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RESEARCH IN MATHEMATICS EDUCATION

STEM Academy for Science Teachers and Leaders: Coaches Training and Development

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Technical Report 19-04

STEM Academy for Science Teachers and Leaders: Coach Training and Development

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Spring 2019

Published by
Southern Methodist University
Department of Education Policy & Leadership
Simmons School of Education & Human Development
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This research was supported by The Texas Instruments Foundation and the O'Donnell Foundation; GT00317. Opinions expressed herein do not necessarily reflect those of The Texas Instruments Foundation, the O'Donnell Foundation or individuals within.

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Abstract

The purpose of this report is three-fold. First, we offer an overview of the ongoing support that a team of instructional coaches provided during the 2018-2019 academic year to teachers and leaders who are a part of the STEM Academy for Science Teachers and Leaders. Second, the training provided for those instructional coaches, which allowed them to fully understand the coaching model utilized during the previous year of ongoing support, is summarized. Finally, this report describes the forms used and the procedures developed when scheduling each coaching cycle for teachers and leaders.

Over the course of the 2018-2019 academic year, seven cycles of coaching occurred, each involving a pre-conference, observation, and post-conference. At schools with systems-level program implementation (e.g., two or more science teachers participating), the leader also participated in a pre-conference, PLC, post-conference, and frequently, classroom walk-throughs. These cycles began in October of 2018 and concluded in May of 2019. The coaches followed developed procedures for both organizing and conducting these meetings.

To begin the training process, each of the prospective coaches completed research compliance courses for working with human subjects. The coaches were also exposed to the science, technology, engineering, and mathematics (STEM) integrated frameworks and the components of inquiry-based instruction, designed and implemented as a part of the professional development for the teachers and leaders in the program. The coaches experienced training focused on engaging in professional relationships as a coach, the observation tool developed for coaching, and finally the use of the pre and post-conferences as part of the coaching cycle for leaders and teachers.

Ongoing co-calibration sessions were used to align the scoring between coaches. Additional training during the PLCs were used to deepen the application of active learning frameworks, social and emotional teaching and learning, and the alignment of Math and Science Process standards. Finally, coaching protocols and forms were streamlined and codified in such a way that their use could be expanded to any district, school, or classroom with the goal of increasing active learning and inquiry-based education for all students.

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STEM Academy for Science Teachers and Leaders: Coach Training and Development

Introduction

The STEM Academy for Science Teachers and Leaders (STEM Academy) project includes two major components for participants. For teachers, an intensive 90-hour summer academy focused on inquiry-based instruction is followed by academic year support comprised of regular on-site coaching and observation with an SMU coach. Each campus that has two or more participating teachers also has a leader participant, typically an instructional coach or assistant principal. The leader attends a two-day professional development workshop during the summer and then receives coaching support throughout the academic year. For additional detail about the project, please reference previous evaluation reports (Adams, Hatfield, Cox, & Ketterlin-Geller, 2018; Adams, Hatfield, Cox, Mota, Sparks, & Ketterlin-Geller, 2018; Perry et al., 2017; Pierce, Adams, Rhone, Hatfield, & Ketterlin-Geller, 2019).

In order to deliver the onsite coaching support during the academic year, STEM Academy staff recruited, trained, and then supported one coach for the 2017-2018 school year and five coaches for the 2018-2019 school year. The initial coach from 2017-2018 was retained as the lead coach for the 2018-2019 school year. The increased number of teachers, leaders, and campuses participating in year two of the project necessitated this expansion; however, the STEM Academy team also recognized the increased need for uniform training and calibration exercises. Since the primary observation tool, the STEM Teacher Observation Protocol (STEM TOP) was also being utilized as a part of the research agenda, it was essential that the coaches approach their classroom observations in as consistent a manner as possible.

Most states are utilizing classroom observations as a component of their teacher evaluation systems and significant focus has been placed on the validity of the weights assigned to these measures (Lazarev & Newman, 2015). Previous studies have found associations between observation scores and class characteristics (Whitehurst, Chingos, & Lindquist, 2014), students of color and free-lunch eligible student populations (Chaplin, Gill, Thompkins, & Miller, 2014), and the grade level being taught (Mihaly & McCaffrey, 2014). Since one major outcome of the STEM Academy project is the development of a classroom observation tool, it was imperative that the coaches be aware of both the importance and constraints of classroom assessment. Additionally, since the coach would be completing the form and logging the data, an understanding of potential bias, the importance of calibration, and the potential future uses of the STEM TOP were relevant. For more detail regarding the development and calibration of the STEM TOP see the *STEM Teacher Observation Protocol Instrument Development* report (Pierce, Hatfield, & Ketterlin-Geller, forthcoming).

