# MODELING INSTRUCTION™ LEADERSHIP WORKSHOP EVALUATION:

Yi Li, Teachers College, Columbia University
Phillip A. Boda, Stanford University
Octavia Zhao, Tilton School
Tim Li, Episcopal High School

## INTRODUCTION

Over the past 50 years with the explosion of population and access to diverse bodies of knowledge, the number of students who are enrolled in U.S. schools has grown substantially and the content taught at schools has become more complex to meet the needs of our growing technological world. A reform of teachers' roles in professional development organizations has been long sought in order to address the fact that it is critical for teachers to help with the restructuring of schools as sites where they are active conduits of learning about this ever-changing world (Berry, Byrd, & Weider, 2013; Carnegie Forum on Education and the Economy, 1986; The Holmes Group, 1986; Katzenmeyer & Moller, 2001; Love, 2010; Smylie, 1995). To this end, experienced and veteran teachers could assume leadership roles to help improve teacher quality and sustain reform policies.

In 1986, the Carnegie Forum on Education and the Economy released *A Nation Prepared,* warning that the imbalance between projected high retirement rates of veteran teachers and low rate of well-prepared new teachers would harm the education system. This call exemplifies there is a need for those veteran teachers to assume instructional leadership roles to train new teachers within and beyond schools. These more novel leadership roles, rearticulated a decade later, included the use of teacher researchers, workshop leaders, curriculum developers, and teacher mentors to achieve this goal (O'Connor & Boles, 1992). Indeed, this call for instructional leadership *by teachers, for teachers* is still reported as some of the most pertinent areas of educational research that is needed to this day (Darling- Hammond & Ruthman, 2015).

Concurrently, after the National Research Council's (NRC) release of *A Framework for K-12 Science Education* (NRC, 2012), and the introduction of the Next Generation Science Standards (NGSS; NGSS Lead States, 2013), reform in science education has taken a recent turn to emphasize science teaching and learning in more novel ways beyond the already purported Nature of Science (NOS) literature. The NGSS's call for an inquiry approach toward teaching science now focuses on the integration of Disciplinary Core Ideas (DCIs), Science and Engineering Practices (SEPs), and Crosscutting Concepts (CCCs) to support students in developing coherent and sophisticated understandings of science in preK-12 contexts.

Different from the traditional way of teaching and learning science, this new reform requires that students use eight Science and Engineering Practices (SEPs) facilitated by their teacher's pedagogies. These practices are, namely:

- asking questions and defining problems,
- developing and using models,
- planning and carrying out investigations,
- analyzing and interpreting data,
- using mathematics and computational thinking,
- constructing explanations and designing solutions,
- engaging in argument from evidence, and
- obtaining, evaluating and communicating information (NGSS Lead States, 2013).

These practices, as it were, are the foundation for the Modeling Instruction™ method of teaching science, a pedagogy developed originally in the 1980s, which is currently sustained and promoted by the American Modeling Teachers Association (AMTA).

*Purpose*

Science teachers that seek to implement these new reform measures need professional development (PD) that caters to these novel practices promulgated by NGSS. Moreover, this current change in science education policy focuses on the fact that "teachers are [indeed] the linchpin in any effort to change K-12 science education" (NRC, 2012, p.255). Thus, in order to realize this vision, science teachers need effective professional development programs that prepare them to use these practices. To implement professional development models with efficacy, though, there is a need to identify specific, research-based elements of professional development programs that have been shown to increase the effectiveness of the PD in relation to its goals. This inquiry into professional development research is where reform-minded teacher support systems should draw from to develop more efficacious science teachers, as well as when these programs seek to evaluate their own practices. Moreover, the question remains: Who trains these PD leaders?

   This research draws on the literature from professional development and teacher leadership to evaluate one such PD Leadership support program developed by the AMTA that sought to support the training of a new generation of leaders for Modeling Instruction™ workshops and support science teachers for the larger goal of reform in science education reported above. The report first touches on the nature of Modeling Instruction™ as it applies to these reformative goals, presents the background literature on PD and teacher leadership, and then reports on an AMTA's Modeling Leadership workshop implemented in the summer of 2016 as it relates to the workshop facilitators' goals compared to the data collected to measure the efficacy and fidelity of the program as implemented.

*The Modeling Instruction Program*

The pedagogy of AMTA's Modeling Instruction™ professional development program was developed based on Karplus's Learning Cycle (1977). The Modeling Cycle is composed of three distinct phases that are *modeled with* professional development participants, rather than *taught to* the teachers, and are driven by a long history of using models and modeling in science education that emphasize using representations for phenomena (Gilbert & Justi, 2016; Halloun, 2007; Hestenes, 1987). The steps are, namely:

1. Model construction: Each cycle starts with a paradigm lab or a science phenomenon. After discussions about their observations, teachers guide students to a researchable question (the relationship between two physical quantities or explanation of the phenomenon);
2. Model Deployment: Teachers present different problems or situations that allow students to employ the model, until the current model cannot explain the new phenomenon, which drives the beginning of the next cycle.

