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STEM Academy for Science Teachers and Leaders: Leader Academy and Coaching Evaluation

Technical Report 20-13

STEM Academy for Science Teachers and Leaders: Leader Academy and Coaching Evaluation

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Executive Summary

In 2013, Texas House Bill 5 (HB 5) required that Grade 8 students select an endorsement area, and just 16.9% of Dallas Independent School District (ISD) students selected the STEM pathway, despite the fact that a wide range of STEM industries are based in Dallas. In response to this need, a partnership between the Texas Instruments Foundation, the O'Donnell Foundation, Southern Methodist University (SMU), and Dallas ISD was established. A primary goal of this partnership was to determine ways to significantly improve students' interest and perseverance in STEM, ultimately affecting the STEM pipeline and equity in the technical fields. Four key areas were identified, including (a) active-learning which includes inquiry-based STEM instructional strategies such as project based learning (PBL), maker-based instruction (MBI), and the 5E model, (b) scientific process standards, (c) teacher content knowledge, and (d) differentiated support for all learners, with an emphasis on social and emotional learning (Perry, Reeder, Brattain, Hatfield, & Ketterlin-Geller, 2017). The STEM Academy included a leader and teacher component. The 5E Model (5E) of instruction includes the five phases of engage, explore, explain, elaborate, and evaluate that are present in good student-centered instruction. PBL and MBI are both inquiry-based pedagogical strategies that were the focal points of the STEM Academy for both teachers and leaders.

The purpose of this report is to: (a) provide an overview of the components and the goals for the leader component of the STEM Academy, (b) summarize components of the leader coaching and PLC support, and (c) describe the leaders' perceptions of the leader components of the STEM Academy. The SMU project team designed the content and structure of the Leader Academy to meet the main goals and address the key areas of the STEM Academy project, by specifically focusing on the role of leadership in supporting inquiry-based instruction. Additionally, the leaders engaged in activities and discussions aimed at developing their understanding of effective PLC meetings as a means of teacher development.

During the summer 2018 Leader Academy, 13 leaders participated, and nine completed the Academy Evaluation Survey. During the Spring 2020 Leader Academy, seven leaders participated, and six completed the Academy Evaluation Survey. It should be noted that only one leader completed the leader academy evaluation survey in both summer 2018 and spring 2020 due to changes in school leadership and STEM Academy participation.

The majority of the leaders, ranging from 78% (7/9) to 100% (9/9) in 2018 and 100% (5/5) in 2020, found the face-to-face professional development (i.e., the Leader Academy) and subsequent coaching beneficial. Leaders found the support and conferencing valuable, and also appreciated the understanding that they gained about the aspects of high-quality inquiry-based science instruction that their teachers were implementing in the classroom. They felt that the Leader Academy and coaching helped them better support the science instruction. The majority of the leaders in 2020, ranging from 80% (4/5) to 100% (5/5), reported that the Leader Academies helped them better understand both the scientific process standards and the resources that the teachers would need to engage in high-quality inquiry-based science instruction. This improved understanding equipped them to support the teachers at their individual campuses and should translate to improved prospects at the teacher and student level of the STEM Academy.

Three recommendations for improving the Leader Academy in the future are suggested, based on the results and analysis within this report. First, improving the participation in the leader book study. Second, due to leader fluidity, the delivery team should prepare to incorporate new leaders every year and should have a plan for integrating new leaders into the existing framework of the program. Finally, future iterations of the STEM Academy should continue to include a significant conferencing and coaching component for the campus leader, in order to facilitate the success of the goals at the teacher and student level of the STEM Academy.

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STEM Academy for Science Teachers and Leaders: Leader Academy and Coaching Evaluation

Background

During the first decade of the 21st century the number of STEM related jobs grew at three times the rate of non-STEM jobs (Smithsonian, 2018). 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).

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, despite the fact that a wide range of STEM industries are based in Dallas.

In response to these statistics, a partnership between the Texas Instruments Foundation, the O'Donnell Foundation, Southern Methodist University (SMU), and Dallas Independent School District (Dallas ISD) was established. Dallas ISD was chosen for this project in part because it is a large urban district. A primary goal of this partnership was to determine ways to significantly improve students' interest and perseverance in STEM, ultimately affecting the STEM pipeline and equity in the technical fields. Four key areas were identified for emphasis within the partnership including:

- Active-learning which includes inquiry-based STEM instructional strategies such as project-based learning (PBL) and maker-based instruction (MBI),
- Scientific process standards,
- Teacher content knowledge, and
- Differentiated support for all learners, with an emphasis on social and emotional learning (Perry, Reeder, Brattain, Hatfield, & Ketterlin-Geller, 2017).

Desired outcomes were determined that would help initiate and refine the goals of this 4-year project. The primary desired outcomes included (a) an increase in student science achievement and engagement, and (b) an increase in teacher implementation of active learning experiences.

Overview of Project

For the participating teachers, there are two main components of the STEM Academy for Science Teachers and Leaders (STEM Academy hereafter). The first is an intensive 90-hour professional development academy each summer, and the second is onsite coaching and professional learning community (PLC) facilitation that occurs during the academic year. Similarly, leaders participated in two main components of the STEM Academy, including an 18-hour professional development each year and onsite coaching and PLC facilitation during the academic year. For additional detail about the teacher components, please reference previous evaluation reports (Adams, Hatfield, Cox, & Ketterlin-Geller, 2018; Adams, Hatfield, Cox, Mota, Sparks, & Ketterlin-Geller, 2018; Adams, et al., 2018; Perry et al., 2017; Pierce, Adams, Rhone, Hatfield, & Ketterlin-Geller, 2019; Pierce, Cox, Hatfield, Adams, & Ketterlin-Geller, 2019).

The program follows a cohort model. At the time of this report, the first cohort of teachers was in their third year of participation (cohort 1), and a second cohort of teachers was in their second year of participation (cohort 2). Cohort 1 teachers began participation in summer 2017; cohort 2 teachers began participation in summer 2018. In summer 2018, some cohort 2 teachers joined the STEM Academy from existing schools. In addition, several new schools joined the STEM Academy. Leaders are considered to be in cohort 1 if their campus joined STEM Academy in the summer of 2017, and cohort 2 if their campus joined in the summer of 2018, regardless of whether the individual leader was present and overseeing the project during those years. For campuses with both cohort 1 and cohort 2 teachers, the leader is considered part of cohort 1.

The STEM Academy content is structured around four key areas that were identified during the development of the goals as being especially influential in fostering both student and teacher interest and success. These pillars are depicted in Figure 1.

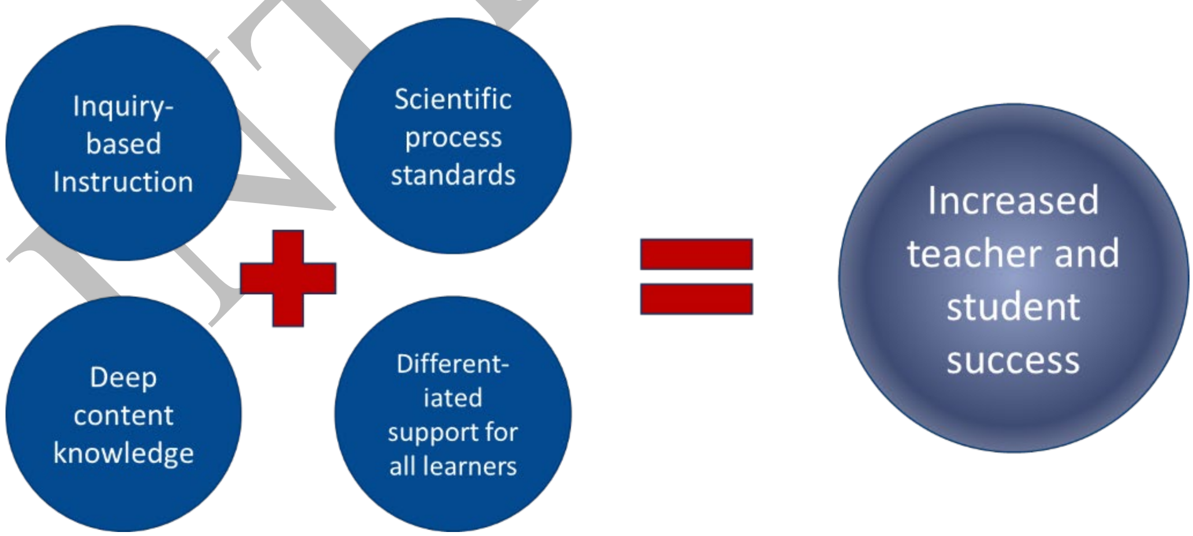


Figure 1. Foundational Pillars of the STEM Academy

As shown in Figure 1, the main outcome of the STEM Academy is teacher- and student-centered (i.e., increased teacher and student success). All aspects of the leader academy and coaching focused on facilitating the development of participating teachers as leaders in their departments as a means of achieving increased teacher and student success. Active learning and inquiry-based instruction in the science classroom lead to a better conceptual understanding by students (Minner, Levy, & Century, 2010). Furthermore, sustained professional development in inquiry-based instructional strategies is associated with positive trends on student growth in science mastery and a narrowed achievement gap within the scientific fields for students (Marshall, Smart, & Alston, 2017; Geier, Blumenfeld, Marx, Krajcik, Fishman, Soloway, & Clay-Chamber, 2008). The leaders were trained in the STEM pedagogical strategies emphasized in the Teacher Academy, so that they would be better able to support the participating teachers on their campuses.

Integrated STEM high schools examined in 2018 specifically supported teacher development by providing "extensive, regular, and embedded professional development that was thoughtfully designed (often by teachers) and tailored to the goals of the school" (Lynch et al., 2018, p. 734). The Leader Academy and the ongoing coaching throughout the year reinforced the idea of making PLC meetings more efficient and more focused on student and teacher outcomes. This was achieved predominantly through the utilization of protocols (see appendix A for example protocols).

The Leader Academy content built on the four key areas, which were the focal points of Teacher Academies 1, 2, and 3 (see Perry et al., 2017 and Pierce et al., 2019 for more detail). During the 2017-18 academic year, six leaders participated in the Leader Academy, which included both professional development and coaching. In 2018-19, 14 leaders participated in the Leader Academy, six from cohort 1 schools and an additional eight from cohort 2 schools. In 2019-20, six leaders participated in components of the Leader Academy.

Purpose of this Report

The purpose of this report is to: (a) provide an overview of the components and the goals of the Leader Academies, (b) summarize components of the coaching and PLC support, and (c) describe the leaders' perceptions about the components of the Leader Academy, including professional development and coaching.

While teachers also participated in STEM Academy, this report focuses only on leaders who participated in the STEM Academy and their experiences. The results of this report are designed to inform future improvements to the design and structure of all components of the STEM Academy that involve the leaders.

Evaluation Question

In addition to describing the content, structure, and activities included in the Leader Academies and the ongoing coaching, this report focuses on the following evaluation questions:

- What are leaders' perceptions of the Leader Academy summer professional development?

- What are leaders' perceptions of the leader coaching? Did they change across time?

- What are leaders' perceptions of the STEM practice and culture at their school? Were changes observed after one year, two years, or three years of treatment?

Content and Structure of the Leader Academy

The SMU project team designed the content and structure of the Leader Academy to meet the main goals and objectives of the STEM Academy project, by specifically focusing on the behaviors that leaders perform that will support inquiry-based instruction on their campuses. Additionally, the leaders engaged in activities and discussions aimed at developing their understanding of effective PLC meetings as a means of teacher development. The content and structure of the Leader Academy was similar across years with opportunities to revisit concepts from the previous year and build on those ideas.

The Leader Academy began with information about the project itself, the expectations for the teachers, and a brief introduction to the planned training that the teachers would receive. Then the facilitators directed the content towards understanding processes of change and allowed the leaders to perform several activities intended to help them narrow down their own personal goals for their campuses and make connections that aligned those goals with the goals of the STEM Academy. This included focus on learning environments, STEM careers and culture, and action planning strategies.

To conclude the Leader Academy, the participants discussed the challenges they anticipated for the upcoming year, and collaboratively prepared solutions. In the sections that follow, these activities and content are described in detail.

The 2017 Leader Academy was held concurrently with the first Teacher Academy. The leaders attended professional development sessions over two days in June on the SMU campus. The 2018 summer Leader Academy sessions occurred on two half days in May and one full day in June. The 2020 spring Leader Academy occurred on two full days; one Friday in February and one Friday in March.

Activities within the Leader Academy

This section outlines the activities conducted for each of the primary content areas. The Leader Academy activities were designed to acquaint the leaders with the different pedagogical strategies that the participating teachers would be implementing in the classroom. Additionally, activities were designed to strengthen the leaders' understanding of STEM education as defined by the four key areas, with a particular focus on learning environments, STEM careers, and STEM culture. The following section describes professional development activities and the tasks in detail. Information on the STEM Academy instructors can be found in appendix B.

Content

The Leader Academy started with a description of the major impetuses and goals of the STEM Academy project. The team included specific focus on the current gaps in Dallas ISD student STEM interest and explained how the STEM Academy had been designed to support teachers and leaders in reducing this gap through PLCs, professional development, and ongoing coaching channels. Expectations, research components, and timelines for the project were outlined in detail.

Next, the leaders were divided into groups of two or three and asked to write what they knew about five different topics that the project team considered essential to the implementation and success of the STEM Academy and achievement of the intended goals. These were:

- Science, Technology, Engineering, and Mathematics (STEM)
- Inquiry-based Instruction
- Scientific Process Standards
- Project Based Learning (PBL)
- Makerspaces and Maker Based Instruction (MBI)

The leaders then wrote their ideas on a large poster board created for each topic. Example artifacts can be seen in appendix C. The facilitator then defined each of these terms as they would be used in the STEM Academy, and the groups of leaders were asked to revisit and expand upon what they now knew about each. After briefly sharing how each group would define each of these topics, the facilitator augmented with any essential components that the leaders had not considered.

To conclude this section of the Leader Academy, the teams then created Venn Diagrams that portrayed the connection and relationship between the five essential concepts that had been discussed and defined (see appendix C).

Process of Change

The STEM Academy requires teachers and leaders to change how they approach the teaching of science. In order for successful implementation to occur, the leaders must be willing to support their participating teachers through the change process. To develop a deeper understanding of how adult learners change, and the different steps in this process that may require support, the leaders investigated their own definitions of change.

The change process was introduced and revisited each year of the academy. For example, during the second year, each leader was given a piece of clay and was asked to sculpt an object that represented change. The leaders then gave feedback to the other Academy members at their table without listening to any explanation or input from the creator.

The leaders were next asked to think of and share a one-word descriptor for the object they created. It should be different than the word 'change' which was the inspiration for the original sculpture. Next, the leaders were asked to change their design, to one that exemplified their new word, based on the feedback they had received. The leaders expressed that this was challenging because they had formulated an idea in their mind for the first sculpture, and changing direction creatively was something they inherently resisted. This activity served as an example of prototype use in teaching, which is a pedagogical strategy that participating teachers were also encouraged to utilize.

Another example of an activity included a discussion of change curves, on which individuals progress through the five stages of denial, resistance, acceptance, commitment, and transformation. Different individuals enter the curve at different point based on the paradigm that is being changed and the individual's own personal comfort and ideological attachment to the old procedure. The facilitator opened a discussion about the different spectrum of emotions that teachers may experience during the change process, and then the leaders and facilitator considered what type of support would be required for an individual at each level on the change curve.

For teachers in denial, listening and empathizing were identified as being essential. For teachers who were resistant, communication was acknowledged as key. Once teachers had accepted the new concept being changed, they would need to be equipped, trained, and further developed. Finally, the leaders determined that committed teachers need to be encouraged and rewarded and once the transformation has occurred the team needed to be allowed to celebrate their results. This session concluded with a brief reflective discussion.

Teacher Leadership

As teachers implement new strategies in their classrooms, the STEM Academy team anticipated that there would be challenges and frustration when a strategy did not achieve the teacher's goals upon first being introduced. This is expected, but the project team identified a need for the teacher to receive support during these times. The SMU coach would be responsible for some support, but it is also important for the school leader to prepare their own strategies to support the teachers on campus.

The facilitator posed the question 'In the era of always-on transformation, how can we make the change process empowering and energizing, as opposed to exhausting?'

The facilitator led a discussion about how different leaders handle teacher support on their own campuses and allowed each leader to give specific examples and share specific challenges that they had faced or anticipated facing in the upcoming year. The 5 Languages of Appreciation in the Workplace were discussed, and the leaders were encouraged to implement this, or a similar, strategy early on so that they would better understand the types of individuals who were on the science team, and therefore be better prepared to support them if the need arose.