This report outlines the model that was presented to the coaches, specific details of the pre-academic year training, and the forms and scheduling procedures that were utilized during the seven observation cycles.

Ongoing Academic Year Support Model

During the academic year of 2018-2019, a team of instructional coaches independently provided ongoing support during the academic year to STEM Academy participants. The ongoing support included, one-on-one coaching for teachers and leaders and professional learning community (PLC) facilitation for teachers. Seven cycles of each support interaction were conducted.

Teacher one-on-one Coaching

The teacher one-on-one coaching began with the coach scheduling a pre-conference approximately 24 hours before an observation and a post-conference within approximately 48 hours of the observation occurring. The pre-conference was intended to probe the teacher to identify aspects of the lesson that would be taught during the observation. It also helped the coach know what to expect during the observation and allowed the coach and teacher to discuss ongoing goals that the teacher had for their classroom.

The observations for each teacher were conducted in the same class period for all seven cycles, and each observation occurred approximately one month apart. The first observations occurred in October and the final observations occurred predominantly in April. Forms used to facilitate the one-on-one coaching are described later in this report.

Leader one-on-one Coaching

For campuses with two or more teachers engaged in the STEM Academy, campus level support was provided by way of the SMU coach meeting with a leader on campus during each cycle. The coach and leader engaged in a pre-conference and a post-conference with similar timelines to the teacher pre- and post-conferences. During the observation day, the leader often attended the PLC meeting (see next section) and participated in classroom walkthroughs with the coach.

The goals of this support were to help the leader identify high quality instruction and determine actions the leader could take to support the STEM Academy participants for the following month. In addition, the coach supported leaders with understanding the requirements of the campus materials allocations.

Professional Learning Community

During the first three cycles, which occurred in the fall semester, the coach attended and observed the PLC meetings at campuses that had two or more teachers participating in the academy. These were led by either the leader or a different individual from the campus. During the leader pre-conference, the coach met with the leader to discuss the content of the PLC and support the planning of the pre-conference. In the leader post-conference, observations with the leader and an action plan for the next month were made.

During the spring semester, the coach led four different PLC meetings for the STEM Academy participants at their campus. Depending on the campus, additional science teachers who were not in the STEM Academy also attended. These were developed by the STEM Academy team and were intended to provide an opportunity for the participating teachers to continue to develop an understanding of and reflect on the pedagogical practices that were discussed at the summer STEM Academy. Action plans were created during the PLC to support how the practices could be used to affect a wide range of students.

For campuses with only one teacher participating in the STEM Academy (single teacher campuses), a PLC was also conducted. During the first cycle of the year, a coach attempted to host a remote PLC with all of the single campus teachers. This proved to be challenging to schedule and have everyone participate due to after school commitments such as tutoring and staff meetings at the campuses. The PLC was redesigned to an online discussion board. The coach identified a reading for the teachers to read. After reading the article, the teachers were asked to post responses to questions and respond to two peers. The assigned reading in the fall was based on areas of growth the coaches identified for the teachers based on the observations. In the spring, the readings aligned to the PLC designed for the campuses with two or more teachers.

Training for Coaches

In year one of the STEM Academy for Science Teachers and Leaders, ongoing support was provided to 15 teachers and a leader from each of six participating schools. All of the coaching was conducted by a single STEM Academy team member. In year two, the program grew to 42 teachers across 15 schools, 10 of which also had a leader participating. Based on the growth in the program, additional staff was needed to provide the ongoing support during the academic year.

The incoming coaches were recruited from various backgrounds, and therefore needed to have training that established a shared understanding of the goals of the program and the coaching model. For more information about the professional background of each coach, see Appendix A.

Initial training for the coaching team occurred before the first cycle in the schools began in October of the 2018-2019 academic year. The training was approximately 35 hours total, and included individual tasks, as well as individual meetings with the lead coach and professional development with the full coaching team. As the first requirement, all coaches were required to complete research compliance training for human subjects.

The training for the coaches provided a baseline of knowledge and desired actions necessary to execute the coaching cycles with each teacher and leader. These were achieved by:

- preparing the coaches to engage in professional discourse grounded in trust and mutual respect,
- developing skills necessary to conduct crucial conversations with a wide range of individuals,

- familiarizing the coaches with the four guiding principles of the academy and informing the coaches of the approach and strategies used throughout the initial year of coaching,
- understanding of the Scientific Process Standards, and their relationship to the frameworks of active learning facilitated during the summer academy, and
- utilizing the Science, Technology, Engineering, and Mathematics Teacher Observation Protocol (STEM TOP) and other discussion facilitation forms as tools and integral parts of the systems of support for the teacher coaching cycles.