Based on this cycle, groups of science teachers within specific disciplines (physics, chemistry, and biology), or in larger grade bands (i.e., elementary or middle), worked together with their respective colleagues to gain fluency in the Modeling Instruction™ Curriculum through experience and discussion.

   These in-service teachers learn Modeling Instruction™ by participating in Modeling Workshops held by the AMTA. In one three-week, 90-hour intensive workshop, teachers go through a few modeling cycles under the facilitation of workshop leaders in two modes, student- mode and teacher-mode. For each Modeling Cycle, in student-mode, teacher participants act as their students and workshop leaders model how they facilitate the Modeling Instruction pedagogy with their students in a simulated classroom experience. In teacher-mode, workshop leaders and teacher participants reflect and discuss rationale behind the pedagogy, while also addressing any specific difficulties in the content and application to context. During all workshops, teacher participants also read research articles around Modeling Instruction pedagogy, discuss personal interpretations of the readings in the workshop, and write reflections based on the ways these participants make sense of this new method of science teaching and learning compared to their own pedagogy.

   Modeling Instruction workshops maintain the same structure wherein the participants learn to use Modeling Instruction™ through engaging in the modeling process, and troubleshooting how to implement the pedagogies they have learned in their own classrooms. However, with the number of Modeling Workshops increasing with time and popularity, there is a growing need to educate more *workshop leaders* who can implement these types of professional development learning environments with fidelity and efficacy. It is with this in mind that AMTA continue to deliver Modeling *Leadership* Workshops to those that have experience with Modeling Instruction™

workshops and wish to facilitate these workshops in their own locale.

Given the nature of this goal, there is a need to inquire about how to develop *leaders* of such PD workshops in ways that meet the goals of the program as a whole. To do this, research-driven principles of how to develop leaders of professional development workshops, such as the ones provided by AMTA, become imperative if it seeks to develop these leaders efficaciously with respective to the goals AMTA have set down for these Modeling Instruction™ workshops. Thus, this research grounds its background literature in professional development and teacher leadership.

## BACKGROUND LITERATURE

### *Professional Development*

In order to more fully understand the effectiveness of professional development programs, its facilitators must recognize the extant PD literature that has been shown to increase fidelity of the goals of such programs, and recognize ways to increase efficacy toward their goals. Many studies have identified characteristics of effective professional development programs and they include, but are not limited to, some of the following themes:

- Developing teachers' content knowledge and the pedagogies that efficiently meet the goals that teachers plan for in their classrooms (Shulman, 1986; Ingvarson, Meiers, & Beavis, 2005; Desimone, 2009);
- Engaging teachers in active learning where professional development facilitators model the method of pedagogy with the teachers (Desimone, 2009; Birman et al., 2000; Garet, Porter, Desimone, Birman, & Yoon, 2001);
- Integrating teachers' classroom experiences and program learning experiences coherently so that there is an alignment of goals (Birman, Desimone, Porter, & Garet, 2000; Luft, 2011; Grierson & Woloshyn, 2013; Ottoson, 1997);
- Nurturing collective participation between all members of the program toward similar goals (Desimone, 2009).

AMTA uses Desimone's framework (2002) within all workshops that they implement and, in doing so, emphasize the following six PD elements: 1) design or organization of the activity; 2) content focus; 3) teacher engagement and active learning, 4) coherence with school standards and goals, 5) long duration, and 6) collective participation to guide the structure its workshops.

Given these characteristics of effective professional development programs more broadly, one question remains: How does one such professional development organization and program – AMTA and Modeling Instruction™ - envision implementing these practice with fidelity, and how does this implementation model larger professional development principles seen as pertinent to sustaining such reform through running instruction leadership workshop? Indeed, this is where the development of *leaders* for these workshops becomes important to think about the Modeling Instruction™ workshops that these organizations provide to science teachers across the country.

### *Teacher Leadership*

Instructional leadership models are especially critical in STEM disciplines (science, technology, engineering, and mathematics) where there is a requirement of highly specific and technical knowledge. Moreover, in order to achieve the goal envisioned in the new science education reform (NGSS Lead States, 2013; NRC, 2012), teachers not only need to know about content knowledge, but also concepts that cut across all science disciplines (CCCs) and practices for scientific inquiry and engineering design. To expedite the process of achieving this goal, teachers who are more experienced and ready to develop and teach curriculum that is in alignment with NGSS could assume instructional leadership roles to support other teachers, a call to arms per se, which is where grass-roots organizations such as AMTA comes into play. Through this type of program, more teachers are prepared to meet the needs of the policies driving new practices and of their students.