Visioning

The first day of the Leader Academy concluded with a vision statement development exercise. The leaders wrote freely for five minutes about what their vision for science education on their campuses was for the next two years. Next the facilitator asked the leaders to share their visions with the group and identified commonalities. Four subgroups were identified based on specific visions, and the leaders split into groups with other like-minded leaders. These support groups then worked collaboratively to develop their visions specifically for students, teachers, and the leadership team on their campus. They identified strategies to increase interest and motivation in STEM, increase persistence in STEM, and increase achievement and content knowledge for each of the three subgroups.

Learning Environments

Learning environments are critical to STEM implementation. As such, this concept was introduced during the first year of the Leader Academy and revisited each year. As an example of an activity focused on learning environments, leaders were divided into groups and each was assigned one of the following perspectives on learning environments:

- Learner Centered
- Knowledge Centered
- Assessment Centered
- Community Centered

The groups then created a poster that they used to teach the rest of the Academy about their assigned perspective, which included a definition of the perspective, evidence in the classroom, pros of the perspective, and cons of the perspective. To see the developed posters, see appendix D.

Next, the leaders read a lesson exemplar and identified which learning perspectives were represented and the evidence that supported their claims. The Academy facilitator presented the diagram in Figure 2 and explained that this represented the ideal learning environment.

Figure 2. Ideal learning environment interaction and intersection of the four learning perspectives.

The leaders identified reasons why developing and maintaining this learning environment would be critical for student success and where their specific science department was currently operating. Leaders also referenced a diagram representing the continuum of teacher scientific content knowledge and teacher utilization of the scientific process standards (Figure 3).

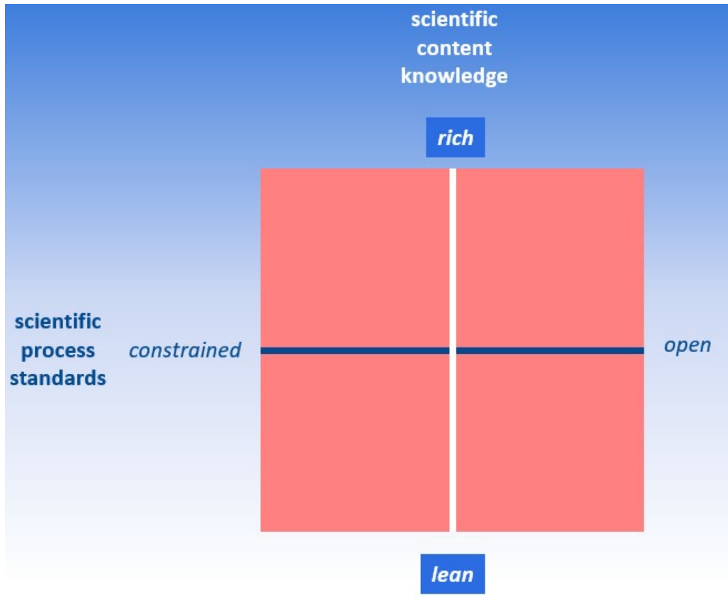


Figure 3. Plane representing the different locations individual teachers occupy regarding scientific content knowledge and utilization of the scientific process standards.

The ultimate goal is for all teachers to fall in the top right quadrant; however, each teacher will have their own individual starting position and will move along their own pathway at their own pace. Leaders should work to support teachers as they move and provide specific training or incentives for each member of their science department to reach the target quadrant. The leaders were informed that the STEM Academy team and coaches would be responsible for the majority of this support, but that it was likely that the teachers would also need departmental and administrative support at their own schools. This is where the leader was expected to provide additional help, so that the teacher could continue making progress and the goals of the STEM Academy could be achieved.

Each leader considered their individual circumstances, based on the science teachers they had in their department, the administration at their school, and the resources and supplies that were available. They made plans and identified strategies that they may need throughout the course of the year to help reach the goals of the STEM Academy.

STEM Careers and Culture

The next focus of the Leader Academy was on STEM careers and culture, and specific questions were asked about how each campus integrated these into the daily activities in their science classrooms. The concept of having a STEM night for students and parents attend was mentioned by several leaders, and the facilitator asked them to reflect on this event and determine whether that alone was enough to fully build STEM culture and expose students to STEM careers. Most leaders, while supportive of their campus STEM nights, acknowledged that a single event was not enough to build the type of interest in STEM fields that Dallas ISD and the STEM Academy sought.

The facilitator and the leaders discussed several different STEM careers, and then expanded to other supportive careers as a way of exploring the depth of the STEM fields. For instance, considering the field of applied physiology and health management, the careers of personal trainer, physical therapist, and wellness coach were added. The goal was for leaders to realize how many different types of careers were encompassed within STEM, and for the leaders to be able to communicate this to teachers, students, and parents who may not understand why studying STEM is important or who may think that they are not interested in the STEM fields.

The leaders created an action plan for how to incorporate more STEM career visibility on their campuses and discussed with each other how to build a stronger STEM culture at their schools. The facilitator asked them to consider their plans through the lens of the vision they had created previously concerning increasing interest and motivation in STEM, increasing persistence in STEM, and increasing achievement and content knowledge for students, teachers, and the leadership team. Guiding questions during this exercise included:

- What things do you already do to support the STEM culture?
- What are your goals for STEM culture, and how do you evaluate them?
- Do your teachers embed careers in every unit?
- How are you going to see the needle moving in the direction you want?
- How are you going to bring STEM culture and careers to the forefront?
- What are your measures of success?

At the end of the action planning session, the leaders each shared out their assessment and plan for their own campus and offered praise and recommendations for other campuses.

Designing an Effective PLC

Leaders assessed how their current department PLC was functioning. They answered the question: “What is one phrase you would use to describe the professional learning community of your science department?” Leaders described how the current reality of their departmental PLCs either aligned or did not align with the aspirational model that was presented (DuFour, DuFour, Eaker, & Many, 2006).

The major building blocks of a PLC are vision, planning, and effort, and the leaders were asked to answer the following questions regarding the building blocks in their own PLCs:

- Why work together?

- Who will be on our leadership team?
- How will we work together?
- When and where will we meet?
- What will be our shared work?

As an example of an activity that extended this concept, leaders created a poster that supported sharing about the lessons learned and topics discussed for one of the key questions. See appendix E for example photographs of these posters. The leaders participated in a gallery walk of the completed posters, which allowed them to see the ideas developed by other leaders and consider more fully how PLCs should be facilitated on their own campuses.

Activities varied slightly by year. For example, in summer 2018, leaders also attended a panel discussion focused on identifying campus needs for PLC meetings. In addition, during summer 2018, leaders received a book entitled *Leading Change Together: Developing Educator Capacity Within Schools and Systems* by Drago-Severson and Blum-DeStefano (2018). During the 2018-19 school year, leaders were invited to participate in a virtual book study focused on supporting instructional change on their campuses.

Structure and Content of Leader Coaching

A second major component of the STEM Academy was ongoing coaching and support. During each year of the STEM Academy, leaders engaged in up to seven coaching cycles. The coaching cycle included a pre-conference, attending a PLC, and a post-conference. During the first year, leader coaching was more focused on information collecting and facilitating alignment of departmental goals with individual leader goals and STEM Academy goals. The PLCs were designed and presented by the SMU coach. The leader provided input and helped guide the trajectory and meeting focus.

During the second year, the SMU coach adopted a more observatory role. The coach and leader still met prior to PLC meetings, but the leader was responsible for conducting the PLC and developing the content independently, although the coach offered suggestions if they were desired. During the second half of year, coaches once again took on the role of PLC content developer and deliverer. The leader began conducting walkthrough observations with the coach. A post-conference was held in order to debrief on reflections and concerns that may have arisen as a result of the PLC meeting or the walkthrough observations.

In the final year of leader coaching, the structure of pre-conference, walkthrough observations, coach-led PLC meetings, and post-conference was continued. The leader attended the PLC meetings but was not directly responsible for deciding what content was covered. Both the coach and leader transferred the responsibility for PLC facilitation to the participating STEM Academy teachers.

2017 – 2018 Leader Coaching

Six leaders participated in the 2017-18 leader coaching. These leaders worked with one SMU instructional coach. To begin the first cycle of leader coaching the SMU coach conducted an introductory meeting. During this meeting, the coach asked the leader to reflect on and identify specific needs, goals, and plans for their department. The guiding concepts for this exploratory conversation were:

- PLC current practices,
- PLC current schedule,
- PLC current needs,
- PLC STEM academy action plan,
- PLC STEM academy schedule,
- Individual leader goals,
- Individual teacher practices and needs,
- Teacher coaching cycle clarification,
- Teacher schedules,
- Teacher coaching cycle questions, and
- Teacher tentative schedule.

After the coach and leader determined what resources the department required that could be delivered at PLC meetings, the coach designed the session content and presented it during the observation cycle. Following a pre-conference with the leader before each PLC, the coach led a PLC with the STEM Academy participating teachers and the leader. The coach utilized literary resources, with specific focus on science content, to facilitate a discussion within the department and allow the teachers to reflect on their own practices and goals. Following the PLC, leaders participated in a post-conference meeting with the coach; achievements were discussed and the plan for the following PLC meeting was decided upon on an individual campus basis.

2018 – 2019 Leader Coaching

Thirteen leaders participated in the second year of coaching implementation for the STEM Academy. These leaders and their campuses were each assigned to one of five coaches. For more information about the coaches' background and training see the *STEM Academy for Science Teachers and Leaders: Coach Training and Development* report (Mota, Pierce, Hatfield, Adams, & Ketterlin-Geller, 2019).

During the first three cycles of coaching, which occurred during the fall semester of 2018, the coaches observed the PLC meetings while the leaders facilitated. During the pre-conference, the coach and leader discussed the goals for the meeting, the roles of different individuals, and considered any obstacles or challenges that may arise. Following the PLC meeting the coach and leader would debrief about what aspects of the meeting accomplished the shared goals of the department and the STEM Academy and identify what aspect needed adjustment or improvement.

During the spring semester, the coach facilitated the PLC meetings. The STEM Academy team developed four different presentations that were intended to help teachers think critically about how they were implementing STEM Academy concepts in their classroom daily. The topics for these lessons were social and emotional learning (SEL), the M in STEM, questioning strategies, and English language learner strategies. Each of these sessions was aligned with a Dallas ISD PLC rubric, several process standards, and the four key areas of the STEM Academy.

In addition to the SMU coach-led PLC meetings, the leaders also conducted walkthrough observations with the coach of each teacher participating in the program. The guiding questions and reflection components of these walkthroughs were developed by the STEM Academy team based on two resources including *How Walkthroughs Open Doors* and the *Downey Walkthrough Approach* (Ginsberg & Murphy, 2002; Downey, Steffy, English, Frase, & Poston, 2004; Millar, 2009).

The guiding questions that were derived from these different sources included:

- What are the 'look fors' for a walkthrough? (identify indicators from the rubric)
    - What are the signs of student engagement?
    - What are the lesson objectives?
    - Are activities aligned with the lesson objectives?
    - What resources/activities foster STEM engagement?
    - Are there opportunities for critical thinking? Students' creativity?
- How will the leader support teachers' growth?
- What are the action plans for the next visit/cycle?

2019 – 2020 Leader Coaching

During the third year of coaching, the leaders and coaches continued the walkthrough evaluations that they had conducted during the spring of year two. Additionally, the STEM Academy team developed several PLC sessions that the coach led. The first meeting included introductory activities that allowed the coach, leader, and teachers to determine what type of adult learners were part of the team and facilitated norm setting. The remainder of the PLC sessions were used to examine student artifacts, teacher artifacts, and teacher lessons. Four protocols were used by the PLC team to guide this process. Depending on the issue being analyzed, the team used either the Tuning Protocol, the Consultancy Protocol, the Charette Protocol, or the Notice and Wonder Protocol (for details of these protocols obtained from Venables, 2011 see appendix A). During the walkthroughs, the leader and coach considered the same guiding questions mentioned above, and the process of pre-conference, walkthroughs and PLC meeting, and post-conference remained the same as the previous year. Please see appendix F for copies of the coaching cycle forms used during the 2019-2020 academic year.

Participating Leaders

During the 2017-18 academic year, six leaders participated in the professional development and coaching aspects of the STEM Academy, but their information and responses were not included in the research components of the project because SMU was awaiting Research Review Board (RRB) approval from Dallas ISD. Therefore, no survey results or demographic information is included in this report about these leaders.

Overall, 13 leaders participated in the STEM Academy during the 2018-19 academic year. Of these, 10 attended the Leader Academy and completed the leader information survey. During the 2019-2020 academic year, eight leaders participated and seven completed the leader information survey. The resulting response rates are 76.9% and 87.5% respectively. Table 1 shows the leader demographic characteristics for 2018-19 and 2019-20.

Table 1
Leader demographic information

Characteristic		**2018-19**		**2019-20**	
		#	%	#	%
Gender	Male	2	20%	1	14%
	Female	8	80%	6	86%
Race	Alaska Native	0	0%	0	0%
	Asian	1	10%	1	14%
	Black	5	50%	1	14%
	Native Hawaiian	0	0%	0	0%
	Other Pacific Islander	0	0%	0	0%
	White	4	40%	4	57%
Ethnicity	Hispanic or Latino	1	10%	2	29%
	Not Hispanic or Latino	9	90%	5	71%
Total		10	100%	7	100%

Note: One leader did not indicate their race in 2019-20. Leader descriptive information is not available for summer 2017.

Table 2 illustrates the work experience for leaders. In 2019-20, participating leaders had slightly fewer years of general experience, but had more experience teaching science compared to leaders in 2018-19.

Table 2
Cohort 1 leaders' work experience

	2018-19	2019-20
	Mean # of Years (*SD*)	Mean # of Years (SD)
Years in education	18.2 (6.6)	15.7 (4.4)
Years teaching	15.1 (6.3)	12.6 (5.1)
Years teaching science	5.1 (6.7)	10.0 (8.2)
Years as an instructional coach for science	1.5 (2.0)	2.6 (3.5)
Years as an assistant principal	3.0 (2.6)	1.3 (2.0)
Years in other careers	7.1 (9.0)	4.7 (5.4)
Years at current school	5.6 (6.1)	6.1 (4.5)

Note: Leader descriptive information is not available for summer 2017. 2018-19 n=10; 2019-20 n=7.

Table 3 illustrates the different undergraduate and graduate degrees leaders obtained, with most leaders in both years obtaining graduate degrees in education.

Table 3
Cohort 1 Major for participating teachers' Bachelor's degrees

Bachelor's Degree	2018-19 #	2019-20 #
Education	2	3
Biology	2	1
Interdisciplinary Studies	2	1
Communication Arts	1	0
Occupational Training and Development	1	0
Psychology	1	0
Allied Health Science	0	1
Business Administration	0	1
Master's Degree	**2018-19 #**	**2019-20 #**
Education	2	2
Educational Leadership and Policy	2	1
Bilingual Education	1	0
Curriculum and Instruction	1	0
Educational Technology and Design	1	0
Human Resources	1	0
Administration	0	1
Environmental Education	0	1
Organizational Management	0	1
Science Education	0	1

Note: Leader descriptive information is not available for summer 2017. 2018-19 n=10; 2019-20 n=7.

Table 4 highlights that most leaders obtained graduate degrees. Two leaders were enrolled in graduate coursework at the time of the 2018-19 survey and one leader was enrolled at the time of the 2019-20 survey.

Table 4
Graduate Degrees

Degree Type	2018-19		2019-20	
	#	%	#	%
Currently Enrolled in Master's	2	20%	1	14%
Currently Enrolled in Doctorate	0	0%	0	0%
Completed Master's	9	90%	6	86%
Completed Doctorate	0	0%	0	0%

Note: Leader descriptive information is not available for summer 2017. 2018-19 n=10; 2019-20 n=7.

Finally, Table 5 and Table 6 indicate the number of hours of professional development in each subject area that the leaders participated in during the previous school year.

Table 5
2018 Leaders' Professional Development during the Previous School Year (n=16)

Topic	None	Less than 6 Hours	6-15 Hours	16-35 Hours	More than 35 Hours
Instructional coaching	13	2	1	0	0
Methods of teaching science	7	5	3	1	0
Instructional leadership	6	8	1	1	0
Managing instructional change	6	9	1	0	0
STEM education content	3	5	6	0	2
Students with disabilities	3	3	3	3	3
English-language learners	2	5	0	8	1
Science content	0	1	8	2	5

Table 6
2019 Leaders' Professional Development during the Previous School Year (n=7)

Topic	None	Less than 6 Hours	6-15 Hours	16-35 Hours	More than 35 Hours
Managing instructional change	2	2	1	2	0
STEM education content	2	2	1	0	2
Methods of teaching science	1	2	0	3	1
Science content	1	1	1	1	3
Instructional coaching	0	1	3	2	1
Instructional leadership	0	0	3	3	1
Students with disabilities	0	7	0	0	0
English-language learners	0	6	1	0	0

Leader Academy and Coaching Evaluation Surveys

The leaders were asked to participate in several surveys, including a leader academy evaluation survey, a leader coaching evaluation survey, and a leader STEM perceptions, practice, and culture (PPC) survey.