Developing Professional Coaching Relationships

The first part of the training for the coaching team focused on building professional relationships with teachers and leaders. This portion of the training used article readings and discussion to pinpoint crucial ideas and actions designed to enable a growth mindset. This portion of the training utilized the work of Jim Knight, a senior research associate at the University of Kansas, considered to be one of the leading researchers in coaching. He has been Co-PI or PI for grants from the Department of Education for the last decade. Two articles were specifically selected, from Knight's larger body of work, to provide a perspective that orients the coaches, the leaders, and the teachers being coached as collegial collaborators. One of the main principles that Knight's work espouses is to consider the teachers as valued sources of knowledge. When coaches acknowledge teachers as collaborators, a culture that is more open to change emerges (Knight, 2011). The ultimate goal of this portion of the training was to provide the coaches with the tools necessary to improve culture at the campus that they would be supporting. Additionally, these strategies are designed to foster positive personal views and experiences with coaching from the participating teachers.

Next, a review of Knight's 2016 lecture, *Examining Factors of Coaching Success*, was utilized to engage in purposeful conversations with the coaching team. The coaches discussed and analyzed the different pathways in which goals are set and how they are used to promote a trust relationship within the teacher-coach team. The coaching team identified actions that promote understanding, while recognizing the complexity of the coach relationship as it pertains to adult professionals as learners. The excerpts from this lecture were used as a baseline to set the expectations for coaching behaviors, including giving teachers authority to determine collaborative goals with the coach and determining next steps in their collaborative work during the cycle.

To further explore each coach's positionality, the coaching team engaged in reflection exercises that allowed them to determine their perceptions of value in the coaching role and the practice habits that are involved in coaching. The coaches categorized six beliefs (Figure 1) in order of importance, to their practice as coaches (Knight, 2015). Each coach discussed their beliefs and their ranking order within their role as a coach with a partner. The partners then discussed beliefs that they shared. After the pair discussion, the entire team reflected together on the beliefs that were common amongst the entire group. The beliefs that differed among the prospective coaches were analyzed, and the reasoning for differing placement was discussed. Each coach had a chance to share their reasoning around their specific arrangement and reflect on the group trends, which served to establish better understanding and create a more cohesive interpretation of their roles as coaches of the academy.

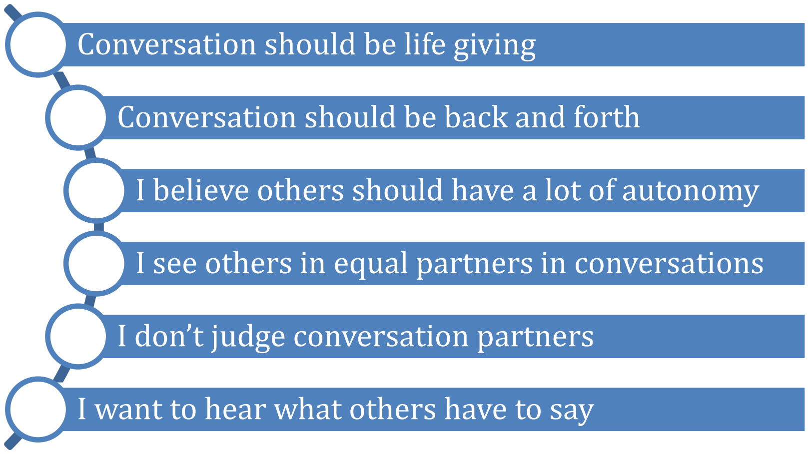

Figure 1 Items representing beliefs about coaching. From Better Conversations: Coaching ourselves and each other to be more credible, caring, and connected *(Knight, 2015).*

During the next training activity, the coaches ranked ten habits (Figure 2) in order of relevance to their practice as coaches (Knight, 2015). The team members individually shared with the group about their thought process in ranking the habits using examples from their own experiences of being coached or as coaches. As a summary exercise, the team members reflected on their level of agreement to the statement “building trust is the main habit,” which was a focal point of the lecture that was viewed at the beginning of the session (Knight, 2016). The lead coach then facilitated the coaching team in developing a common language of how their beliefs and habits would support the conversations with teachers in the STEM Academy as a way of concluding the training on this topic.