Research has shown that teachers assuming instructional leadership models help make teaching a

profession (Mangin, 2007). Teachers who hold a wealth of experiences, large repertoires of information on teaching from the field, and insight on ways to foster student learning from experience can greatly contribute to education reform decision-making (Ingvarson, 2014). This process, in turn, can help teachers feel valued, develop a sense of empowerment, increase self- efficacy, and become more willing to support their peers (DiRanna & Loucks-Horsley, 2001; O'Connor & Boles, 1992; Timperley, Wilson, Barrar, & Fung, 2007; Youngs & Lane, 2014). This development of 'teachers helping teachers' has also shown promise in retaining high-quality teachers and improving the overall quality of education, especially in the STEM disciplines (Baker-Doyle & Yoon, 2010). Therefore, inquiry into teacher leadership is important to understand how to more efficaciously implement science education reform. Indeed, the evaluation of the fidelity of such leadership programs modeled with teachers that have minimal to moderate familiarity of these new roles in education is increasingly imperative.

## THE MODELING INSTRUCTION TEACHER LEADERSHIP PROGRAM

There is no doubt that potential teacher leaders need support. Based on a previous evaluation of the Modeling Instruction™ Leadership workshop (Boda & Li, 2015), the data supported that although teacher leader candidates brought in a wealth of teaching experiences and experiences working with fellow teachers in various informal mentoring capacities, they felt underprepared in the area of education research, conflict resolution skills, and organizational fluency to implement these professional development programs. Similarly, in O'Connor and Boles's 1992 study, they found that teachers who had already assumed leadership roles also reported that they wished they had known about team building and strategies for working with adults. These leaders also felt they were lacking in leadership knowledge pertaining to communication skills, motivational techniques, and organization skills more broadly. However, in O'Connor and Bole's (1992) study, most of those teacher leaders were selected because they were interested in curriculum reform and research in the content areas – focusing the pool for such leaders on those that are already fluent in teaching in general. In Ontario's Teacher Learning and Leadership Program (TLLP), Lieberman, Campbell, and Yashkina (2017) similarly found that initially teacher leaders reported that they had difficulties in organizing, communicating with, and motivating other teachers.

Among these studies, the leaders were lacking various bodies of knowledge that are pertinent to working with adult learners. Teacher leadership programs that can prepare teachers to be fluent with the needs of workshop participants are therefore needed. To do this, a plethora of supportive structures need to be set in place so that these leaders feel like they can draw on multiple sources, and people, when needed – to develop a community among leaders. Research has shown the importance of building community to sustain reform (Avalos, 2011; Desimone & Stuckey, 2014; Dufour, 2004; Gordon, Jacobs, & Solis, 2014) and therefore one goal for workshops is to develop and sustain these communities of practice around Modeling Instruction™ *leadership* with new workshop facilitators whose primary career is K-12 teaching and learning.

*Communities of Practice*

A community of practice refers to groups of people who share goals and common interests by working with the same tools and using a common language (Lave & Wenger, 1991). Through their common activities, they share similar beliefs about their community and support each other to achieve common goals. For potential science teacher leaders, they need two layers within their community of practice: one being an instructional community and the other being their leadership community. They also need skills to build a community of science teachers locally and virtually to exchange teaching ideas and practices to strengthen science education reform for lasting generations. Moreover, they need to form a leadership community among themselves.

In O'Connor and Boles's study, when teacher leaders were asked to describe the visions of teacher leadership, many suggested to build a teacher leadership community outside their schools so that they could support each other around the difficulties and issues of taking leadership (1992). Recent research also indicates that teacher leaders learn more when they communicate with each other to solve problems (Gordon, Jacobs, & Solis, 2014). AMTA has already developed Modeling communities of practice for the disciplinary content areas (chemistry, physics, biology, workshop leaders, etc) during the past 20 years. Here, this base is furthered by studying the ways in which AMTA makes the elements of the communities of practice explicit to the potential workshop *leaders* and how the potential leaders are trained to introduce and enculture new members to the existing community of practice

fostered by AMTA.