The leader academy evaluation survey was revised slightly from 2018-19 to 2019-20. In summer 2018, the survey included 18 Likert items ranging from strongly agree to strongly disagree and four open response questions. In spring 2020, the survey included 23 Likert items ranging from strongly agree to strongly disagree and eight open response questions. The 2018 survey is saved https://smu.box.com/s/ahm3nj1tf0u4k0zbohs8r03x5bizdxpo. The 2020 survey is saved https://smu.box.com/s/9gytijo9yuaq4qg5byk0vw1eryr81wuh.

Similarly, the leader coaching evaluation survey was revised slightly from 2018-19 to 2019-20. In 2018-19, the leader coaching evaluation survey included one ranking item, 10 Likert agreement items, and 11 open response questions. In 2019-20, the leader coaching evaluation survey included one ranking item, 11 Likert agreement items, and 11 open response questions. The 2018-19 survey is saved https://smu.box.com/s/vhcvl9ad99tbky2ge8oqkfh2eudkwjmj. The 2019-20 survey is saved https://smu.box.com/s/4qzzcx02r1fw8xksywa2docdegmvowev.

The STEM PPC survey consisted of two major components. The first was a set of seven practices that leaders may engage in while providing support to science teachers. The leaders were asked to rate the importance of each, indicate their own personal confidence level with implementing the practice, and indicate the frequency that they actually implemented each practice at their schools. The second portion of the STEM PPC included nine statements about teaching and STEM visibility on campus and each leader indicated the extent to which they agreed with each statement. A copy of the STEM PPC can be found at https://smu.box.com/s/3szpu5uttsu79qg6g6exiyga2xlj8prr.

Results

The results in this section are guided by the key areas and are grouped based on leader perceptions (a) overall, (b) specific to *active learning* strategies in the classroom, which includes PBL, MBI, and the 5E model, (c) specific to application of activities that teach and incorporate the *scientific process standards*, (d) specific to *content knowledge*, and (e) specific to *differentiated support for teachers*. We examine leaders' perceptions quantitatively by looking at agreement rates.

In 2018-19, 13 leaders participated in the summer academy and coaching. Only nine of the thirteen responded to the summer 2018 leader academy evaluation survey (69%) and only six of the thirteen responded to the 2018-19 leader coaching evaluation survey (46%).

Leaders were only eligible for leader coaching during the academic year if more than one teacher at their campus participated in the STEM Academy. In 2019-20, the Leader Academy was not held during the summer due to challenges associated with scheduling leader time during their contract hours. Therefore, the Leader Academy for the third year was held during the academic year, which allowed greater participation. Additionally, SMU invited all leaders to the spring leader academy, regardless of the number of teachers participating, resulting in eight leaders participating in one or both components of the Leader Academy. Seven leaders participated in the spring leader academy and four leaders participated in leader coaching. Five of the seven who attended the Academy responded to the spring 2020 leader academy evaluation survey (71%). On the 2019-20 leader coaching evaluation survey, two responded, which is 50% of the leaders receiving coaching treatment. The content of the academy and coaching evaluation surveys was updated each year to reflect revisions to the content and structure of the academy and coaching. In addition, leader participation changed across years, both in sample size and who participated. As such, we present the results by year without making cross year comparisons.

The STEM PPC survey was given three times over the course of the Leader Academy. The first was in the summer 2018, and nine of the 13 participating leaders (69%) completed the survey. The second administration was in the summer 2019, and 6 of the 8 participating leaders (75%) completed the survey. The final survey was administered in spring 2020, and four of four leaders (100%) engaged in coaching completed the survey.

Leader Academy Evaluations Summer 2018 and Spring 2020

Leaders attended the Leader Academy in summer 2018, then again in spring 2020. It should be noted that only one leader completed the leader academy evaluation survey in both summer 2018 and spring 2020 due to changes in school leadership and STEM Academy participation.

The majority of 2018 and all 2020 leaders agreed that they would share the knowledge they gained with their colleagues, that the Academy was a valuable professional development opportunity, and that the content of the Academy met their expectations (see Figure 4).

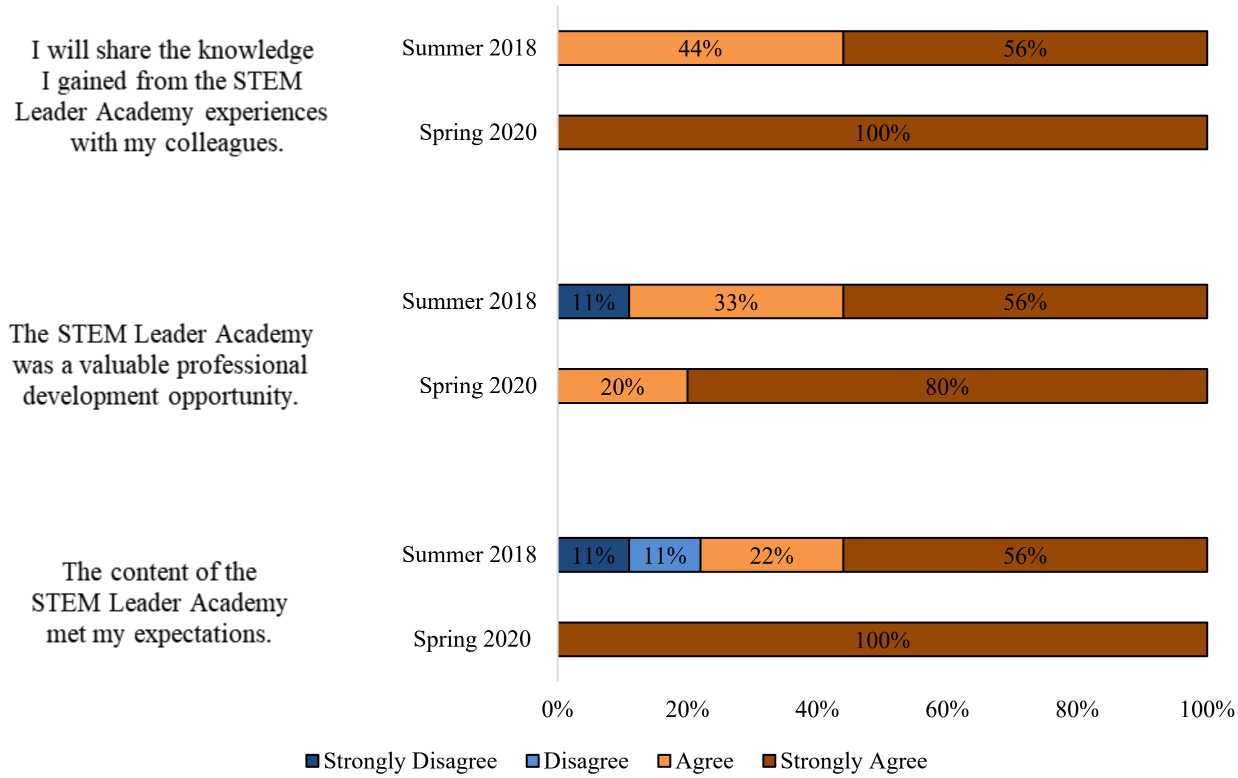


Figure 4. Percent of leaders who agreed or disagreed with overall statements about the Leader Academy. (Summer 2018 n=9; Spring 2020 n=5)

Regarding the inquiry-based instructional strategies of PBL and MBI, 89% (8/9) of the 2018 leaders agreed that the Leader Academy deepened their understanding and provided them with necessary tools to apply these principles at their campuses (Figure 5). Similarly, 89% (8/9) of the summer 2018 leaders agreed that the Leader Academy deepened their understanding of STEM integration, which focused on applying process standards and cross-curricular content in the science classroom. Figure 5 shows these results, along with the responses from the spring 2020 leaders, who were 100% (5/5) in agreement. New statements about 5E were added to the spring 2020 academy evaluation survey, and leaders also responded 100% (5/5) in agreement with these.

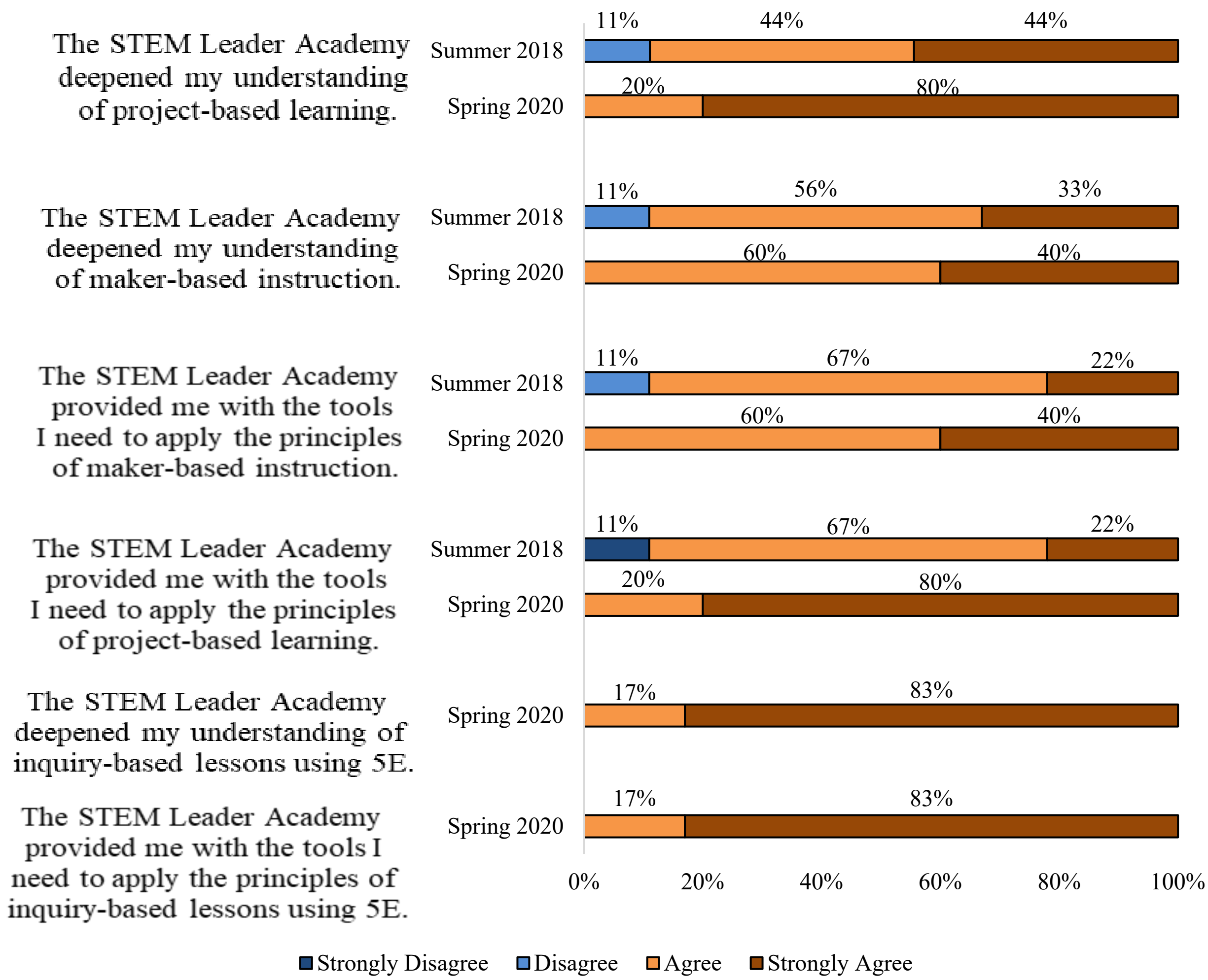


Figure 5. Percent of leaders who agreed or disagreed with statements about inquiry-based instructional strategies presented during the Leader Academy. (Summer 2018 n=9; Spring 2020 n=5)

Leaders in both years had high agreement, eight out of nine (89%) and five out of five (100%) respectively, to the statement that the Leader Academy deepened their understanding of STEM integration in middle school (Figure 6).

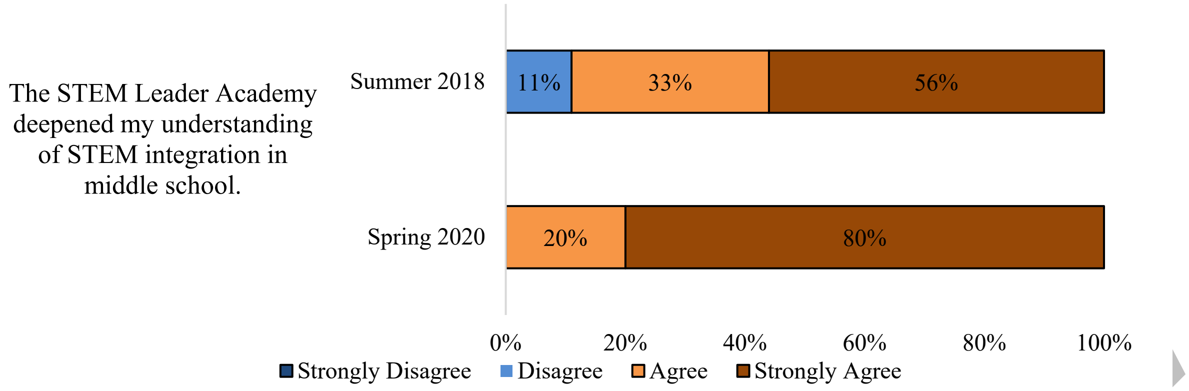


Figure 6. Percent of leaders who agreed or disagreed with the statement about process standards as presented through STEM integration during the Leader Academy. (Summer 2018 n=9; Spring 2020 n=5)

Additionally, 89% (8/9) of the summer 2018 leaders and 100% (5/5) of the spring 2020 leaders agreed that the structure of the Academy enhanced their understanding of middle school science content and believed that this would help them support science instruction on their individual campuses (Figure 7).

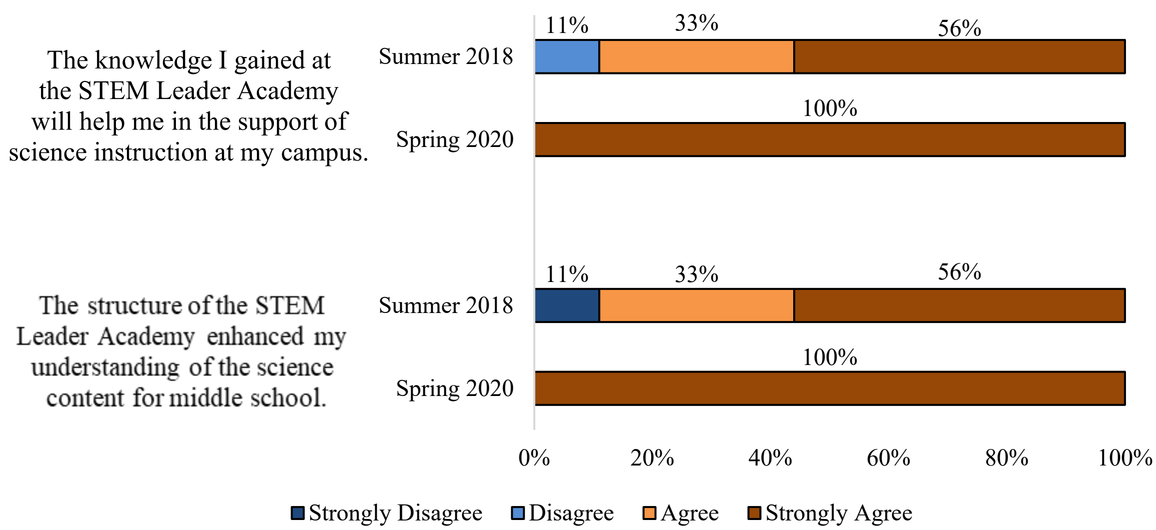


Figure 7. Percent of leaders who agreed or disagreed with statements about science content knowledge presented during the Leader Academy. (Summer 2018 n=9; Spring 2020 n=5)

Finally, the majority of leaders agreed with statements concerning differentiated support for the teachers in their departments, including team building, non-traditional classroom observation strategies, crucial conversations, and the role administration plays in supporting STEM education (Figure 8). Additionally, new statements about transitional management, time management, supporting adult learners, and the use of protocols to facilitate PLC meetings were added to the spring 2020 survey. All spring 2020 leaders agreed or strongly agreed with all of these statements, and the agreement rate for summer 2018 leaders ranged from 78% (7/9) to 100% (9/9).