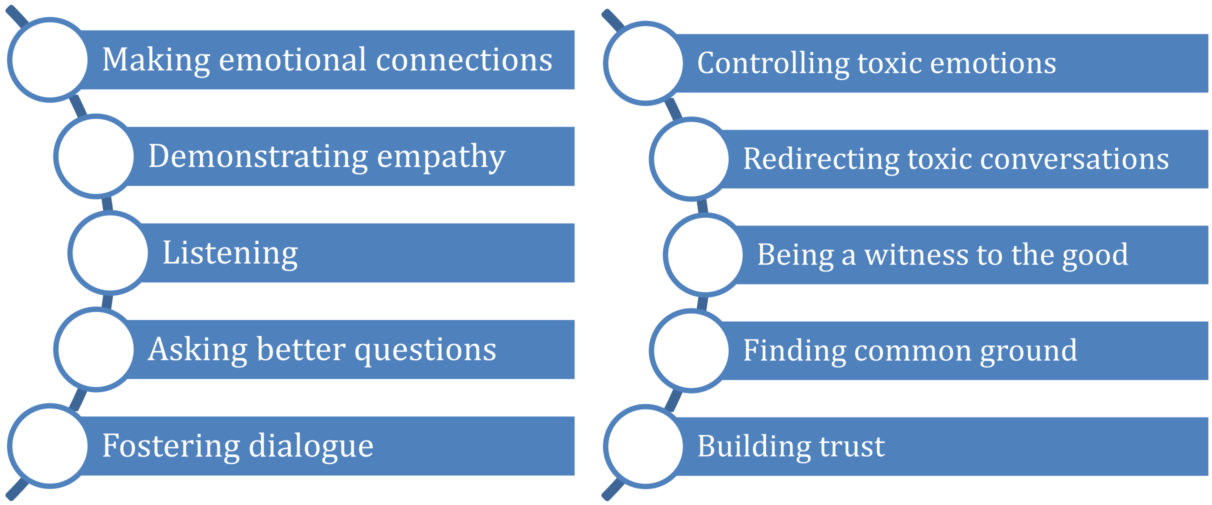

Figure 2 Items representing habits to form while coaching. From Better Conversations: Coaching ourselves and each other to be more credible, caring, and connected *(Knight, 2015).*

Engaging in Crucial Conversations

The next component of the coaches' training was attending a professional development focused on engaging people in crucial conversations. The training was approximately 8 hours and utilized the Crucial Conversations Participant Toolkit produced by VitalSmarts (McMillan, Switzler, Grenny, & Patterson, 2012). The main claim of the Crucial Conversations philosophy is that the cause of most problems "lies in how people behave when others disagree with them about high-stakes, emotional issues" (Patterson, Grenny, McMillan, & Switzler, 2012, p. xiii). When working in schools with teachers, leaders, and administrators, the coach balances a multitude of priorities and opinions. Even though all of the stakeholders have the common goal of providing the best education for students, it is probable that these individuals may at times have different belief systems about what constitutes high quality.

The Crucial Conversations pathway outlines eight main steps, organized into four ordinal categories (Figure 3) (McMillian et al., 2012). First, the coaches were trained to 'Work On Me First', where they got unstuck by identifying how a crucial conversation could improve outcomes by starting with heart and focusing on what they really wanted the outcome of the discussion to be, and then mastering their stories by learning how to create emotions that are conducive to healthy dialogue (McMillan et al., 2012, Patterson et al., 2012).

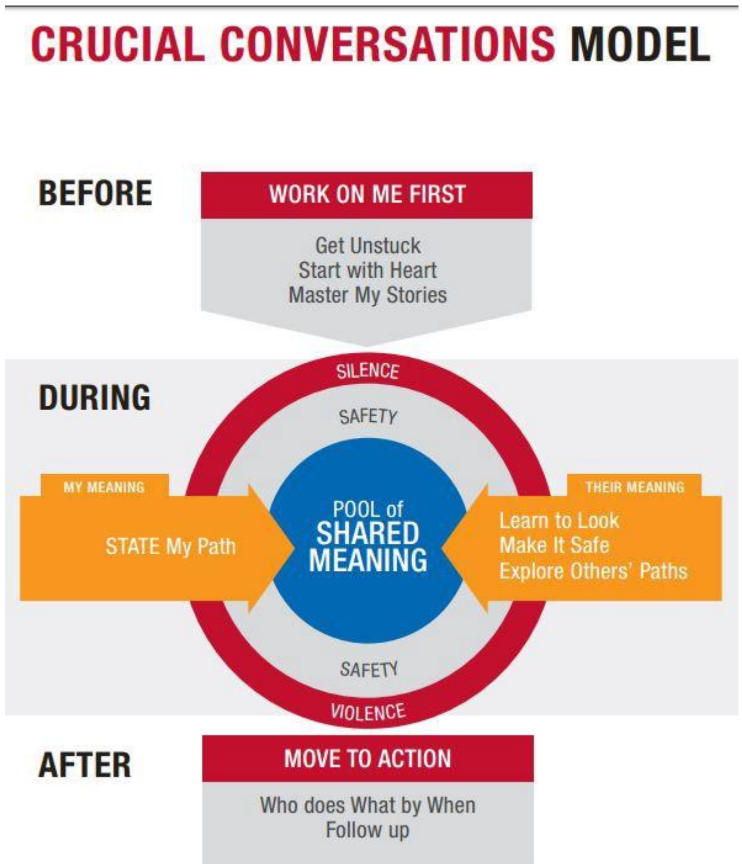

Figure 3 Crucial Conversations Model from Crucial Conversations Participant Toolkit *(McMillan et al., 2012).*