The Modeling Instruction™ community is facing the same issues for educating their leaders as discussed above, but are responding in ways that focus the goals of this community of practice on change rather than lament. In the summer of 2015 AMTA, sponsored by Simons Foundation hosted the second Modeling Leadership Workshop, following a previous effort in Miami in the previous summer. Twenty-four science teachers, who had already attended at least two Modeling Instruction professional development workshops and implemented the Modeling pedagogy in their classrooms for at least 2 years, were selected and assigned into two cohorts. Each cohort of 12 participants attended a one-week, 30-hour Modeling Leadership workshop.

In the summer of 2016, another 24 science teachers were selected to participate in this same structure of the Modeling Leadership workshop. The second iteration of this leadership workshop is reported here. Through this evaluation, the authors present findings on the study of the two Modeling Leadership workshops implemented within two 1-week intervals in the summer of 2016. By analyzing the goals of the workshop and evaluating whether the goals were achieved, this researcg identifies strengths and limitations that can lead to more efficacious implementation of the Modeling Leadership workshop and measure the fidelity of new workshops based on data-driven design changes.

Given that AMTA seeks to not only educate teachers how to enact Modeling Instruction™ but also develop future leaders of Modeling workshops, the need to design a Modeling Leadership workshop that focuses on elements of professional development for science teachers more broadly is paramount. Moreover, the effectiveness of the workshop itself to achieve those goals is fundamental to understand the how the workshops can become more efficacious. Thus, the analysis of the Modeling Leadership workshops enacted in the summer of 2016 are presented here as a set of structures based on the goals of the workshop to better understand how to attain the goals of this new Modeling Leadership Workshop. Through this evaluation of these workshops, AMTA should be capable of incorporating the findings and suggestions presented by these evaluators to design a more efficacious workshop for their Modeling Instruction™ Leaders.

Below are the goals of the Modeling Leaders workshops as articulated by the facilitators of these workshops:

1. **Grounding in theory and practice literature:** *Leader candidates* will become better grounded in Modeling Instruction Theory and Practice to understand the philosophical core of Modeling Instruction.
2. **Grounding in the structure of the Modeling Method of Instruction:** *Leader candidates* will observe, record, discuss and make sense of what should happen in a Modeling Workshop within the context and structure of the Modeling Cycle. They will examine and assess activities, approaches, resources, framing devices, pedagogical practices and identify the 'non-negotiables' that will be critical for helping teachers learn to practice Modeling Instruction in the Modeling Workshops they will lead.
3. **Building self-efficacy:** *Leader candidates* will work explicitly on building their identity and confidence as Modeling Workshop Leaders by identifying, discussing, and practicing the skills and techniques used for successfully managing routine aspects of workshop leadership.
4. **Participating in Modeling Communities:** *Leader candidates* will examine methods for providing ongoing support for their workshop participants after completion of a Modeling Workshop. They will learn about the nature and extent of the Modeling teacher network and the AMTA leadership network, and appreciate the layers of the Modeling Instruction community. They will plan for inducting their workshop participants into the Modeling teacher community of practice. They will consider approaches to build the "Modeler" identity in their workshop participants. *Leader candidates* will develop a network of connections among Leadership Workshop Participants, workshop leaders, AMTA officers, and members of the Modeling community. *Leader candidates* understanding of the Modeling community will be shaped by an understanding of the history of Modeling Instruction.
5. **Developing a big picture of Modeling Instruction and Modeling Workshops:** *Leader candidates* will identify and explore features common to all Modeling Workshops, and pinpoint others that are characteristic of specific workshop contexts. Since this learning experience serves leader candidates from multiple content areas, particular content-area workshops are not singled out for special attention. Some workshop activities will be contextualized in a content area.

Based on these goals provided by the Modeling Leadership workshop facilitators, and in coordination with the background literature on professional development and teacher leadership, we identified one primary theme that

could be analyzed given the data collected: (1) Increasing the confidence of participants in the Modeling Leaders workshop as they become more prepared for their new roles as prospectus Modeling Instruction™ workshop facilitators. An additional theme, outside of the workshop's intended goals, emerged that focused on the design of the workshop itself and the pedagogies used therein by the facilitators.

## RESEARCH DESIGN

Given the goals within professional development literature more broadly, as well as those for this specific professional development program, multiple research questions were identified for inquiry. The general goal of this research can be answered through a singular thematic question: How does the Modeling Leaders workshop support the growth of Modeling Instruction™ professional development facilitators? This larger research question is addressed through two research sub-questions that align specifically to the goals of the Modeling Leaders workshop, and the data that was collected to answer these questions. These questions, and the data aligned to answer them, are presented below in Table 1, with the data analysis schema also presented below in Table 2.