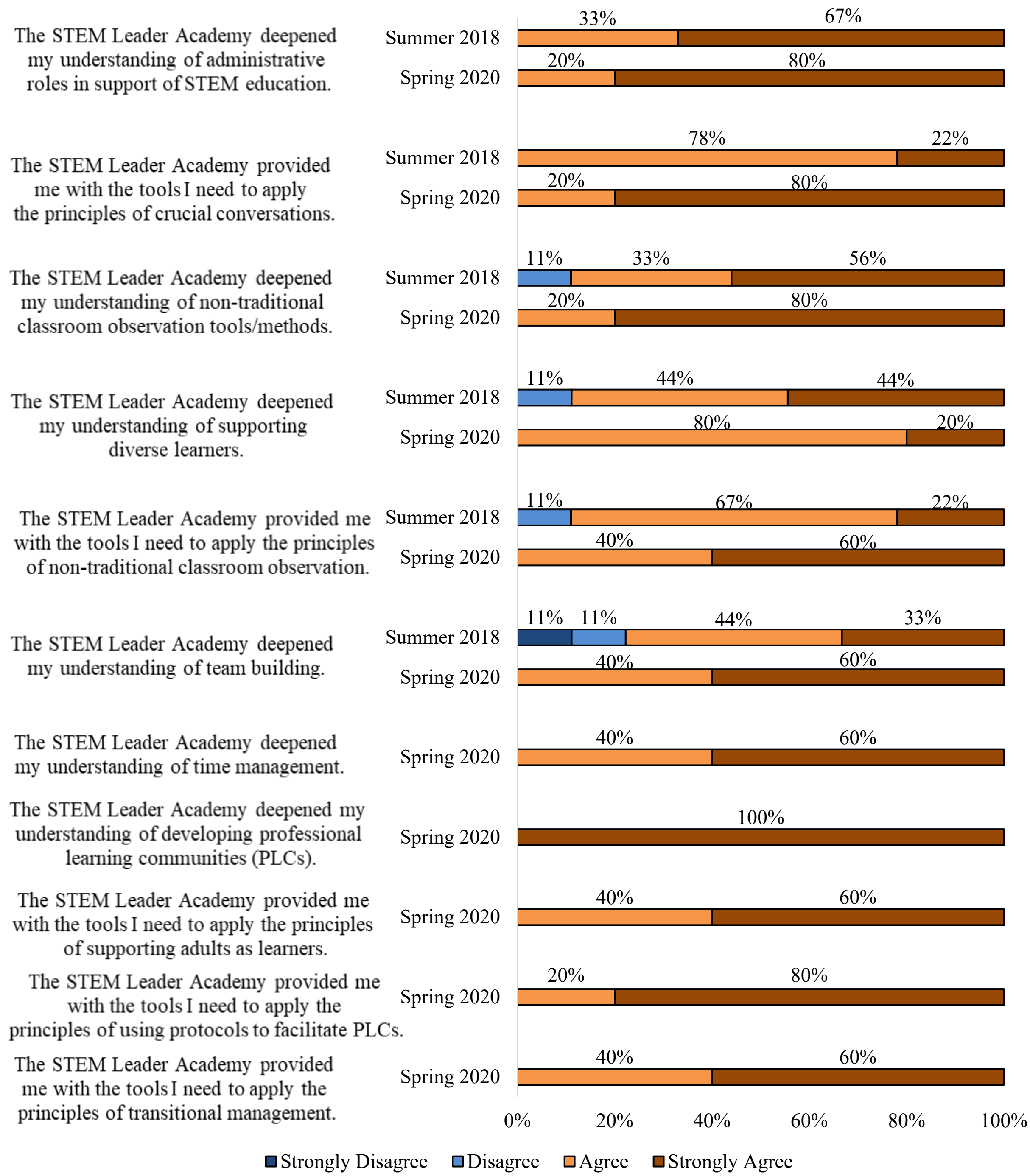


Figure 8. Percent of leaders who agreed or disagreed with statements about differentiated support strategies presented during the Leader Academy. (Summer 2018 n=9; Spring 2020 n=5)

In addition to the analyses described previous, we examined means and standard deviations for each item. Items on the academy evaluation survey were assigned a score of 1 for "Strongly Disagree", 2 for "Disagree", 3 for "Agree", and 4 for "Strongly Agree". The means represent all leaders who participated in the leader academy. In general, leaders responded mostly favorably about their experience in the leader academy in both summer 2018 and spring 2020. The mean response for each item was slightly higher for the spring 2020 leader academy compared to the summer 2018 leader academy. Means for summer 2018 range from 3.0 to 3.7, which indicates leaders tended to agree with most statements. Means for spring 2020 range from 3.2 to 4.0. In summer 2018, leaders rated certain items as strongly disagree (e.g., "The STEM Academy deepened my understanding of team building"). In spring 2020, all five leaders agreed or strongly agreed with all statements. See Table 10 in appendix G for the means and standard deviations by item.

Leader Coaching Evaluation Spring 2019 and Spring 2020

A total of six leaders completed the spring 2019 coaching evaluation survey. Table 7 illustrates their ranking of usefulness of coaching activities throughout the school year. Half of the 2018-19 leaders ranked "Classroom walk-throughs with your SMU coach" as the most useful followed by "conferencing with your SMU coach before and/or after PLCs". Although not shown in the table due to small sample size, responses in 2019-20 were similar. In 2019-20, two of the three listed the PLC meeting with their campus teachers and SMU coach as the most useful. The third leader listed the Leader Academy as the most useful. The Leader Coaching Evaluation data is not included in this section for the spring 2020 timepoint, because fewer than 5 leaders completed the survey, and the collected sample therefore did not meet the required size for analysis and inclusion in this report. A summary of the three leader responses in spring 2020 is included at the end of this results section.

Table 7

Ranking of STEM Academy Supports in spring 2019 (n = 6)

	Rank of Usefulness					
Aspect	1	2	3	4	5	6
Classroom Walk-throughs	3 (50%)	2 (33%)	0 (0%)	0 (0%)	1 (17%)	0 (0%)
Conference about Walk-throughs	2 (33%)	2 (33%)	2 (33%)	0 (0%)	0 (0%)	0 (0%)
Conference about PLCs	1 (17%)	0 (0%)	2 (33%)	2 (33%)	1 (17%)	0 (0%)
PLC Meetings	0 (0%)	2 (33%)	1 (17%)	2 (33%)	1 (17%)	0 (0%)
Summer PD	0 (0%)	0 (0%)	1 (17%)	2 (33%)	1 (17%)	1 (17%)
Book Study	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (33%)	1 (17%)

Note. 1 indicates most useful and 6 indicates least useful.
Note. Aspects are ordered from most useful to least useful.

Leaders were also asked about their perception of different aspects of coaching. Figure 14 summarizes the leaders' responses. Most leaders either agreed or strongly agreed that coaching activities were valuable, improved their ability to lead science teachers, improved their understanding of the process standards, improved their understanding of high-quality science instruction, and improved their ability to engage students in STEM. The highest levels of agreement were for the two aspects that incorporated pre and post conferencing. Although not shown in the figure due to small sample size, the two 2019-20 leaders who completed the survey either agreed or strongly agreed with all but one item on the survey. The only item that these two leaders disagreed with was that the aspects of the STEM Academy coaching improved their ability to engage parents in understanding STEM.

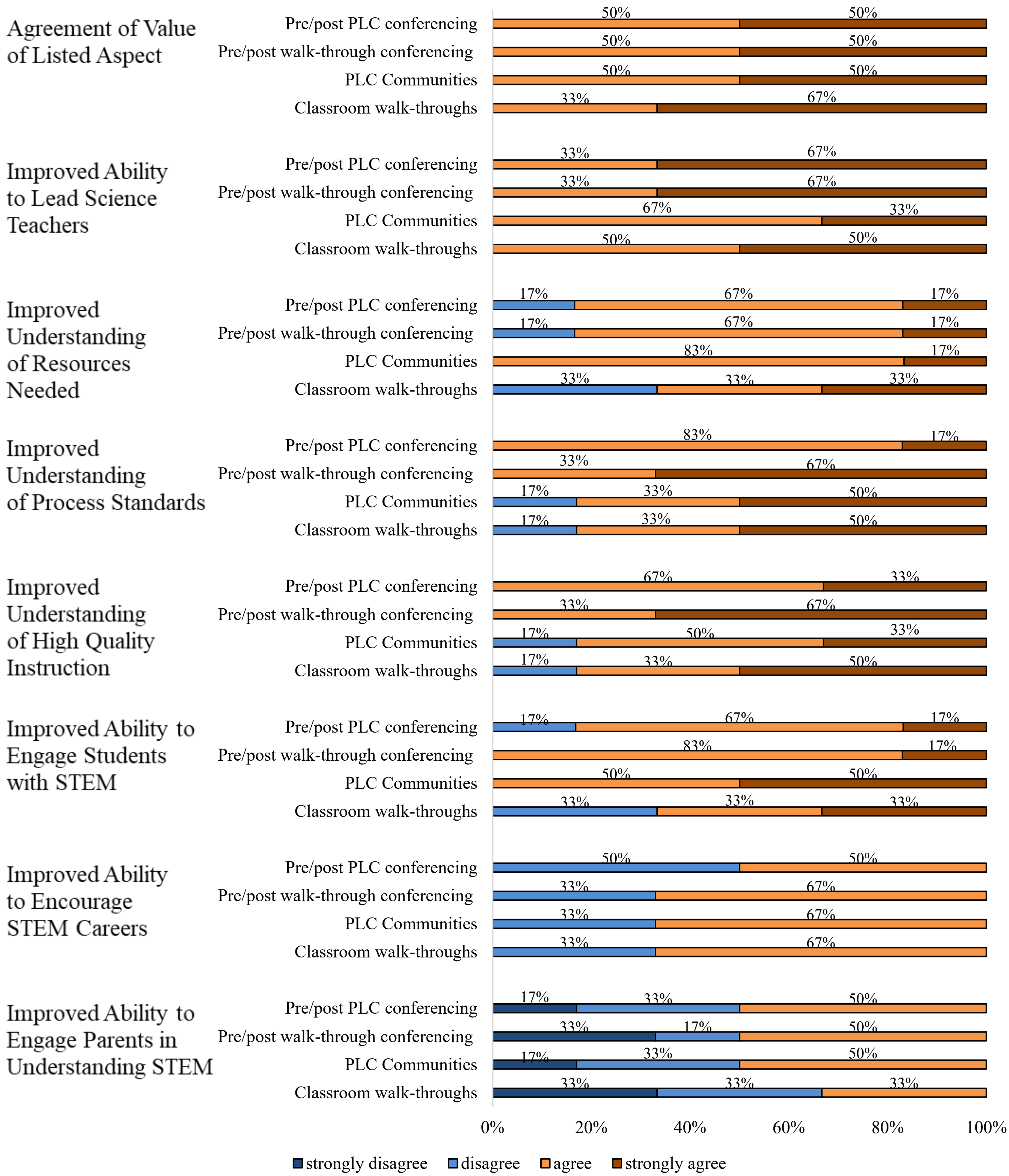


Figure 9. Leader Perceptions about how Various Aspects of the Leader Academy Influenced their Understanding and Abilities (n=6)

Leaders were also asked their perceptions of the STEM Academy in general and their confidence in supporting the key areas of the STEM Academy (e.g., PBL, MBI). Tables 8 and 9 summarize the leaders' responses. In all areas, the majority of leaders, five out of six (83%) to six out of six (100%) perceived the STEM Academy as helpful for teachers at their school, and leaders felt confident in assisting science teachers with active-learning strategies.

Table 8
The STEM Academy has Supported Science Teachers at My School with Implementing: (n=6)

Statement	Strong Disagree/Disagree	Agree/Strongly Agree
Inquiry-based instruction	0 (0%)	6 (100%)
Scientific process standards	0 (0%)	6 (100%)
STEM education community-based resources	0 (0%)	6 (100%)
Project-based learning	1 (17%)	5 (83%)
Maker-based instruction	1 (17%)	5 (83%)
High-quality science content knowledge	1 (17%)	5 (83%)
Differentiation strategies to support all learners	1 (17%)	5 (83%)

Table 9
I Feel Confident in my Ability to Support Teachers in Implementing: (n=6)

Statement	Strong Disagree/Disagree	Agree/Strongly Agree
Inquiry-based instruction	0 (0%)	6 (100%)
Project-based learning	0 (0%)	6 (100%)
The scientific process standards	0 (0%)	6 (100%)
Science content knowledge	0 (0%)	6 (100%)
Differentiation strategies to support all learners	0 (0%)	6 (100%)
Encouraging students to consider STEM careers	0 (0%)	6 (100%)
Maker-based instruction	1 (17%)	5 (83%)
Community-based STEM education resources	1 (17%)	5 (83%)
Encouraging student engagement in STEM	1 (17%)	5 (83%)
Engaging parents in understanding STEM	1 (17%)	5 (83%)

Three of the 2018-19 leaders participated in the book study and were asked how that aspect of the coaching influenced their understandings and abilities. All three agreed that the book study improved their ability to lead science teachers, their understanding of high-quality STEM instruction, and their ability to engage students with STEM. Two of the three leaders (67%) felt the book study improved their understanding of the process standards and was an overall valuable addition to the Leader Academy. Only one of three (33%) felt that it improved their understanding of the resources needed to support inquiry-based instruction, their ability to encourage students in STEM careers, or their ability to engage parents in understanding STEM.

After observations and campus visits by the SMU coach for the 2019-20 academic year were finished, the participating leaders were asked to complete a coaching evaluation survey. Only three leaders submitted any responses, and only two leaders completed the evaluation. When asked to rank the aspects of the STEM Academy supports from most to least useful, two of the three listed the PLC meeting with their campus teachers and SMU coach as the most useful. The third teachers listed the Leader Academy as the most useful.

STEM PPC Survey

The SMU team developed the STEM PPC survey to measure leaders' perceived confidence, importance, and frequency in using active learning strategies. Each year the participating leaders at schools with more than one participating teacher were asked to complete the STEM PPC. Due to changes in leadership at each school and attrition of participating teachers across years, the sample size of leaders completing the STEM PPC was small. In the summer of 2018 nine leaders completed this survey and in the summer of 2019 six leaders completed this survey. The STEM PPC survey was not included for the spring 2020 timepoint, because fewer than 5 leaders completed the survey, and the collected sample therefore did not meet the required size for analysis and inclusion in this report. Additionally, only one leader participated in all three timepoints of data collection. While the following figures show the results for two years, caution should be taken when making comparisons across years because the individual leaders are not consistent.

Figure 10 illustrates the means for the importance, confidence, and frequency of STEM practices across all items on the STEM PPC survey. Leaders tended to rate the frequency in which they implement practices the highest, although this was on a six-point scale while importance and confidence were on four-point scales, so they cannot be directly compared. Leaders rated the importance of implementing the practices higher than their confidence in implementing the practices. To summary statistics by item, please reference Table 10 in appendix G.

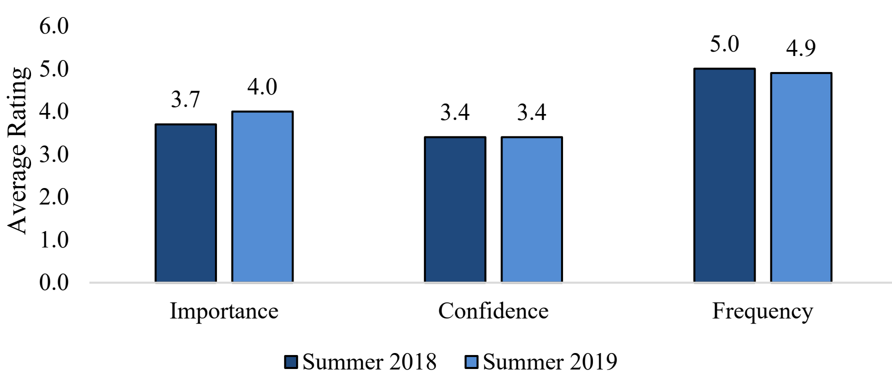


Figure 10. Leaders' Perceived Importance, Confidence, and Frequency on all STEM PPC Items. Summer 2018 n=9; Summer 2019 n=6)

Figures 11, 12, and 13 highlight the frequency, importance, and confidence for the individual practices listed in items on the STEM PPC survey, with most items following the same pattern mentioned in Figure 10. Additional descriptive statistics for each item can be found in Table 12 in appendix G. Compared to leaders in summer 2018, leaders in summer 2019 reported higher frequency of use for the seven items on the STEM PPC survey, as shown in Figure 11.