The next two phases of conducting crucial conversations occur while the conversation is taking place, and the coaches participated in role paying and reflective discussion about identifying ‘My Meaning’ and also determining ‘Their Meaning’ (McMillan et al., 2012). To conclude the training, the coaches looked at different ways to follow up after a crucial conversation and provided examples from conversations in which they had previously personally been involved. Specifically, techniques for making decisions, assigning actions, and the documenting of progress and results were covered (Patterson et al., 2012).

This course was included in the coaching training because the techniques and skills explored align with the above-mentioned goals of building trust and developing healthy professional relationships with both teachers and leaders.

Active Learning Frameworks and the STEM Academy

The next objective was to build the coaches’ understanding of the professional development that the teachers engaged in during the summer academies. Teachers in Cohort 1 had participated in two academies. See Perry, Reeder, Brattain, Hatfield, & Ketterlin-Geller (2017) and Pierce et al. (2019) for more information. Teachers in Cohort 2 had participated in one academy. See Adams et al., 2019 for more information. A discussion of the main components of the training resulted in a baseline of knowledge to guide conversations during coaching. The overarching principles of the academy were also discussed and reviewed so that the coaches had a perspective of the main goals, the experiences, and the content that the teachers were exposed to as part of their participation. The coaches reflected on the practices the teachers were trained on during the summer including active learning through Project Based Learning (PBL), Maker Based Instruction (MBI), and the 5E lesson model. By engaging in training on the teachers' experiences, the coaches should be better able to collaboratively promote the four pillars of the academy training in the classroom throughout the coaching cycles. These four pillars were the use of active learning, differentiated instruction, the use of the scientific process standards, and deepening content knowledge.

Scientific Process Standards

Throughout year one of coaching, teachers reflected a need to invest in more conversations about the process standards during the coaching cycles. In a survey given regarding participating teacher's perceptions of coaching, only 66% of the responding teachers agreed or strongly agreed that coaching "provided me with the tools needed to apply the scientific process standards" (Adams et al., 2018, pg. 14). Additionally, only 66% of the responding teachers agreed or strongly agreed that coaching "deepened my understanding of the scientific process standards" (ibid., pg. 14). The survey also found that 75% of the teachers agreed or strongly agreed that the pre-conferences "helped incorporate the scientific process standards" (ibid., pg. 15), and 100% agreed or strongly agreed that the post-conference sessions encouraged teachers "to use the scientific process standards" (ibid., pg. 17). However, only 83% of the responding teachers agreed or strongly agreed that after the post-conference they felt confident in implementing the scientific process standards (ibid., pg. 17).

As a reflection of the data provided by the previous year of work and the teacher feedback, the coaches analyzed and studied all of the scientific process standards. Based on the feedback from participants and the understanding that the scientific process standards are one of the pillars of the academy, placing an emphasis on developing coaches' understanding of this guiding principal was emphasized. The coaches studied the middle school scientific process standards (see Appendix B for vertical alignment chart). Each coach reflected on the intended goals of scientific process standards and the teacher and student behaviors that would show evidence of the scientific process standards in a lesson. Furthermore, the connection to how the scientific process standards support student engagement in STEM integrated lessons was expanded upon. Major focal areas are below.

- Designing, constructing, and building models.
- The use of mathematics (e.g., use of descriptive statistics in investigations, interpreting charts and graphs, using formulas appropriately) as part of understanding and experiencing science.
- The use of tools at each grade level.

After studying the scientific process standards, the coaching team engaged in investigations of classroom vignettes to clarify inquiry-based instructional practices that incorporate the process standards (Contant, Tweed, Bass, and Carin, 2018). The coaches compared and discussed two different lessons to distinguish factors and components in inquiry-based instruction. The conversations focused on process standards and also included personal classroom experiences. This was used to establish a baseline of practices in engaging the teachers during the coaching cycle.

Use of the STEM TOP Observation Protocol

In addition to developing the team knowledge of above-mentioned pedagogical strategies, the coaches were integrated into the process of the development of the STEM TOP observation protocol through an iterative design process. After finalizing the observation protocol, coaches calibrated scores utilizing the observation tool prior to conducting classroom observations. Additionally, ten percent of all classroom observations were co-observed as a means to continue calibration and gather validity evidence to support the ongoing development of the protocol. For more information about the STEM TOP development see the *STEM Teacher Observation Protocol Instrument Development* report (Pierce et al., in press).