*Table 1*

*Research Questions/Data Alignment for Modeling Leaders Workshop Evaluation*

| Research Question | Data Sources |
|---|---|
| 1. To what extent does the Modeling Leader workshop increase the confidence of its participants to see themselves as future Modeling workshop leaders? | Pre-Post Survey; Interviews |
| 2. How did the participants feel about the workshop's ability to prepare them to lead Modeling Instruction workshops? | Post-survey open-ended responses |

*Context*

There were two Modeling Leaders workshops implemented subsequently in the summer of 2016, each 1-week long, with participants attending Monday through Friday for close to 6 hours a day. Two experienced Modeling Instruction™ teachers who also have extensive experience facilitating Modeling Instruction™ professional development workshops led the first workshop. One highly experienced Modeling Instruction™ expert and professor of education who also has decades of experience facilitating Modeling Instruction™ professional development workshops led the second workshop.

In general, the structure of the first workshop was such that the facilitators wanted the participants to discuss the fundamental requirements for implementing a Modeling Instruction™ workshop, have the participants peer-teach an example of a Modeling Instruction™ workshop they were familiar with to each other while discussing strengths and areas of improvement, as well as visiting actual Modeling Instruction™ workshops that were being held during the same time these Modeling Leaders workshops were taking place. The second week's workshop facilitator took into consideration the feedback from the first week's participants, but the structure and purposes generally stayed the same between weeks.

Given this context, it was appropriate that the workshops would be combined and considered as one sample from which to draw conclusions from of how this Modeling Leadership workshop structure supported its participants. Moreover, since no descriptive or inferential statistics were the focus of this research, the use of both samples as a singular source of data does not influence the nature of the data analysis for this research.

*Participants*

In general, the participants believed that they had a strong background and grasp of Modeling Instruction™, as over 92% of the participants reported somewhat to strong agreement that they were experts in Modeling Instruction™ entering the leadership workshops. Moreover, as shown in Figure 1 below, the participants also came into the workshops with a perceived notion of supportive structures already in place where they work and a general acceptance of Modeling Instruction™ in their home instructional sites, lending credence to the claim that these participants were able to draw on both their theoretical knowledge of Modeling Instruction™ as well as their practical experiences implementing Modeling Instruction™ in K-12 classrooms. With this extensive perceived expertise in Modeling Instruction™, as well as the practical experiences to ground any discussions of possible implementation strengths and weaknesses, these participants were ideal candidates for the Modeling Leaders workshops investigated in this research.

*Data Collection and Analysis*

The analysis of each research question is presented in a similar format as Table 1, in Table 2 below. Overall, given that this research project was mixed-methods in its design (Creswell, 2013), the quantitative elements have been chosen to introduce first, as the primary sources of data, to present any population change that may have occurred within the Modeling Leadership workshops. The qualitative data from samples within that population then provide context to the quantitative findings. In this way, neither data source was considered more legitimate, but rather that they provide a multitude of ways to answer the questions posed in this research (Bryman, 2006).

For all quantitative data provided in the findings, the number of participants that responded to the pre-workshop survey was 22, and there were 19 respondents to the post-workshop survey. The results presented for this report involving quantitative data is provided through Pre-/Post-frequency counts to showcase any shifting patterns of participants' responses.
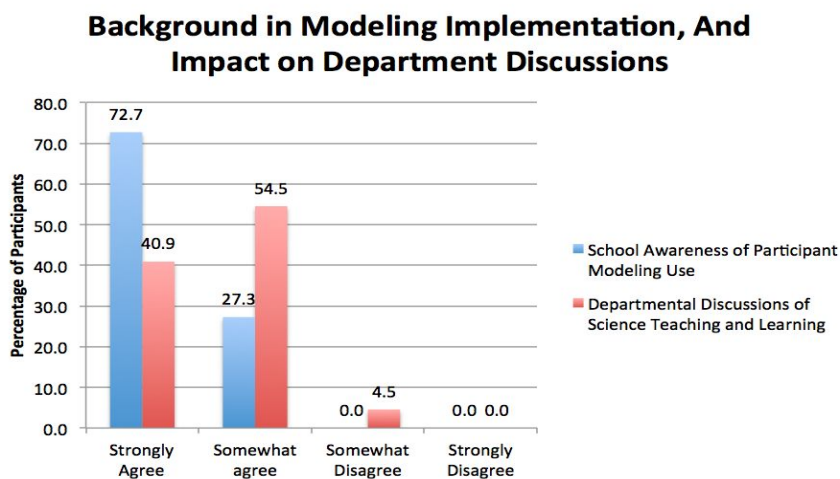


**Background in Modeling Implementation, And Impact on Department Discussions**

*Figure 1:* Pre-Workshop Likert Survey of School Context.