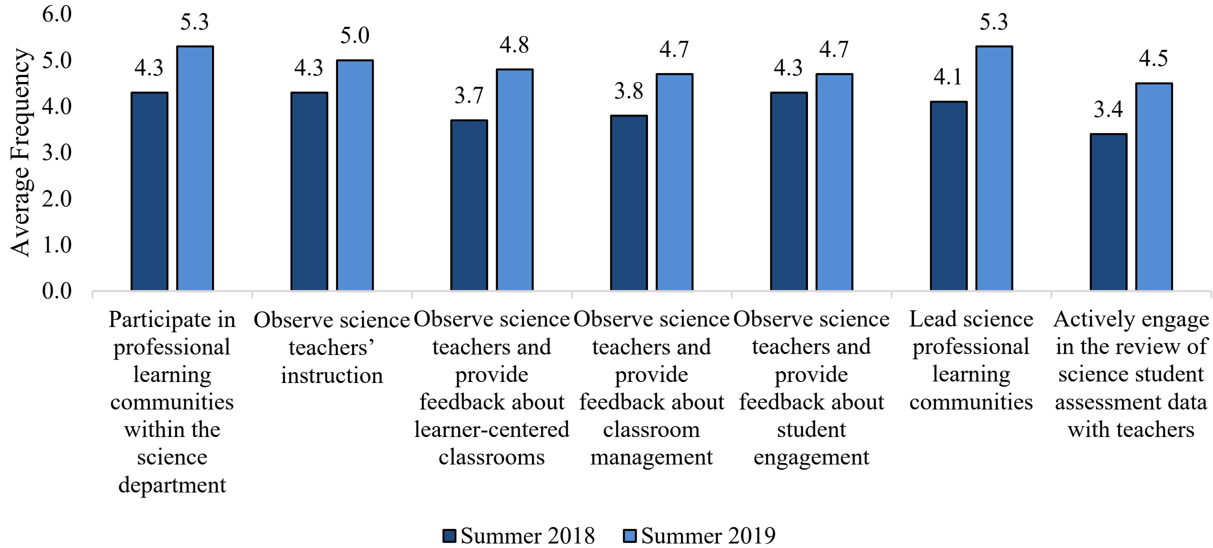


Figure 11. Leaders' Perceived Frequency of Individual STEM PPC Items (Summer 2018 n=9; Summer 2019 n=6)

Compared to leaders in summer 2018, leaders in summer 2019 reported higher perceived importance of use for six of the seven items, and no change in use for one of the six items, on the STEM PPC survey, as shown in Figure 12. These values were all very close to the maximum score of four, so it is also possible that a ceiling effect contributed to consistency in responses. The leaders at both timepoints indicated that each practice was of very high importance, with the mode being four for all seven items except for 'Lead science professional learning communities' in 2018-19.

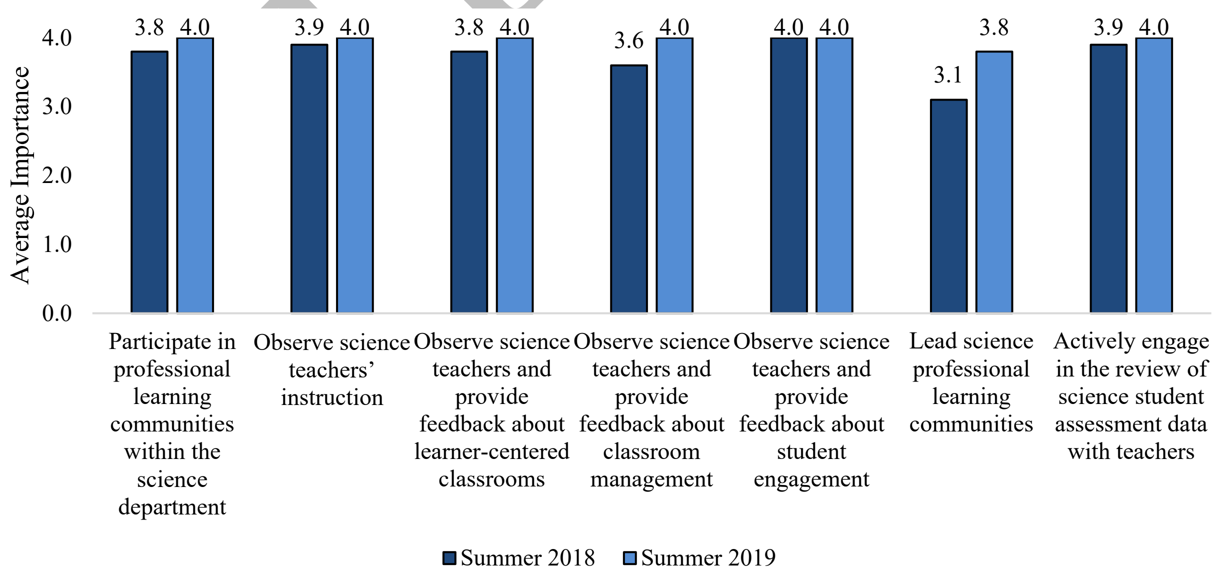


Figure 12. Leaders' Perceived Importance of Individual STEM PPC Items (Summer 2018 n=9; Summer 2019 n=6)

Compared to leaders in summer 2018, leaders in summer 2019 reported higher perceived confidence of use for two items, remained constant for two items, and decreased for three items, as shown in Figure 13. The means and standard deviations for each item can be found in Table 12 in appendix G.

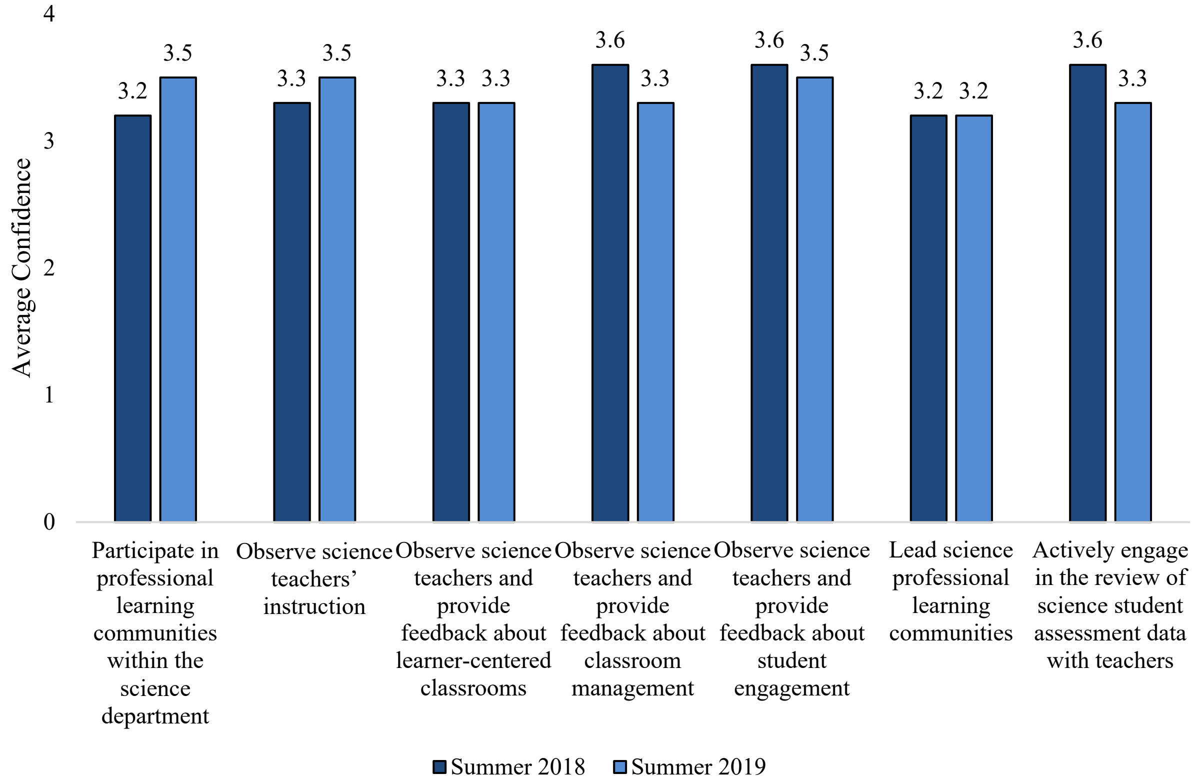


Figure 13. Leaders' Perceived Confidence of Individual STEM PPC Items (Summer 2018 n=9; Summer 2019 n=6)

Figure 14 emphasizes leaders' degree of agreement that their school incorporates nine STEM related practices. In general, school-level items, such as "My school emphasizes to students the importance of STEM", had higher level of agreement among leaders than teacher-level items such as "The science teachers on my campus use project-based learning when teaching science lessons".

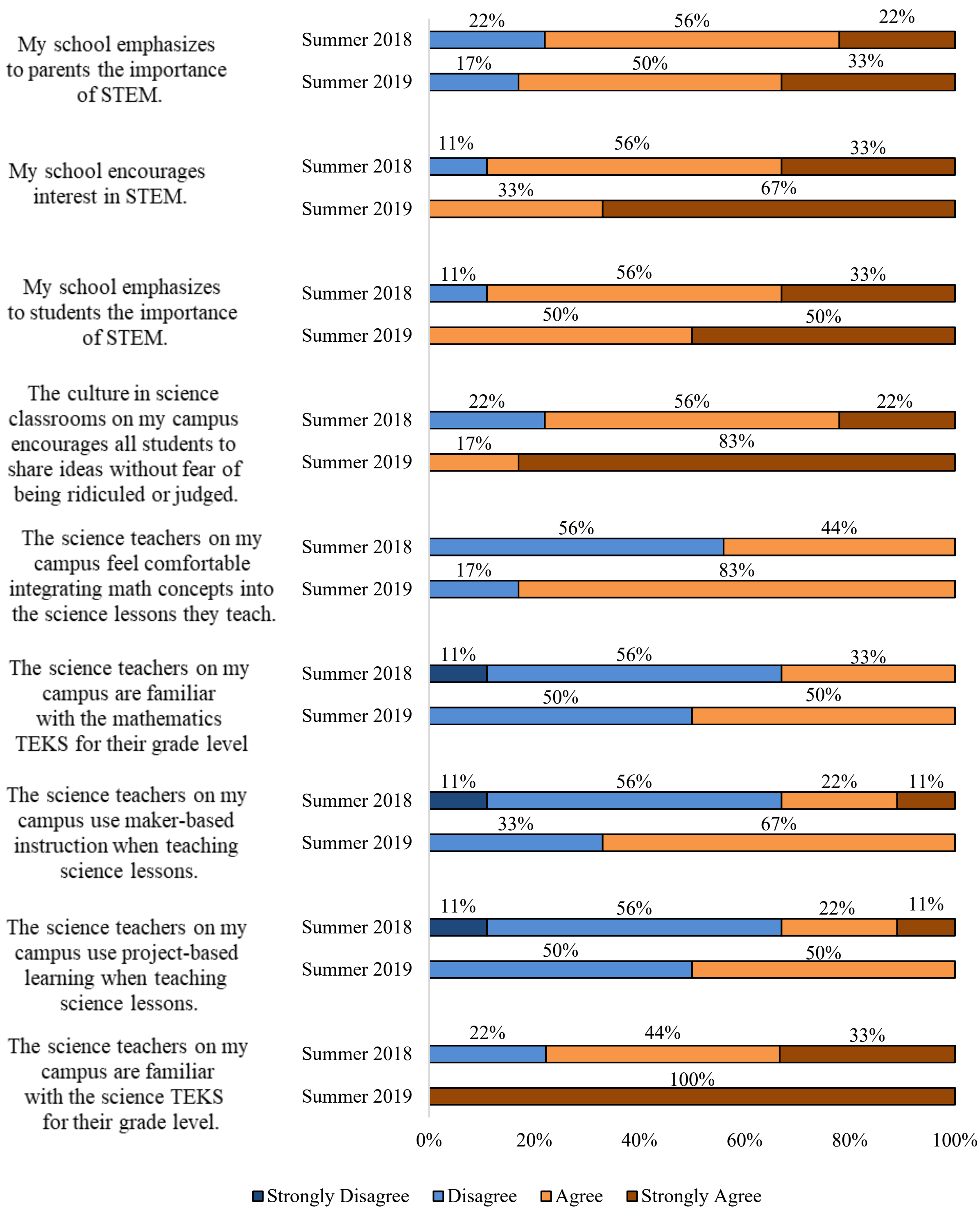


Figure 14. Percent of Leaders by Agreement to Statements about their Campuses (Summer 2018 n=9; Summer 2019 n=6)

Summary

Overall. The majority of the leaders found the Leader Academy and subsequent coaching beneficial. Leaders found the support and conferencing valuable and also appreciated the understanding that they gained about the aspects of high-quality inquiry-based science instruction that their teachers were implementing in the classroom. They felt that the Leader Academy and coaching helped them better support the science instruction occurring on their campuses, which ultimately improved the engagement of both students and parents in STEM.

Leader Academy. Leaders tended to agree with most statements on the leader academy survey in both summer 2018 and spring 2020. In summer 2018, leaders were mostly positive of the leader academy. In a few instances, leaders rated certain items as strongly disagree. An example of such item includes, “The STEM Academy deepened my understanding of team building”. In spring 2020, all five leaders agreed or strongly agreed with all statements, which suggested improvement in the overall quality of the leader academy. It should be noted that only one leader completed the leader academy evaluation survey in both 2018 and 2020 due to changes in school leadership.

Leader Coaching. Across both years, leaders tended to rank “Classroom walk-throughs with your SMU coach” as the most useful aspect of coaching, followed by “conferencing with your SMU coach before and/or after PLCs”. In 2018-19, most leaders either agreed or strongly agreed that STEM Academy activities were valuable, improved their ability to lead science teachers, improved their understanding of the process standards, improved their understanding of high-quality science instruction, and improved their ability to engage students in STEM. In all areas, leaders perceived the STEM Academy as helpful for teachers at their school, and leaders felt confident in assisting science teachers with active-learning strategies. Only two leaders participated in the coaching evaluation survey in 2019-20. The only statement that these two leaders disagreed with was that the aspects of the STEM Academy coaching improved their ability to engage parents in understanding STEM.

STEM PPC. Leaders rated the importance of implementing the practices higher than their confidence in implementing the practice. Compared to leaders in summer 2018, leaders in summer 2019 reported higher frequency of use for the seven items on the STEM PPC survey. Compared to leaders in summer 2018, leaders in summer 2019 reported higher perceived importance of use for six items and remained constant for one item, but all items were rated at or near the top of the scale for all timepoints, indicating a ceiling effect. Compared to leaders in summer 2018, leaders in summer 2019 reported higher frequency of use for two items, remained constant for two items, and decreased for three items, indicating wider variability between either campuses or leaders.

Conclusion and Recommendations

Overall leaders who participated in the STEM Academy found the Leader Academy to be valuable. The opportunity to network with other campus leaders and get training in the specific inquiry-based techniques that their participating teachers were implementing in the classroom helped them be better prepared to support the teachers at their specific campuses. The leaders reported that the Leader Academy helped them better understand both the scientific process standards and the resources that the participating teachers needed to engage in high-quality inquiry-based science instruction. This improved understanding made them better equipped to support the teachers at their individual campuses and should translate to improved outcomes for students and teachers.

The leaders also felt strongly that the STEM Academy had improved the teachers at their campuses' ability to deliver science instruction using a variety of inquiry-based pedagogical strategies. Most leaders also felt that the STEM Academy was improving an emphasis on STEM instruction and careers, although this is an area that could still be improved upon. Additionally, outreach to parents was considered important, but was identified as an opportunity for improvement.

Finally, an interesting division emerged between leaders' perceptions about their campuses in general and the science teachers at their campuses specifically. Leaders saw their schools as encouraging interest in STEM and emphasizing the importance of STEM to students and parents, but did not always agree that the teachers were employing the inquiry-based methods (i.e. PBL and MBI). While it is important for a campus to have an encouraging culture towards STEM, it is also important that science teachers employ inquiry-based pedagogies. It is possible that many leaders are more attuned to the external factors, such as parents, and are therefore able to recognize and rate the level of engagement and participation in these groups. The difference in leader perceptions of engagement in school and classroom STEM practices warrants further investigation in future work.

Ultimately, future implementations of the STEM Academy should continue to engage and coach campus leaders. Ideally, these leaders should be able to spend a significant amount of time observing, coaching, and supporting their campus science teachers. Three recommendations for improving the Leader Academy in the future are suggested, based on the results and analysis within this report.

