacher stated, "I think the one-on-one coaching was extremely helpful…I had a very difficult year and sometimes my coach was the only source of positive feedback I was getting from anyone…I was struggling with how to implement process standards with content and how to differentiate instruction and he gave me a lot of really useful instructions."

2. The PLCs need to be modified to meet the needs of the teachers. Teachers' positive perceptions of PLCs fell sharply in some aspects of STEM instruction. Teachers' perceptions also supported the need modify the PLC model. The changes in perceptions could be attributed to the coaches' role changing during the spring semester, where the coach delivered the content of PLC instead of co-facilitating the PLC with a school leader. The implementation of the virtual PLC did not appear to have a considerable influence on teachers' perceptions of the PLCs. However, the sample of teachers who participated in the virtual PLC and responded in the spring was small (n=3). We recommend the STEM Academy coaches work with teachers and leaders to understand individual campus needs.

3. Teachers perceived the PLC as more helpful when co-facilitated by campus leadership. Therefore, we recommend identifying strategies to encourage campus leadership's active participation in the STEM Academy coaching. This might necessitate revisions to the program components to improve alignment with the campus vision. We recommend involving campus leadership in the refinement of the STEM Academy components. This process would foster ownership of the STEM Academy with campus leadership, which may encourage higher levels of program implementation and buy-in at the campus level.

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Appendix A – STEM Teaching Observation Protocol

SMU | Annette Caldwell Simmons School of Education & Human Development

STEM Teaching Observation Protocol

Teacher: _____ **Coach:**_____ **Observation Date:**_____ **Double Observation**
Campus:_____ **Start Time:** _____ **End Time:** _____ **Y N**
Instructional format (circle all that apply): **Number of Students:** _____ **Grade Level:** _____ **Cycle:** _____
Whole class Individual Small group **Day of Week:** _____ **Class Type (Regular/PreAP):** _____

Rate the extent to which each indicator was:

0= *Not observed: Not demonstrated at all*

1= *Emerging: This is an opportunity for growth; demonstrated at a low level*

2= *Proficient: Demonstrated at an expected level*

3=*Exemplary: Demonstrated at a high level*

Domain	Indicator	Score (0-3)	Notes
1. Lesson Structure	a. The lesson objectives are clear to students		
	b. The lesson is structured to build understanding and maintain a sense of purpose		
	c. The lesson includes an investigative or problem-based approach (e.g., students investigate or discover scientific ideas)		
	d. The lesson is clearly connected to students' prior knowledge and experiences		
2. Learner Centered Instruction	a. Students explain and justify their thinking		
	b. Students engage in behaviors reflective of the process standards		
	c. Students direct their own learning (e.g., are provided with flexibility or choices during the lesson)		
	d. Teacher engages students in appropriately challenging content (e.g., critical thinking, problem-solving strategies)		
	e. Teacher openly welcomes discussion about mistakes or misconceptions		
	f. Teacher poses cognitively demanding, open-ended questions		
	g. Teacher explicitly connects learning to the real world (e.g., careers, current events)		
	h. Teacher explicitly connects learning to other disciplines (e.g., social studies, mathematics)		
	i. Teacher involves all students (e.g., calling on non-volunteers, facilitating student-student interaction, checking in with hesitant learners, etc.)		
	j. Teacher is attentive to students' academic and social/emotional needs (e.g., use of cooperative learning, language-appropriate strategies and materials, awareness of student comfort)		
3. Evaluation and Feedback	a. Teacher uses a variety of assessment strategies (e.g., large group questions, one on one discussion, small group feedback, exit tickets, quiz or test, informal progress check)		
	b. Teacher provides feedback focused on expanding learning and understanding (formal and informal formative), not correctness or the end product (summative)		
	c. Students evaluate their own or other's work		
4. Management and Discipline	a. Students are on task throughout the class		
	b. Students demonstrate an understanding of expectations for behavior		
	c. Students demonstrate an understanding of classroom procedures/routines		
	d. Teacher efficiently manages time (e.g., transitions, wait time, pacing)		
	e. Teacher redirects off task or disruptive behavior *(NA if no disruptive behavior)*		

Page **1** of **2**

STEM Teacher Observation Report

Summary of Lesson (optional):
Praise/Reinforcement:
Polish/Refinement:
Recommendations/Questions:

Coach Initials: _____

Appendix B – Teacher Coaching Evaluation Survey

STEM Academy for Science Teachers and Leaders: On-Campus Support Evaluation for Teachers

To what extent do you agree with the following statements?

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. The STEM Academy coaching has been valuable in my professional development.				
2. The STEM Academy coaching deepened my understanding of: ○ project-based learning ○ maker-based instruction ○ other inquiry-based instruction (e.g., labs, stations, centers) ○ community-based STEM education resources ○ science content knowledge ○ the scientific process standards				
3. The STEM Academy coaching provided me with tools I need to apply in my classroom using the principles of: ○ project-based learning ○ maker-based instruction ○ other inquiry-based instruction (e.g., labs, stations, centers) ○ community-based STEM education resources ○ the scientific process standards ○ differentiation strategies to support all learners				
4. The pre-planning session of the coaching cycle helps me think about how my lesson will: • increase active learning (e.g., PBL, MBI, labs, stations, centers).				

• incorporate the scientific process standards. • provide differentiated support for all learners. • increase my personal science content knowledge.				
5. The post conference session of the coaching cycle: ○ is a confidential, cooperative session between me and the coach. ○ allows me to reflect on what was observed in my class. ○ encourages me to implement active learning (e.g., PBL, MBI, labs, stations, centers)in future lessons. ○ encourages me to use the scientific process standards in future lessons. ○ encourages me to use differentiation strategies to support all students in future lessons. ○ increases my personal science content knowledge.				
6. After the post conference session, I feel confident I will be able to implement: • active learning (e.g., PBL, MBI, labs, stations, centers • the scientific process standards • differentiation strategies to support all learners • new science content knowledge				
7. The STEM Academy Professional Learning Community at my school delivers high-quality information about: ○ project-based learning ○ maker-based instruction ○ how to integrate other inquiry based instruction (e.g., stations, centers, labs)				

○ how to engage students with STEM career information ○ differentiation strategies to support all learners ○ science content				

8. In what ways, if any, did coaching support your understanding and utilization of **active learning (e.g., PBL, MBI, labs, stations, centers)**?

9. How could coaching better support your understanding and utilization of **active learning (e.g., PBL, MBI, labs, stations, centers)**?

10. In what ways, if any, did coaching support your understanding and utilization of **the scientific process standards**?

11. How could coaching better support your understanding and utilization of **the scientific process standards**?

12. In what ways, if any, did coaching support your understanding and utilization of **differentiation strategies to support all learners**?

13. How could coaching better support your understanding and utilization of **differentiation strategies to support all learners**?

14. In what ways, if any, did coaching support your understanding and utilization of **community-based STEM education resources**?

15. How could coaching better support your understanding and utilization of **community-based STEM education resources**?

16. Overall, which areas of the STEM Academy including on-campus support and the summer academy were **most useful** to you?

17. Overall, which areas of the STEM Academy including on-campus support and the summer academy **need improvement**?

18. Is the STEM Academy Professional Learning Community different from your campus-led professional learning communities? If yes, how so?

19. Is there anything else you would like to share about the STEM Academy?