*Table 2*

*Data Analysis for Modeling Leaders Workshop Data Sources*

| Research Question | Data Type(s) | Analysis Method |
|---|---|---|
| 1. To what extent does the Modeling Leader workshop increase the confidence of its | Nominal[a] and Descriptive[b] | Frequency Counts[c]; |

| participants to see themselves as future Modeling workshop leaders? | | Grounded Theory[d] |
|---|---|---|
| 2. How did the participants feel about the workshop's ability to prepare them to lead Modeling Instruction workshops? | Descriptive | Grounded Theory |

[a] Nominal data refers to the non-numerical set of survey data (strongly agree, agree, etc.) collected from the Likert-style survey measure implemented pre- and post-workshop

[b] Descriptive data refers to any written observations or transcriptions of spoken word collected

[c] Frequency counts refers to numerically representing the accumulation of nominal data within a given question (e.g., 3 participants chose 'agree'; 5 participants chose 'disagree') and then graphically representing those findings

[d] Grounded theory is a method of qualitative analysis where emergent codes are derived from the data itself through open-coding all descriptive data, axial coding to determine larger constructs within the open codes, and then re-coding the data set with a final coding scheme

FINDINGS

For concision and clarity, each research question is addressed in its own section.

*Research Question 1*

*Confidence of the workshop participants to see themselves as future Modeling Workshop leaders*. In terms of the participants' confidence, the pre-/post-survey instrument elicited multiple components that are important for facilitating Modeling Instruction[TM] Workshops. Not all survey component data are reported below for concision. To summarize the overall findings, one representative Figure (Figure 2) is provided to showcase that the general trend for all confidence components measured by the Pre-/Post-Survey self-reported by the participants.

Figure 2 below, elicited from the aggregation of 3 questions from the participant Pre-workshop survey and 4 questions from the participant Post-workshop survey (listed below), measured the Modeling Leadership workshop participants' general confidence to see themselves as future Modeling Workshop leaders and the extent the Modeling Leaders workshops achieve this goal.

Survey Questions (1-3 from both Pre-/Post-survey; 4 is only in Post-survey)
1. *I feel that I have the skills to plan a Modeling workshop by myself;*
2. *I feel that I can manage the logistics of running a Modeling workshop;*
3. *I feel that am an expert at sustaining a Modeling workshop series;*
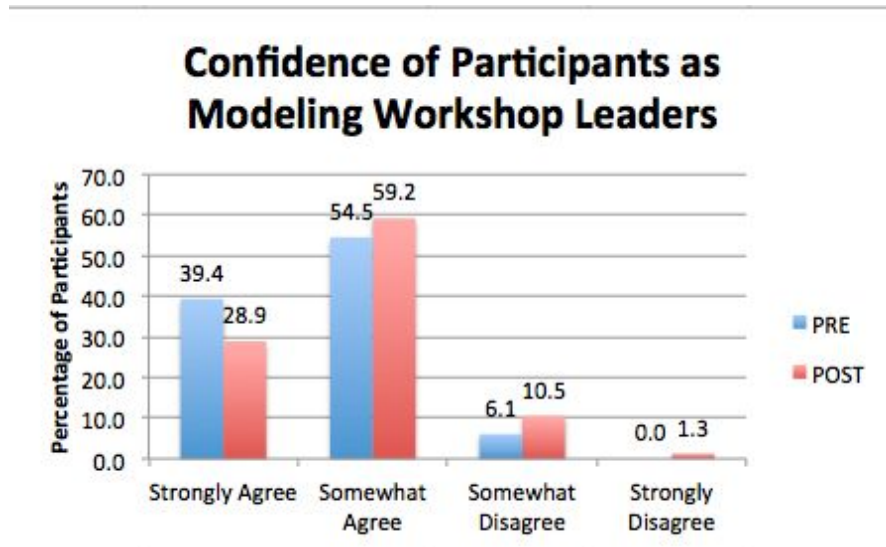4. *I feel confident in my role as a Modeling Workshop leader.*

*Figure 2*: General confidence shift of workshop participants.

In general, the data support that while the participants seem to have lost some confidence in themselves a more critical analysis would be that they recognized the substantial amount of structuring needed to facilitate Modeling Instruction™ workshops. This, then, led to a reported loss of confidence on the survey instrument but, as shown below in interview data, the participants actually feel like they gained crucial experience for when they go out and attempt to facilitate a Modeling Instruction™ workshop.

In the interviews, the participants were asked what they learned from the workshop. Their answers showcased that they gained more experience leading workshops and discussing practices from a Modeling *leaders* perspective. These experiences can, then, improve their confidence as Modeling Instruction™ workshop leaders. For example, one participant mentioned his shift from thinking about making models understandable for students to potential workshop participants' ways of thinking about what a model is in the future:

> "In our workshop, we discussed what a model is repeatedly. I have noticed that by making the meaning clearer in my own mind, I have been able to make models more apparent to my own students this school year. It also reminds me that I need to make this point apparent to my workshop participants through discussions throughout the workshop."