1. Only three leaders participated in the book study, and all three leaders who participated found it valuable overall. In the future, project staff should clearly communicate time commitments to leaders. Since participants found the experience beneficial, the recommendation would be to first increase participation before deciding whether this aspect of the STEM Academy warrants modification.

2. A second recommendation for the STEM Academy would be to encourage continuity in leader participation across years. If continuity is not possible due to leaders' changing roles at the campuses, the project team should prepare to incorporate new leaders every year and should have a plan to integrate new leaders into the program.

3. Finally, the components that leaders ranked as most valuable typically included an aspect of conferencing with the SMU coach. Whether it was conducting walkthroughs with the coach or pre and post conferencing about a PLC meeting, the leaders reported that these supportive coaching interactions were the most useful. Future iterations of the STEM Academy should continue to include a significant conferencing and coaching component

for the campus leader, in order to facilitate positive outcomes at the teacher and student levels.

References

Adams, E. L., Hatfield, C., Cox, C. T., Mota, A., Sparks, A., & Ketterlin-Geller, L. R. (2018). *STEM Academy for Teachers and Leaders: 2017-18 Coaching and PLC Evaluation* (Tech. Rep. No. 18-03). Dallas, TX: Southern Methodist University, Research in Mathematics Education.

Adams, E. L., Hatfield, C., Cox, C. T., & Ketterlin-Geller, L. R. (2018). *STEM Academy for Science Teachers and Leaders: 2018 Teacher Academy I Evaluation* (Tech. Rep. No. 18-02). Dallas, TX: Southern Methodist University, Research in Mathematics Education.

Bevan, B., Gutwill, J. P., Petrich, & Wilkinson, K. (2014). Learning through STEM-rich tinkering: Findings from a jointly negotiated research project taken up in practice. *Science Education, 99*(1), 98-120.

Capraro, R. M., Capraro, M. M., & Morgan, J. R. (2013). *STEM project-based learning.* New York, NY: Springer.

DeJarnette, N. (2012). America's children: Providing early exposure to STEM (science, technology, engineering and math) initiatives. *Education*, *133*(1), 77-84.

Downey, C. J., Steffy, B., English, F., Frase, L. & Poston, W. K. Jr., (2004). *The three-minute classroom walk-through: Changing school supervisory practice one teacher at a time.* Thousand Oaks, CA: Corwin Press

Drago-Severson, E., & Blum-DeStefano, J. (2018). *Leading change together: Developing educator capacity within schools and systems*. ASCD.

DuFour, R. (2004). What is a "professional learning community"?. *Educational Leadership*, *61*(8), 6-11.

Easton, L.B. (2009). *Protocols for professional learning*. Alexandria, VA: ASCD.

Geier, R., Blumenfeld, P. C., Marx, R. W., Krajcik, J. S., Fishman, B., Soloway, E. & Clay-Chamber, J. (2008). Standardized test outcomes for students engaged in inquiry-based science curricula in the context of urban reform. *Journal of Research in Science Teaching, 45*(8), 922–939.

Ginsberg, M. B. & Murphy, D. (2002). How walkthroughs open doors. *Educational Leadership*, *59*(8), 34-36.

Gray, J. (2005). The Four A’s Text Protocol. Retrieved from https://www.schoolreforminitiative.org/download/four-as-text-protocol/

Honey, M., Pearson, G., & Schweingruber, H. (Eds.). (2014). *STEM integration in K-12 education: Status, prospects, and an agenda for research* (Vol. 500). Washington, DC: National Academies Press.

Jennings, P., & Greenberg, M. (2009). The Prosocial Classroom: Teacher Social and Emotional Competence in Relation to Student and Classroom Outcomes. *Review of Educational Research*, *79*(1), 491–525. https://doi.org/10.3102/0034654308325693

Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development*. FT press.

Krummeck, K., & Rouse, R. (2017). Can you dig it? Designing to support a robust maker culture in a university makerspace. *International Journal of Design for Learning, 8*(1), 98-111.

Lynch, S. J., Burton, E. P., Behrend, T., House, A., Ford, M., Spillane, N., Matray, S., Han, E., & Means, B. (2018). Understanding inclusive STEM high schools as opportunity structures for underrepresented students: Critical components. *Journal of Research in Science Teaching*, *55*(5), 712-748.

Marshall, J. C. & Alston, D. M. (2014). Effective, sustained inquiry-based instruction promotes higher science proficiency among all groups: A five-year analysis. *Journal of Science Teacher Education, 25*(7), 807– 821. doi:10.1007/s10972-014-9401-4.

Marshall, J., Smart, J., & Alston, D. (2017). Inquiry-Based Instruction: A Possible Solution to Improving Student Learning of Both Science Concepts and Scientific Practices. *International Journal of Science and Mathematics Education*, *15*(5), 777–796. https://doi.org/10.1007/s10763-016-9718-x

Millar, J. A. (2009). The impact of the Downey walk-through approach on effective instructional leadership practices, teacher self-reflection, and on enhancing student learning.

Minner, D., Levy, A., & Century, J. (2010). Inquiry-based science instruction—what is it and does it matter? Results from a research synthesis years 1984 to 2002. *Journal of Research in Science Teaching*, *47*(4), 474–496. https://doi.org/10.1002/tea.20347

Mota, A., Pierce, K., Hatfield, C., Adams, E., Ketterlin-Geller, L. (2019). *STEM Academy for Science Teachers and Leaders: Coach Training and Development.* Dallas, TX: Research in Mathematics Education, Southern Methodist University.

National Research Council. (2000). *How people learn: Brain, mind, experience, and school: Expanded edition*. National Academies Press.

National Science Board. (2010). *Science and engineering indicators 2010*. Arlington, VA: National Science Foundation.

NRC. (2000). *Inquiry and the national science education standards: A guide for teaching and learning.* Washington, DC: National Academies Press.

Perry, L., Reeder, M.J., Brattain, Hatfield, C., & Ketterlin-Geller, L. (2017). *STEM Academy for Teachers and Leaders: 2017 Academy Evaluation.* Dallas, TX: Research in Mathematics Education, Southern Methodist University.

Pierce, K., Adams, E.L., Rhone, A.M., Hatfield, C., & Ketterlin-Geller, L. (2019). *STEM Academy for Science Teachers and Leaders: 2018 Teacher Academy II Evaluation* (Tech. Rep. No. 18-07). Dallas, TX: Southern Methodist University, Research in Mathematics Education.

Pierce, K., Cox, C.T., Hatfield, C., Adams, E. L., & Ketterlin-Geller, L. (2019). *STEM Academy for Science Teachers and Leaders: 2019 Teacher Academy 3 Evaluation* (Tech. Rep. No. 19-08). Dallas, TX: Southern Methodist University, Research in Mathematics Education.

Reiss, K. (2012). *Be a Changemaster: 12 Coaching Strategies for Leading Professional and Personal Change*. Corwin Press.

Roach, A., Kratochwill, T., & Frank, J. (2009). School-Based Consultants as Change Facilitators: Adaptation of the Concerns-Based Adoption Model (CBAM) to Support the Implementation of Research-Based Practices. *Journal of Educational and Psychological Consultation.*, *19*(4), 300–320. https://doi.org/10.1080/10474410802463304Sawyer, R. K. (2006). The new science of learning. *The Cambridge handbook of the learning sciences*, *1*, 18.

Smithsonian (2018). *The STEM Imperative.* Retrieved December 12, 2018 from https://ssec.si.edu/stem-imperative

Venables, D. R. (2011). *The practice of authentic PLCs: A guide to effective teacher teams*. Retrieved from http://ebookcentral.proquest.com

Appendix A – Protocols Used During 2019-20 PLCs

Traffic Jam

A team-building activity that mirrors the characteristics of a PLC.

Time allotted: 45 minutes (25 minutes for task, 20 minutes for debrief/discussion)

Materials: 7 mouse pads, cardstock paper, or masking tape to mark off the "stones"

Participants: 6 volunteers

There are seven stepping stones placed on the floor in a line, with spaces between them. On the three left-hand stones, facing right, stand three of the people. The other three people stand on the three right-hand stones, and face left. The center stone is not occupied to start.

The challenge: exchanging places

Participants move so that the people originally standing on the right-hand stepping stones end up on the left-hand stones, and those originally standing on the left-hand stepping stones end up on the right-hand stones, with the center stone again unoccupied.

The rules:

- After each move, each person must be standing on a stepping stone.
- Participants may only move forward, in the direction they originally face.
- There are two ways to move forward:
    - Participants may *jump* one person if there is an empty stone on the other side. Only one person may be *jumped,* and that person must be facing the *jumper.* (i.e., someone from the other side of three).
    - Participants may *slide* to an empty stone directly in front of them.
- If the group finds itself in a "traffic jam," participants must go *all the way back* to the starting position and try again. They may *not* simply redo the last few moves.

Explanation:
https://www.youtube.com/watch?v=KizRWfuT5uQ

Compass Points

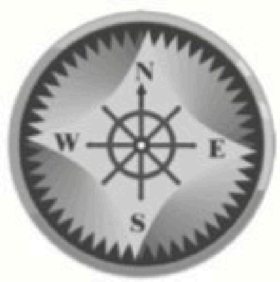
An exercise in understanding preferences in group work. Developed in the field by educators affiliated with the National School Reform Faculty (NSRF).

Time: 35 minutes

1. The room is divided into four sections: North, South, East, and West.
2. PLC members are asked to place themselves at one of the four stations based on their style in working as part of a group (see below). It is worth noting that most teachers see themselves as some combination of these four; they should nonetheless commit to one that is most dominant in their style. (3 minutes)

North
Acting–"Let's do it."
Likes to act, try things, plunge in

West
Attention to Detail–Likes to know the who, what, when, where and how before acting



East
Speculating–Likes to look at the big picture and possibilities before acting

South
Feeling–Likes to know that everyone's feelings have been taken into consideration and that their voices have been heard before acting

3. At each Compass Point, the teachers answer the following and post their group responses on chart paper. (20 minutes)
   a. List three strengths of your style.
   b. List three limitations of your style.
   c. Which style do you find most difficult to work with and why?
   d. What do people from other styles need to know about you so you can work together effectively?
   e. What do you value about each of the other three styles?
4. The group of teachers at each Compass Point shares out to the large group. (12 minutes)

Peeves & Traits Protocol

Time: 20 minutes

1. Participants are each given an index card (5″ × 7″).
2. On one side of the card, participants write down *one* pet peeve they have regarding working in groups or at teacher meetings. They begin their pet peeve with the following phrase:

"It burns my butt when . . ."

(e.g., *"It burns my butt when people come late to meetings,"* or *"It burns my butt when people are interrupted during discussions,"* or *"It burns my butt when one person does all the talking,"* etc.) (5 minutes)

3. On the other side of the card, participants write *one* trait about themselves that everyone in the group should know about them in order to work best with them in a group setting. They begin their trait with the following phrase:

"One thing you all should know about me is . . ."

(e.g., *"One thing you all should know about me is that my silence is not due to disinterest; I just need process time,"* or *"One thing you all should know about me is I get excited during discussions and sometimes people are put off by my enthusiasm,"* or *"One thing you all should know about me is I am very visual and need to see on chart paper or on the Smart Board what we're discussing,"* etc.) (5 minutes)

4. Participants share both sides of their card in volunteer order without discussion (or elaborating on the card). (10 minutes)

Norm-Setting Protocol

Time: 60 minutes

1. The coach gives participants three index cards (5″ × 7″) and a black marker.
2. Writing on only one side of the card, participants write down *one* group norm they would like to see. No more than one norm per card; participants can write as many cards as they like. (5 minutes)
3. The coach collects all cards and randomly passes them out to participants. Each participant reads the cards she has been given and other participants share their card if theirs is the same or closely related to the one being read. As cards are read, they are collected by the facilitator and posted in groups of like norms (e.g., "respect," "disagreements," "agenda," etc.). Discussion is limited to grouping norms and identifying similarities between norms. (20 minutes)
4. *Dissent option.* After the coach posts all cards into categories (though some will be "stand alones"), participants can propose to eliminate any norm. If one other participant "seconds" the opinion that a particular norm be eliminated, the index card of that norm is removed. (5 minutes)
5. As a whole group, the facilitator leads a discussion of condensing each group of norms into a single norm (without stringing them all together with the use of "and"). The goal is to word a single norm that captures the essence of the group of like norms. (30 minutes)
6. *Next steps.* The facilitator asks for a volunteer to do whatever "wordsmithing" is still needed for the norms, after the meeting. The final product is a list of four to six group norms that will govern all discourse in the PLC. [I like to make a poster of the final list and have all PLC members sign the poster. It is then displayed prominently in the meeting room.] Hereafter, the group norms should appear at the bottom of each meeting agenda.

Tuning Protocol

Developed by Joseph McDonald and David Allen.

1. Introduction (5 minutes)
   - Facilitator briefly introduces protocol goals, guidelines, and schedule
   - Participants briefly introduce themselves (if necessary)
2. Presentation (15 minutes)

   The presenter has an opportunity to share the context for the student work:
   - Information about the students and/or the class—what the students tend to be like, where they are in school, where they are in the year
   - Assignment or prompt that generated the student work
   - Student learning goals or standards that inform the work
   - Samples of student work—photocopies of work, video clips, etc.—with student names removed
   - Evaluation format—scoring rubric and/or assessment criteria, etc.
   - Focusing question for feedback
   - Participants are silent; no questions are entertained at this time
3. Clarifying Questions (5 minutes)
   - Participants have an opportunity to ask "clarifying" questions in order to get information that may have been omitted in the presentation that they feel would help them to understand the context for the student work. Clarifying questions are matters of "fact."
   - The facilitator should be sure to limit the questions to those that are "clarifying," judging which questions more properly belong in the warm/cool feedback section.
4. Examination of Student Work Samples (15 minutes)
   - Participants look closely at the work, taking notes on where it seems to be in tune with the stated goals, and where there might be a problem. Participants focus particularly on the presenter's focusing question.
   - Presenter is silent; participants do this work silently.
5. Pause to reflect on warm and cool feedback (2–3 minutes)
   - Participants take a couple of minutes to reflect on what they would like to contribute to the feedback session.
   - Presenter is silent; participants do this work silently.
6. Warm and Cool Feedback (15 minutes)
   - Participants share feedback with each other while the presenter is silent. The feedback generally begins with a few minutes of warm feedback, moves on to a few minutes of cool feedback (sometimes phrased in the form of reflective questions), and then moves back and forth between warm and cool feedback.
   - Warm feedback may include comments about how the work presented seems to meet the desired goals; cool feedback may include possible "disconnects," gaps, or problems. Often participants offer ideas or suggestions for strengthening the work presented.
   - The facilitator may need to remind participants of the presenter's focusing question, which should be posted for all to see.
   - Presenter is silent and takes notes.
7. Reflection (5 minutes)
   - Presenter speaks to those comments/questions he or she chooses while participants are silent.
   - This is not a time to defend oneself, but is instead a time for the presenter to reflect aloud on those ideas or questions that seemed particularly interesting.
   - Facilitator may intervene to focus, clarify, etc.
8. Debrief (5 minutes)
   - Facilitator-led discussion of this tuning experience.

Consultancy Protocol

The Consultancy Protocol was developed by Gene Thompson-Grove, Paula Evans, and Faith Dunne as part of the Coalition of Essential Schools' National Re:Learning Faculty Program, and further adapted and revised as part of the work of NSRF.

A consultancy is a structured process for helping an individual or a team think more expansively about a particular, concrete dilemma.

Time: Approximately 50 minutes

Roles:

Presenter (whose work is being discussed by the group)

Facilitator (who sometimes participates, depending on the size of the group)

1. The presenter gives an overview of the dilemma with which s/he is struggling, and frames a question for the consultancy group to consider. The framing of this question, as well as the quality of the presenter's reflection on the dilemma being discussed, are key features of this protocol. If the presenter has brought student work, educator work, or other "artifacts," there is a pause here to silently examine the work/documents. The focus of the group's conversation is on the dilemma. (5–10 minutes).

2. The Consultancy group asks clarifying questions of the presenter—that is, questions that have brief, factual answers. (5 minutes)

3. The group asks probing questions of the presenter. These questions should be worked so that they help the presenter clarify and expand his/her thinking about the dilemma presented to the Consultancy group. The goal here is for the presenter to learn more about the question s/he framed or to do some analysis of the dilemma presented. The presenter may respond to the group's questions, but there is no discussion by the consultancy group of the presenter's responses. At the end of the 10 minutes, the facilitator asks the presenter to restate his/her question for the group. (10 minutes)

4. The group talks with each other about the dilemma presented. (15 minutes)

   Possible questions to frame the discussion:

   What did we hear?

   What didn't we hear that we think might be relevant?

   What assumptions seem to be operating?