Coaching Protocols and Forms

Following training focused on providing a baseline understanding of STEM inquiry-based instruction and desired coaching behaviors necessary to execute the coaching cycles with teachers and leaders, the coaching team was provided with protocols and forms to utilize during the ongoing support. The purpose of the protocols and forms was to help guide the pre- and post-conference discussions in a way that allowed for both the teacher and coach to evaluate and reflect on the inquiry-based pedagogical approaches being implemented in the classroom. The utilization of forms provided a way of ensuring that the ongoing coaching was consistent across coaches.

Teacher Coaching Cycle Forms

Pre-Conference Form

The coach conducted a pre-conference with each teacher approximately 24 hours before the observation took place. This was either done in person, over the phone, or via a video conference meeting through Zoom. Each meeting lasted between 15 minutes and one hour, dependent on the teacher, the available time to conduct the conference and the depth that the teacher and coach were able to discuss the questions.

The following questions that were included on the pre-conference form.

- Have you been able to implement some of your action items from PLC and our coaching cycle? Can you share a reflection on your experience?

- What is the objective(s) of your lesson? What are the TEKS?
- How will you know that students have mastered the objectives in this lesson?
- What are the prerequisite skills that the students have to know in order to be successful in this lesson?
- How will you incorporate active learning and process standards into your lesson?
- Are there any particular grouping structures in place (pairs, cooperative groups, etc.)?
- If so, how will you hold students accountable for their work?
- What are your plans for lesson closure and reflection?
- Is there anything you want me to particularly observe of your lesson?
- Is there anything else you want me to be aware of before observing this lesson?

STEM Teacher Observation Protocol

The STEM TOP was utilized during each observation and allowed the coach to quickly and efficiently document different teacher and student behaviors that were occurring in the classroom. The STEM TOP is divided into four domains (Lesson Structure, Learner Centered Instruction, Evaluation and Feedback, and Management and Discipline) which encompass 22 indicators. In addition, coaches documented areas of strength and areas in need of improvement and provide direction for the coach and teacher to focus their energy and attention during the post conference.

For each indicator the coach scored whether the behavior was present and the level at which the teacher performed the behavior. Score options were:

- 0 – Not observed: not demonstrated at all
- 1 – Emerging: this is an opportunity for growth; demonstrated at a low level
- 2 – Proficient: demonstrated at an expected level
- 3 – Exemplary: demonstrated at a high level

For more detail on the different indicators and how they were developed see the *STEM Teacher Observation Protocol Instrument Development* report (Pierce et al., in press).

Post-Conference Form
Following the observation, the coach met with the teacher in person or over video chat to reflect on the classroom visit. The behaviors observed were discussed along with each teacher's goals for future class periods. Each meeting lasted between 15 minutes and one hour. The following questions that were included on the post-conference form.

- Why do you think the lesson went the way it did?
- What evidence from the lesson tells you if the students achieved your goals?
- What did you learn that you will apply to your future lessons?
- What would you like to work on for the next time?

Also, the coach provided the following feedback based on their notes from the observation:

- Reinforcement Area (Praise/I Like)
- Refinement Area (Question/I wish)
- Recommendations (Polish/I wonder)

Leader Coaching Cycle Forms

During each cycle the coach met with the leader prior to the observation day to ask questions about the upcoming PLC and get an understanding of what was occurring at a systems level on campus. The fall semester included questions about the PLC content and preparation, since the coach was observing a typical PLC led by the campus. In the spring semester the pre-conference form included questions about what the leader expected to see during the walkthrough observations and the questions about the PLC procedures and preparation were removed since the coach would be delivering this content.

The pre-conference form in both iterations initiated a discussion about whether the leader had been able to visit the teachers in their classrooms and what behaviors they had observed. The questions guided the coach to explore culture and climate, process and content TEKS, and specific focal instructional practices.

During the observation no official form was completed during the walkthrough observations, but the coach was able to use their notes from the STEM TOP to guide discussion of observed behaviors. The coach also completed a STEM Academy Campus Summary form as a record of the PLC meeting. This included information about the participants, topic, agenda, future teacher action steps, and relevant TEKS discussed or included.

To conclude the observation cycle, the coach led a post-conference meeting with the leader to reflect on the pedagogical behaviors witnessed and discuss the goals that the leader had for each teacher and the department. The guiding questions for this meeting are below.

- Tell me about the highlights of the observation.
- What is your reflection on student engagement? What would take the teacher to the next step?
- What evidence from the observation tells you that they are implementing your shared goals?
- What evidence from the lesson informs you about the process standards level of implementation?
- What specific goals focused on the process standards do you envision for the teacher based on your observation?
- What are the short- and long-term 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)
- What specific actions based on this observation would you like us to revisit on our next cycle?