Another participant also brought up that he found the experience of running a workshop as a leader, and engaging in discussions to reflect that practice, had been really helpful – emphasizing that this participant is finding more fluency and confidence in his ability to discern elements in need of change:

> "I really like the time when we run through a lesson. We have leader mode, and we will go through that process. Then we will discuss what we do well. I think that is really helpful. I have thought about it for the rest of the day about anything that is not going well, anything that I am worrying about."

Through this data, the Modeling Leadership workshop participants can be seen as showing a shift from thinking about Modeling Instruction™ workshops through the eyes of a participant to thinking about how to approach such a workshop through the eyes of a leader/facilitator. In doing so, this PD for Modeling Leaders provides, at the very least, the place and space for new leaders to recognize and shift their perspectives on what is needed to facilitate a Modeling Instruction™, all the while also uncovering the possible lacking fluency the future leaders may have about the key components of such workshops.

*Research Question 2*

*Modeling leaders workshop ability to prepare participants to feel prepared to lead Modeling Instruction™*

*workshops.* Given that all data for this research question is qualitative, it is presented here based on the over-arching reactions to the Modeling Leadership, with each reaction parsed into themes. Within the positive reactions to the workshop, three themes emerged based on the nature of the reaction: Community, Adult Education, and General Modeling Instruction Fluency.

       *Positive, community.* As the participants' open-ended survey responses showcased, the nature of the workshop to foster a sense of 'energizing' and 'lifelong' community of practitioners from which they could draw for support when discussing Modeling Instruction™ was the largest positive aspect of this Modeling Leadership workshop:

> "I believe that I already understood the importance of a teacher network
> from my past experiences learning how to using modeling in my own classroom. However, this workshop was a reminder to me of how energizing it can be to spend time with other teachers who are passionate about teaching well. After a year with minimal time spent networking with other teachers, this workshop brought new energy for me, personally. This reminds me of why it is a critical part of a workshop"

Moreover, as noted below, this 'networking' principle was not just for individual gain, but also for dissemination and policy change:

> "The network is by far the most important thing here in my opinion. We
> need to build the network to keep modeling and the AMTA in the minds of those making policy and curriculum decisions. Being able to discuss what others are doing around the country really brings a sense of credibility to the modeling method."

The leadership workshop also gave teacher participants a great opportunity to meet modelers across the country, which allowed them to see that there are a lot more resources in the Model Instruction community that they can draw from in the future. When a teacher participant was asked about how he thought about the importance of teacher network, he stated the following:

> "The teacher network can really create a connection between teachers.
> Teachers can share their experience while teaching. About the AMTA, the good things about it are that I can talk to a teacher in Arizona and I can talk to teachers across the country. I even have a friend from a international school who uses modeling in her daily teaching. So, because of this connection, even if we have different policies at each school, we still have the commonality that we share across the country [Modeling Instruction]."

Some also related the positive aspects of the workshop to feelings of 'belonging,' a sense of community that should continue post-workshop, and the nature of the resources that were available to them as AMTA members, as well as Modeling Instruction™ teachers:

> "It has the greatest influence because I want all teachers to be exposed to
> Modeling, experience it and practice it It helped me realize I am not alone. Their are lots of people with similar ideas and values that are working towards the same goals, helping students think more critically using models. It helped me understand how I can utilize the vast resources that are available and be a part of something bigger,"
> "I have always appreciated the teacher network, though admittedly, I am not strong when it comes to maintaining a network from a distance. I do think the workshop made me realize that improving my "post-workshop" communication skills will need to be a goal I have for workshops."

The community building that is fostered through this workshop was widely discussed among all participants in the post-survey questions. However, as noted in the quantitative data from research question 1, this may not necessarily translate into *immediate* confidence in being able to facilitate Modeling Instruction™ workshops based on the singular experience in the Modeling Leadership workshop. There are, though, other positive elements that were

present in these participants' responses that shed light on more aspects of the workshop were fruitful.

*Positive, adult education.* As the Modeling Leadership workshop was highly focused on developing *leaders* of Modeling Instruction™ workshops, one theme that emerged from the participants' responses was the idea of gaining more fluency with adult education. From the participants reflecting on their experiences in the workshop, the focus of what was 'new' to their repertoire of understandings about leading Modeling Instruction™ workshops was their new-found comprehension that teaching fellow adult learners was not the same as teaching students. Shown below, this 'switching of frames' contributed to new thoughts on what it means to lead teachers:

> "This workshop helped me think like a workshop leader. It shows how to
> think like a teacher going to a workshop thinking like a student and then reflecting and thinking like a
> workshop leader while going through some of the activities."