   What questions does the dilemma raise for us?

   What do we think about the dilemma?

   What might we do or try if faced with a similar dilemma? What have we done in similar situations?

Members of the group sometimes suggest actions the presenter might consider taking. Most often, however, they work to define the issues more thoroughly and objectively. The presenter doesn't speak during this discussion, but instead listens and takes notes.

5. The presenter reflects on what s/he heard and on what s/he is now thinking, sharing with the group anything that particularly resonated for him or her during any part of the Consultancy. (5 minutes)

6. The facilitator leads a brief conversation about the group's observation of the Consultancy process. (5 minutes)

Charette Protocol

Original written by Kathy Juarez, Piner High School, Santa Rosa, California.
Revised by Gene Thompson-Grove, January 2003, NSRF.
Revised by Kim Feicke, October 2007, NSRF.

The following list of steps attempts to formalize the process for others interested in using it.

1. A team or an individual requests a charette when
   a. the team/individual is experiencing difficulty with the work,
   b. a stopping point has been reached, or
   c. additional minds (thinkers new to the work) could help move it forward.

2. A group, ranging in size from three to six people, is formed to look at the work. A moderator/facilitator is designated from the newly formed group. It is the moderator's job to observe the charette, record information that is being created, ask questions along the way, and occasionally summarize the discussion.

3. The requesting team/individual presents its "work in progress" while the group listens. (There are no strict time limits, but this usually takes 5 or 10 minutes.) Sometimes, the invited group needs to ask two or three clarifying questions before moving on to step 4.

4. The requesting team/individual states what it needs or wants from the charette, thereby accepting responsibility for focusing the discussion. The focus is usually made in the form of a specific request, but it can be as generic as "How can we make this better?" or "What is our next step?"

5. The invited group then discusses while the requesting team/individual listens and takes notes. There are no hard and fast rules here. Occasionally (but not usually) the requesting team/individual joins in the discussion process. The emphasis is on improving the work, which now belongs to the entire group. The atmosphere is one of "we're in this together," and our single purpose is "to make a good thing even better."

6. When the requesting team/individual knows it has gotten what it needs from the invited group, they stop the process, briefly summarize what was gained, thank the participants and moderator, and return to the "drawing board."

7. Debrief the process as a group.

Notice & Wonder Protocol—Student Work

A protocol for analyzing and discussing student work.

Time: 45 minutes

1. Participants are presented with a sample of student work pertaining to their practice. This might be a single piece of work from one student copied for all participants or class samples of the same assignment, with each participant getting an individual student's work. It generally provides richer discussion if the work is corrected or scored by the presenting teacher.

2. The presenter of the work briefly provides the context in which the work was assigned (e.g., grade level of students, description of the unit on which the students were working, prior knowledge of students, how long the students were given to complete the work, etc.). *Participants are silent and take notes.* (5 minutes)

3. The participants ask clarifying questions of the presenter. These are questions that provide information that participants feel they need to better understand the context. The presenter answers each clarifying question briefly, in a sentence or two. (5 minutes)

4. Each participant is given a 5″ × 7″ index card. Quietly and individually, participants write three observations evident in the work sample. These observations must be free of inference or speculation; they are factually based from objectively examining the work sample. Each observation starts with the phrase, *"I notice that. . . ."* (5 minutes)

5. *Round 1.* In turn, each participant reads aloud one new observation that has not yet been shared, each time beginning with the phrase, *"I notice that . . . ."* After the last participant shares one new observation, the first participant offers a second new observation and the process continues until all observations have been shared aloud, *without discussion. The presenter is quiet and takes notes*. (5 minutes)

6. Each participant turns over his index card and quietly writes three suggestions or question-statements based on any observations heard in Round 1. These comments attempt to offer possible suggestions or pose questions for the presenter to think about. No attempt should be made to *evaluate* the work or the assignment; the intent is for the presenter to gain insights into how to strengthen the assignment or the method used to score the assignment. Each comment starts with the phrase, *"I wonder if . . . ."* (5 minutes)

7. *Round 2.* In turn, each participant reads aloud one new thought that has not yet been shared, each time beginning with the phrase, *"I wonder . . . ."* This process continues as in Round 1 until all speculations have been shared aloud, *without discussion. The presenter is quiet and takes notes*. (10 minutes)

8. *Reflection.* The presenter quietly reviews her notes and then reflects aloud to the group any thoughts related to the comments she heard. *The participants are silent*. (5 minutes)

9. *Debrief.* The team now debriefs the *process* and refrains from additional comments pertaining to the student work samples. (5 minutes)

Appendix B – Leader Academy Presenter Biographies

Cassandra Hatfield: Cassandra received her B.S. in Interdisciplinary Studies - Mathematics from Texas A&M University Commerce and her M.Ed. in Leadership of Learning from Abilene Christian University where she received certification as a K-12 Principal and in Conflict Resolution. Prior to arriving at SMU, she served as an Elementary Math Specialist for two area school districts. Her primary role was to support campus administrators with coaching teachers in pedagogy, including classroom discourse and mathematical content, as well as writing district curriculum and assessments. She has taught 4th - 8th grade mathematics and worked on various national, state, and local assessment projects.

Alain Mota: Alain Mota is the STEM Development and Implementation Coordinator at RME. He has a Master of Science in Interdisciplinary Studies (Environmental Engineering/Geophysics/Public Health) and is a current graduate student Master of Fine Arts Design and Innovation. 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 part of SMU's STEM Academy for Science Teachers and Leaders initiative, 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.

Appendix C – Academy Topic Definition Posters and Diagrams

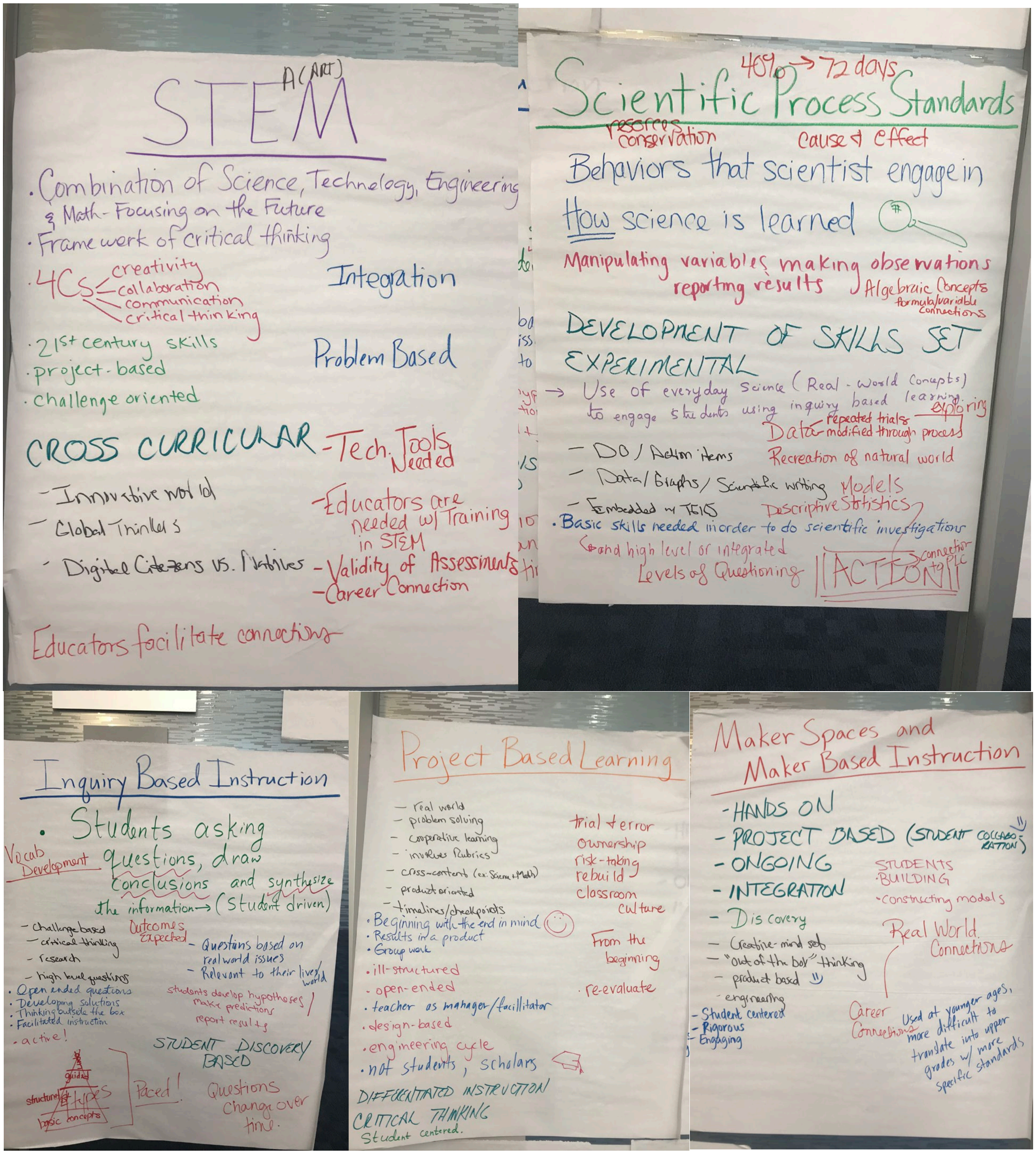


Figure 15. Posters developed during the Leader Academy to define five different essential components of the STEM Academy.

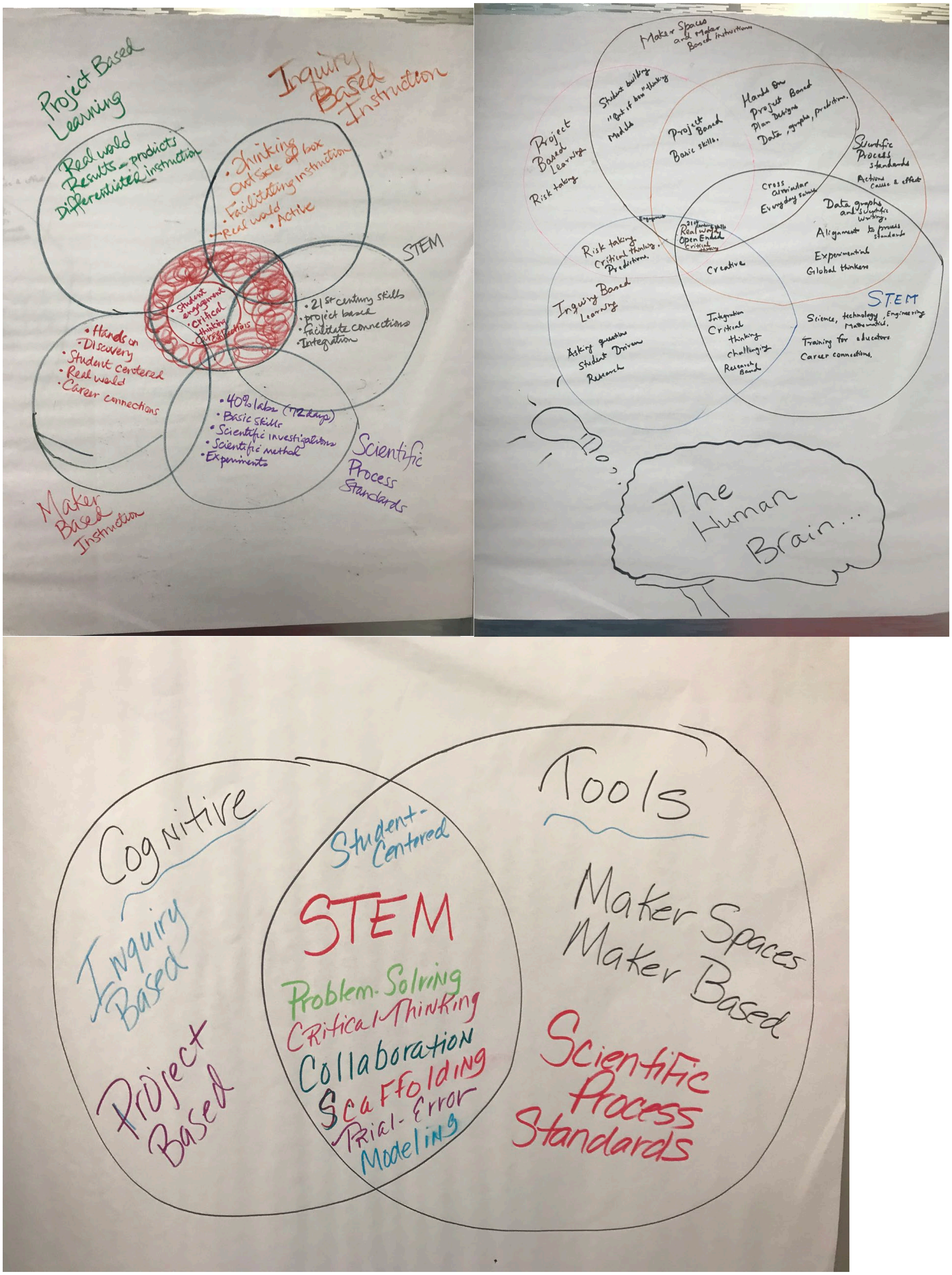


Figure 16. Venn Diagrams connecting the five essential components of the STEM Academy.

Appendix D – Perspectives on Learning Environments Posters

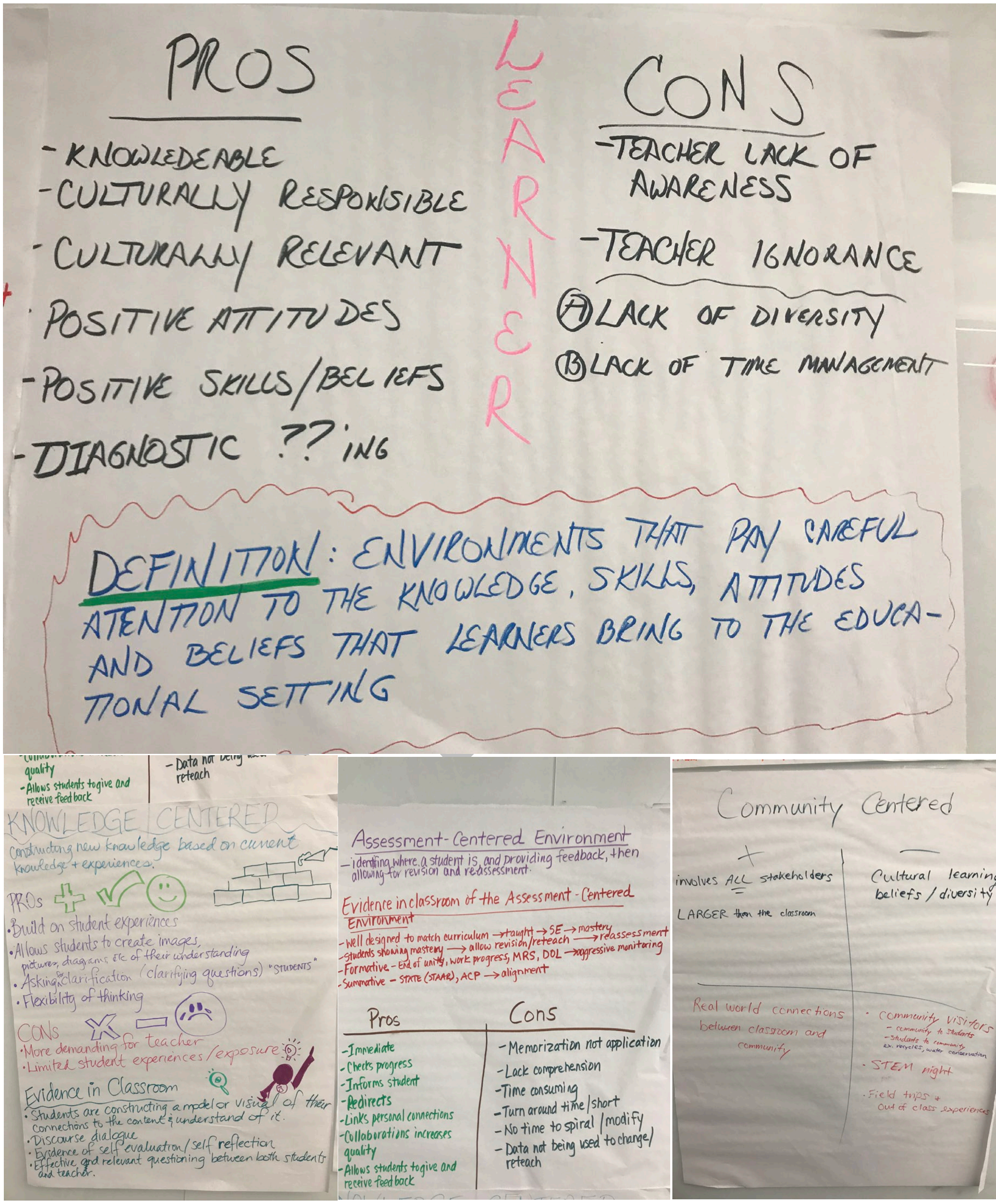


Figure 17. Posters developed by leaders about the four different perspectives on learning environments, including the definition, evidence, pros, and cons.