Scheduling Coaching Cycles

Expectations

Each coach was responsible for scheduling their own observation cycles. This was done initially by the coach coordinating with the campus participants and determining a single day that the observation could take place. Then the pre and post-conferences for each teacher and leader were scheduled and facilitated.

Primarily, the MS Outlook calendar was utilized by the coaches to schedule all coaching cycle events (e.g., pre-conference, classroom observation, PLC, post-conference). This allowed invitations to be sent to the participants so they could easily add the appointments to their own digital calendars. AppToTo was also used to send reminders via email and text 24 hours before each scheduled meeting.

The coaches had an internal calendar that was updated with each coach's observation dates. This was made available to other members of the STEM Academy team. The internal calendar was crucial in assisting the research team when scheduling coaching co-calibration observations, as well as other data collection including student surveys and research observations.

Constraints

One major constraint was the amount of time that often passed between the initial scheduling of an observation and the actual observation date. This was remedied by the addition of AppToTo reminder software, and specific naming strategies within calendar invites and email that helped both AppToTo and the participants more easily detect scheduled meetings.

A second common issue was the difficulty that arose when an observation was missed. This happened due to teacher illness, coach illness, testing schedule changes, and emergency drills on campuses. When an observation needed to be cancelled, the teacher or coach notified the other parties involved, which included the campus leader, STEM Academy staff, the lead coach, and the research team when calibration or research activities were scheduled during the cycle.

For more information the procedures and policies regarding scheduling please references the *STEM Academy for Science Teachers and Leaders Coaching Field Guide* (Hatfield et al., 2018).

Conclusions

The STEM Academy Coaching sought to tackle two contemporary issues facing education. First, higher education and economic parties have become increasingly concerned about the numbers of qualified students entering the work force in STEM fields (Kuenzi, 2008). This is problematic because many STEM fields are seeing expansions of high paying job opportunities but are having difficulty finding individuals to fill them. Within the STEM Academy, trained coaches provided participating teachers with the support needed to increase inquiry-based pedagogical strategies in the classroom. Second, as classroom observations become increasingly utilized in teacher evaluation, it is imperative that the observation tools and protocols are used in consistent ways across raters. Within the STEM Academy, coaches trained and engaged in continued co-calibration efforts to collect data needed to evaluate the STEM TOP.

High levels of continuity between coaches, as well as a deep understanding of all of the goals of the STEM Academy, were emphasized in the training. Ultimately, the coaches identified the value of providing ongoing academic year support, received instruction about the focal pedagogical strategies, and standardized the use of all coaching and observation forms that had been developed. Future research will continue to analyze the benefits and challenges of coaching, and the STEM Academy team will utilize the coach training procedures followed during academic year 2018-2019 and codified in this report in the upcoming third year of the STEM Academy for Science Teachers and Leaders.

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Appendix A – Coach Biographies

Coach 1: Coach 1 is the STEM Development and Implementation Coordinator at RME. In this role, he supports campus leaders and science teachers in the delivery of classroom lessons that focus on the integration of STEM and active learning techniques through individualized coaching, co-planning and facilitating Professional Learning Communities, and feedback following classroom observations. This role is 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.

Coach 2: Coach 2 holds an M.A. in STEM Curriculum Development and Implementation from Concordia College. She was a teacher and vice principal in Jamaica from 1996-2009. She taught at Roots Public Charter School from 2009-2015 in Washington, DC. She became a part of the DC Common Core Collaborative and was on a team selected by Pearson to set the rubric for the mathematics component in Partnership for Assessment in Readiness in College and Careers (PARCC). She became a part of a cohort organized by the engineering team at Catholic University to develop a STEM/Science Curriculum for PreK-12 on the PIQUED Curiosity Project using the Next Generation Science Standards (NGSS).

Coach 3: Coach 3 is an experienced regional administrator, assistant principal, and classroom teacher. She has a demonstrated history of working in the public education sector. Her skills include K-8 education, leadership, regional administration, STEM, coaching, data management, and state assessments. Prior to work in education she was an engineer and business consultant in the healthcare industry for over 20 years. In addition to her engineering degree she has an MBA, a Master of Educational Leadership focused in Educational Leadership and Administration and is currently a doctoral student in the Simmons School of Education and Human Development at Southern Methodist University.

Coach 4: Coach 4 earned her bachelor's degree in biology and master's degree in teaching from Austin College. She then taught high school science in New Mexico for eight years. During that time, she taught a wide variety of courses including biology, physics, AP chemistry, genetics, microbiology, and pharmacology. Her academic interests include curriculum design and vertical alignment. She is currently working towards her Ed.D. in Higher Education from SMU, with a planned completion date of May 2021.

Coach 5: Coach 5 holds a PhD in Education Policy and Leadership from Southern Methodist University. His dissertation focused on reclassification policies of English learners. He holds a BA from the University of North Carolina at Greensboro with a concentration in secondary education. While teaching, he pursued his master's degree in education with a concentration in English as a second language. In addition, he completed a MS in Statistics through Texas A&M in 2019. Prior to working with RME, he was a graduate research assistant with the Budd Center where he co-collaborated on research projects. His research interests include mathematics instruction of English learners and policies that impact English learners.

Appendix B – Scientific Process Standards Vertical Alignment

<table>
<tr><td colspan="3">2018 Streamlined TEKS Scientific Process Standards</td></tr>
<tr><td>6th grade</td><td>7th grade</td><td>8th grade</td></tr>
<tr><td colspan="3">(A) Scientific investigations and reasoning

(i)To develop a rich knowledge of science and the natural world, students must become familiar with different modes of scientific inquiry, rules of evidence, ways of formulating questions, ways of proposing explanations, and the diverse ways scientists study the natural world and propose explanations based on evidence derived from their work.

(ii) Scientific investigations are conducted for different reasons. All investigations require a research question, careful observations, data gathering, and analysis of the data to identify the patterns that will explain the findings. Descriptive investigations are used to explore new phenomena such as conducting surveys of organisms or measuring the abiotic components in a given habitat. Descriptive statistics include frequency, range, mean, median, and mode. A hypothesis is not required in a descriptive investigation. On the other hand, when conditions can be controlled in order to focus on a single variable, experimental research design is used to determine causation. Students should experience both types of investigations and understand that different scientific research questions require different research designs.

(iii) Scientific investigations are used to learn about the natural world. Students should understand that certain types of questions can be answered by investigations, and the methods, models, and conclusions built from these investigations change as new observations are made. Models of objects and events are tools for understanding the natural world and can show how systems work. Models have limitations and based on new discoveries are constantly being modified to more closely reflect the natural world</td></tr>
<tr><td colspan="3">(1) Scientific investigation and reasoning. The student, for at least 40% of instructional time, conducts laboratory and field investigations following safety procedures and environmentally appropriate and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations as outlined in Texas Education Agency-approved safety standards; and
(B) practice appropriate use and conservation of resources, including disposal, reuse, or recycling of materials.</td></tr>
<tr><td colspan="3">(2) Scientific investigation and reasoning. The student uses scientific during laboratory and field investigations. The student is expected to:

(A) plan and implement comparative and descriptive investigations by making observations, asking well defined questions, and using appropriate equipment and technology;
(B) design and implement experimental investigations by making observations, asking well defined questions, formulating testable hypotheses, and using appropriate equipment and technology;
(C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;
(D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and
(E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.</td></tr>
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<table>
<tr><th>6th grade</th><th>7th grade</th><th>8th grade</th></tr>
<tr><td colspan="3">(3) Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:

(A) analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;</td></tr>
<tr><td>(B) use models to represent aspects of the natural world such as a model of Earth's layers;</td><td>(B) use models to represent aspects of the natural world such as human body systems and plant and animal cells;</td><td>(B) use models to represent aspects of the natural world such as an atom, a molecule, space, or a geologic feature;</td></tr>
<tr><td colspan="3">(C) identify advantages and limitations of models such as size, scale, properties, and materials; and
(D) relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content.</td></tr>
<tr><td colspan="3">(4) Scientific investigation and reasoning. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:</td></tr>
<tr><td>(A) use appropriate tools, including journals/notebooks, beakers, Petri dishes, meter sticks, graduated cylinders, hot plates, test tubes, balances, microscopes, thermometers, calculators, computers, timing devices, and other necessary equipment to collect, record, and analyze information; and</td><td>(A) use appropriate tools, including life science models, hand lenses , stereoscopes, microscopes, beakers, Petri dishes, microscope slides, graduated cylinders, test tubes, meter sticks, metric rulers, metric tape measures, timing devices, hot plates, balances, thermometers, calculators, water test kits, computers, temperature and pH probes, collecting nets, insect traps, globes, digital cameras, journals/notebooks, and other necessary equipment to collect, record, and analyze information; and</td><td>(A) use appropriate tools, including lab journals/notebooks, beakers, meter sticks, graduated cylinders, anemometers, psychrometers, hot plates, test tubes, spring scales, balances, microscopes, thermometers, calculators, computers, spectroscopes, timing devices, and other necessary equipment to collect, record, and analyze information; and</td></tr>
<tr><td colspan="3">(B) use preventative safety equipment, including chemical splash goggles, aprons, and gloves, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher.</td></tr>
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