Appendix E – PLC Key Question Posters

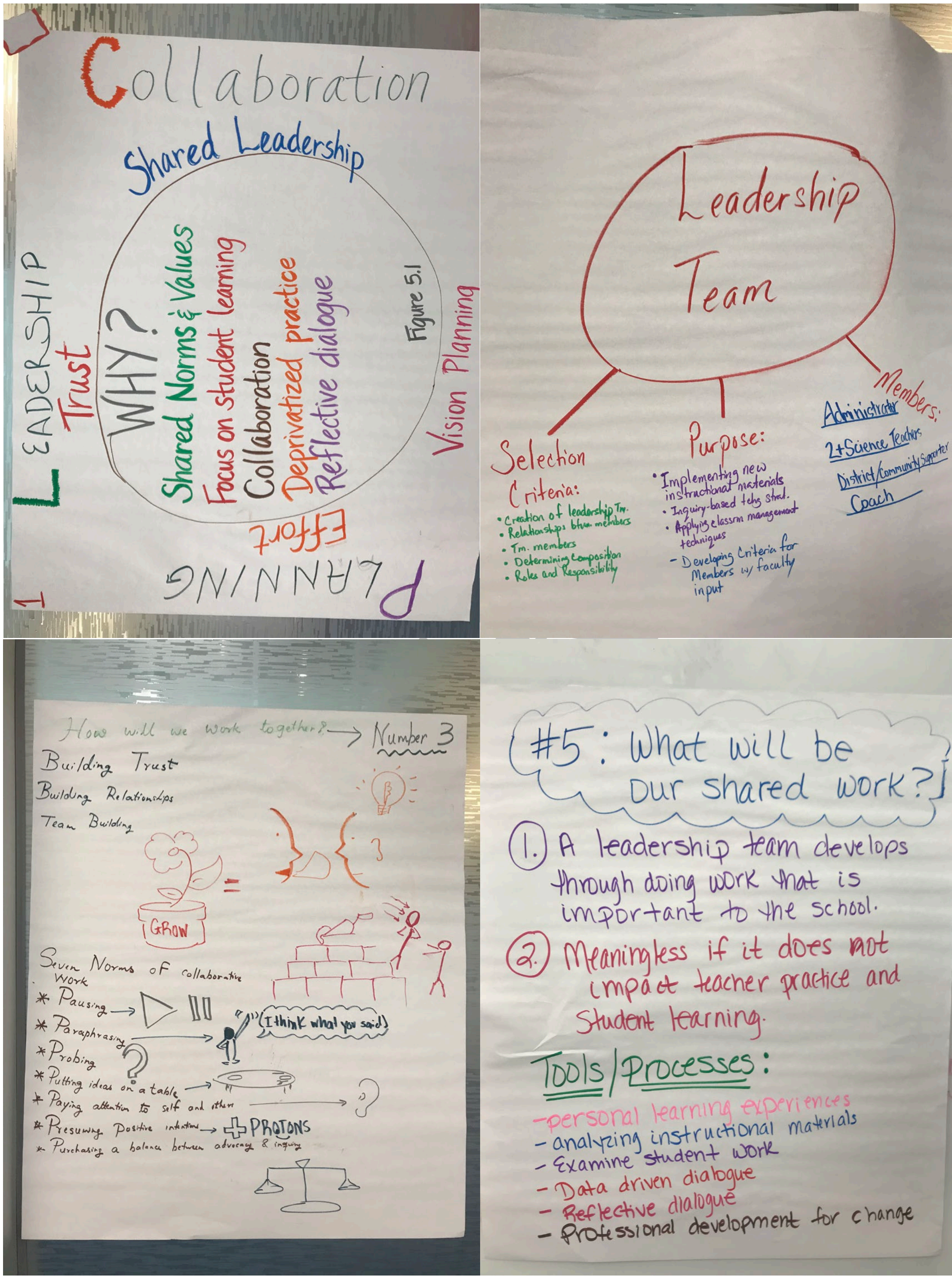


Figure 18. Posters developed by the leaders to share their reflections and ideas about an essential question for PLC development.

Appendix F – 2019-20 Leader Coaching Forms

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Leader Pre-Conference Form

Name:	Date	
School:	Elapsed Time	Date:
Have you been able to visit teachers?		
Last time we talked about following up with the teachers [describe the follow up]. How did that go?		
Based on your follow-up this last month, what are your "look-for" during our observations?		
What process standards are you anticipating we will see during our observations?		
Last time your follow up action items after the PLC were []. How did that go?		
How are your weekly PLCs going? What is going well? What are some challenges?		
Our initial plans for this month's PLC was []? Is this a good starting place?		
What protocol would you like to deploy this cycle?		
Who is bringing the lesson plan, student work, or teacher video to use during the protocol?		
What is your role, teacher's role, and my role in the protocol?		
Optional follow up questions: How can I best support (e.g. Co-facilitate, take notes, etc.)		

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STEM Academy Campus Summary

Campus:	Date:
Attendees:	

Grade Levels:	PLC Start Time:	PLC End Time:
Who Facilitated PLC (circle): Teacher	School Leader	SMU Coach

PLC Topic (Circle relevant topic)				
Active learning (e.g., MBI, PBL, 5E Model)	Science content delivery	Strategies for diverse learners (e.g., SEL, ELLs)	STEM culture and careers	Other:

Protocol used during PLCs (Circle relevant protocol)							
Compass Points	Peeves & Traits	Norm Setting	Tuning	Consultancy	Charette	Notice & Wonder	Lead Teacher Development

Task (circle what was done)				
Looking at student work	Looking at teacher lesson plans	Looking at classroom video footage	Other:	Lead Teacher Development

Leader meeting occurrence (Circle what happened and document number of minutes				
Pre # of minutes: __	PLC	Classroom Observations # of teachers: ___	Post # of minutes: __	Singleton Campus (no leader engagement)

If Pre, PLC, Classroom Observation, or Post is not checked above please describe the reason for meeting not occurring unless it is a singleton campus: Communication attempts (dates and times):

PLC Agenda/Notes	Teacher PLC action steps
Content TEKS	Process TEKS
In Qualtrics[ ]	

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Leader Reflection

Leader________________Campus________________Coach_____________Date__________

Tell me about the highlights of the observation.
What is your reflection on the "look fors" for each teacher? What evidence do you have of this?
What evidence of active learning and process standards did you see in the lesson?
What would you like the teacher to improve or change?
What are the new goals that you have for the teacher based on our observation?
How do you plan to follow up with the teacher (goal setting session, co facilitation, PLC reflections, student artifact analysis)?
How do you think the PLC went?
What are your follow up action items based on today's PLC between now and the next time I come?
What is our goal for my next visit?

Appendix G – Data Tables

Table 10

Leader Academy Evaluation Over Time

Item	Summer 2018						2019-20					
	n	Mean (SD)	# (%) Strongly disagree	# (%) Disagree	# (%) Agree	# (%) Strongly Agree	n	Mean (SD)	# (%) Strongly disagree	# (%) Disagree	# (%) Agree	# (%) Strongly Agree
The STEM Leader Academy was a valuable professional development opportunity.	9	3.3 (1.00)	1 (11 %)	0 (0%)	3 (33%)	5 (56%)	5	3.8 (0.45)	0 (0%)	0 (0%)	1 (20%)	4 (80%)
The knowledge I gained at the STEM Leader Academy will help me in the support of science instruction at my campus.	9	3.3 (1.0)	1 (11%)	0 (0%)	3 (33%)	5 (56%)	5	4.0 (0.0)	0 (0%)	0 (0%)	0 (0%)	5 (100%)
The content of the STEM Leader Academy met my expectations.	9	3.2 (1.09)	1 (11%)	1 (11%)	2 (22%)	5 (56%)	5	4.0 (0.0)	0 (0%)	0 (0%)	0 (0%)	5 (100%)
The structure of the STEM Leader Academy enhanced my understanding of the science content for middle school.	9	3.4 (0.73)	0 (0%)	1 (11%)	3 (33%)	5 (56%)	5	4.0 (0.0)	0 (0%)	0 (0%)	0 (0%)	5 (100%)
I will share the knowledge I gained from the STEM Leader Academy experiences with my colleagues.	9	3.6 (0.53)	0 (0%)	0 (0%)	4 (44%)	5 (56%)	5	3.8 (0.45)	0 (0%)	0 (0%)	1 (20%)	4 (80%)
The STEM Leader Academy deepened my understanding of STEM integration in middle school.	9	3.4 (0.73)	0 (0%)	1 (11%)	3 (33%)	5 (56%)	5	3.8 (0.45)	0 (0%)	0 (0%)	1 (20%)	4 (80%)
The STEM Leader Academy deepened my understanding of project-based learning.	9	3.3 (0.71)	0 (0%)	1 (11%)	4 (44%)	4 (44%)	5	3.8 (0.45)	0 (0%)	0 (0%)	1 (20%)	4 (80%)
The STEM Leader Academy deepened my understanding of maker-based instruction.	9	3.2 (0.67)	0 (0%)	1 (11%)	5 (56%)	3 (33%)	5	3.4 (0.55)	0 (0%)	0 (0%)	3 (60%)	2 (40%)
The STEM Leader Academy deepened my understanding	9	3.4 (0.73)	0 (0%)	1 (11%)	3 (33%)	5 (56%)	5	3.8 (0.45)	0 (0%)	0 (0%)	1 (20%)	4 (80%)

Item	Summer 2018 n	Mean (SD)	# (%) Strongly disagree	# (%) Disagree	# (%) Agree	# (%) Strongly Agree	2019-20 n	Mean (SD)	# (%) Strongly disagree	# (%) Disagree	# (%) Agree	# (%) Strongly Agree
of non-traditional classroom observation tools/methods.												
The STEM Leader Academy deepened my understanding of team building.	9	3.0 (1.0)	1 (11%)	1 (11%)	4 (44%)	3 (33%)	5	3.6 (0.55)	0 (0%)	0 (0%)	2 (40%)	3 (60%)
The STEM Leader Academy deepened my understanding of administrative roles in support of STEM education.	9	3.7 (0.50)	0 (0%)	0 (0%)	3 (33%)	6 (67%)	5	3.8 (0.45)	0 (0%)	0 (0%)	1 (20%)	4 (80%)
The STEM Leader Academy deepened my understanding of supporting diverse learners.	9	3.3 (0.71)	0 (0%)	1 (11%)	4 (44%)	4 (44%)	5	3.2 (0.45)	0 (0%)	0 (0%)	4 (80%)	1 (20%)
The STEM Leader Academy provided me with the tools I need to apply the principles of project-based learning.	9	3.0 (0.87)	1 (11%)	0 (0%)	6 (67%)	2 (22%)	5	3.8 (0.45)	0 (0%)	0 (0%)	1 (20%)	4 (80%)
The STEM Leader Academy provided me with the tools I need to apply the principles of maker-based instruction.	9	3.1 (0.60)	0 (0%)	1 (11%)	6 (67%)	2 (22%)	5	3.4 (0.55)	0 (0%)	0 (0%)	3 (60%)	2 (40%)
The STEM Leader Academy provided me with the tools I need to apply the principles of non-traditional classroom observation.	9	3.1 (0.60)	0 (0%)	1 (11%)	6 (67%)	2 (22%)	5	3.6 (0.55)	0 (0%)	0 (0%)	2 (40%)	3 (60%)
The STEM Leader Academy provided me with the tools I need to apply the principles of crucial conversations.	9	3.2 (0.44)	0 (0%)	0 (0%)	7 (78%)	2 (22%)	5	3.8 (0.45)	0 (0%)	0 (0%)	1 (20%)	4 (80%)
The STEM Leader Academy deepened my understanding of time management.							5	3.6 (0.55)	0 (0%)	0 (0%)	2 (40%)	3 (60%)
The STEM Leader Academy deepened my understanding of developing professional learning communities (PLCs).							5	4.0 (0.0)	0 (0%)	0 (0%)	0 (0%)	5 (100%)
The STEM Leader Academy deepened my understanding							5	3.8 (0.45)	0 (0%)	0 (0%)	1 (20%)	4 (80%)

Item	Summer 2018						2019-20					
	n	Mean (SD)	# (%) Strongly disagree	# (%) Disagree	# (%) Agree	# (%) Strongly Agree	n	Mean (SD)	# (%) Strongly disagree	# (%) Disagree	# (%) Agree	# (%) Strongly Agree
of inquiry-based lessons using 5E.												
The STEM Leader Academy provided me with the tools I need to apply the principles of transitional management.							5	3.6 (0.55)	0 (0%)	0 (0%)	2 (40%)	3 (60%)
The STEM Leader Academy provided me with the tools I need to apply the principles of using protocols to facilitate PLCs.							5	3.8 (0.45)	0 (0%)	0 (0%)	1 (20%)	4 (80%)
The STEM Leader Academy provided me with the tools I need to apply the principles of supporting adults as learners.							5	3.6 (0.55)	0 (0%)	0 (0%)	2 (40%)	3 (60%)
The STEM Leader Academy provided me with the tools I need to apply the principles of inquiry-based lessons using 5E.							5	3.8 (0.45)	0 (0%)	0 (0%)	1 (20%)	4 (80%)

Table 11

Summary Statistics for Leaders' Perceived Importance, Confidence, and Frequency as measured on the STEM PPC

Timepoint	**Statistic**	**Importance**		**Confidence**		**Frequency**	
		Sum	Mean	Sum	Mean	Sum	Mean
Summer 2018	Mean	26.0	3.7	23.8	3.4	28.0	5.0
(n=9)	SD	1.2	0.2	2.6	0.4	5.2	0.7
	Min	24	3.4	21	3.0	20	3.9
	Max	28	4.0	28	4.0	35	6.0
Summer 2019	Mean	27.8	4.0	23.7	3.4	34.3	4.9
(n=6)	SD	0.4	0.1	3.6	0.5	2.7	0.4
	Min	27	3.9	20	2.9	30	4.3
	Max	28	4.0	28	4.0	38	5.4
Spring 2020	Mean	27.5	3.9	28.0	4.0	34	4.9
(n=4)	SD	1.0	0.1	0.0	0.0	2.9	0.4
	Min	26	3.7	28	4.0	30	4.3
	Max	28	4.0	28	4.0	37	5.3

Table 12

Means and Standard Deviations for Leaders' Perceived Importance, Confidence, and Frequency over Time on the STEM PPC

Item	Summer 2018				Summer 2019			
	n	Imp.	Conf.	Freq.	n	Imp.	Conf.	Freq.
Participate in professional learning communities within the science department	9	3.8 (.44)	3.2 (.44)	4.3 (1.2)	6	4.0 (0)	3.5 (.55)	5.3 (.52)
Observe science teachers' instruction	9	3.9 (.33)	3.3 (.50)	4.3 (1.1)	6	4.0 (0)	3.5 (.55)	5.0 (.63)
Observe science teachers and provide feedback about learner-centered classrooms	9	3.8 (.44)	3.3 (.50)	3.7 (.87)	6	4.0 (0)	3.3 (.52)	4.8 (.75)
Observe science teachers and provide feedback about classroom management	9	3.6 (.53)	3.6 (.53)	3.8 (1.1)	6	4.0 (0)	3.3 (.52)	4.7 (.52)
Observe science teachers and provide feedback about student engagement	9	4.0 (0.0)	3.6 (.53)	4.3 (1.0)	6	4.0 (0)	3.5 (.52)	4.7 (.52)
Lead science professional learning communities	9	3.1 (.60)	3.2 (.44)	4.1 (1.6)	6	3.8 (.41)	3.2 (.75)	5.3 (.82)
Actively engage in the review of science student assessment data with teachers	9	3.9 (.33)	3.6 (.53)	3.4 (1.2)	6	4.0 (0)	3.3 (.52)	4.5 (.55)

Note for Tables 11 and 12: Means are based on the 7 items included on the survey. Leaders reported the importance of and their confidence in using active learning strategies on a four-point scale where 1= "not confident/important at all", 2= "not very confident/important", 3= "Important/Confident", and 4= "Very important/confident." Leaders reported frequency on a six-point scale where 1 = "Less often than 1 time per month", 2 = "1 time per month", 3 = "2-3 times per month", 4 = "1 time per week", 5 = "2-3 times per week", and 6 = "every day."