This was especially important when thinking about how to engage teachers that aren't necessarily 'buying into' the importance, and nature of constructivism, within Modeling Instruction™:

> "I think one of the most important aspects about the leadership training
> for me was role-playing various scenarios of teacher reluctance, not buying in, telling everyone the 'right'
> way. This was very valuable to me because I don't like confrontation and I learned ways to deal with these
> situations."

Indeed, the notion that leading fellow teachers to understand the importance of Modeling Instruction™ was simply an enactment of Modeling Instruction™ *with* them, and discussion of those elements, was consistently shown to be false as the participants reflected on their experiences, as noted in the following quotes.

> "I think it helped frame the idea that it is about a battle of ideas and that
> you need to be able to sell people on why your idea is the best. It isn't enough to have research and student
> success on your side. In order to change minds, you also need to be able to pitch and sell why this is an
> important way to be teaching,"
> "I was able to get a perspective of working with adult educators. One very important insight is that you
> have to make it relevant for educators. They need to be able to take something away with them to use in
> their classroom. Knowing your workshop participants will help you better gear your workshop to meet their
> needs."

Through their workshop experience, the focus of 'new' knowledge was not necessarily on understanding Modeling Instruction™ better, but rather understanding adult education as a fundamental component for educating teachers *about* and *with* Modeling Instruction™ as a model of itself. Finally, there was another theme that was expected – Modeling Instruction™ fluency.

*Positive, general modeling instruction fluency*. As the other two positive themes have highlighted, developing leaders for Modeling Instruction™ workshops was not solely a focus on Modeling Instruction™ - nor, as they say, should it be. However, these participants did still focus on the refining of their paradigms toward Modeling Instruction™ as something that remained 'in the making' and should always be confronted when leading a workshop. In particular, the participants emphasized the importance of a working definition of a model:

> "In our workshop, we discussed what a model is repeatedly. I have
> noticed that by making the meaning clearer in my own mind, I have been able to make models more
> apparent to my own students this school year. It also reminds me that I need to make this point apparent to
> my workshop participants through discussions throughout the workshop,"
>
> "Hearing the different explanations of a model from each participant and hearing how they try to explain
> models probably gave me more to think about in a short time than any comparable segment of the

workshop,"

"The workshop reminded me of the importance on building the model, as well as using it to explain new phenomena."

Again, as expected, the participants also focused on how the workshop reminded them to focus on particular elements of Modeling Instruction™ that should be 'modeled' in the workshop itself, but to also stay attentive and authentic their own personal style of Modeling Instruction™:

"Their use of student, teacher, and leader modes and being strict in
staying in those roles was extremely helpful in guiding my own thinking and to process how to use and lead others in developing models,"

"The various ways in which individuals approach student mode vs.
teacher mode was important to see as it allowed us to see a wide array of facilitator styles (and some that may not work for our own personalities)."

However, the responses from the workshop survey were not all positive, thus, the suggestions the participants provided for improving these workshops are provided in their own section after the discussion of the data.

DISCUSSION

Overall, the Modeling Leadership workshop that took place in the summer of 2016 fostered more fluency with the larger community of practice that exists within the AMTA. Additionally, the participants' perceived ability to teach adult learners was increased, and the Modeling Leadership workshop also provided a supplementary addition of more fluency with Modeling Instruction™. While this was beyond the goals of the workshop, it complements the nature of becoming a leader of such a professional development program (i.e., becoming more sophisticated in the nature of the program emphasized in the professional development).

In terms of research question 1 (confidence ofparticipants for leading Modeling Instruction™ workshops), the workshop seems to have had a shift in impact when these participants thought about their readiness to run Modeling Instruction™ workshops without outside help from their larger parent organization (AMTA). This is seen prominently in the quantitative data set where participants self-report a decrease in confidence in their ability to run these workshops. While these participants may be self-motivated and be fluent in Modeling Instruction™, as *they have experienced it*, these participants did not feel that they were given what they needed to fully embrace an identity as Modeling Instruction™ workshop *leaders*, and they feel like they are not completely comfortable with the facilitation of these workshops. However, given the single week nature of this leadership professional development workshop, this is not necessarily a negative finding. What the participants may have come to realize are the complexities of actually facilitating a Modeling Instruction™ workshop and, therefore, had merely moved their understanding from a novice leader point of view to a more expert leader point of view, which would cause less confidence since they have little to no experience implementing all the pieces needed to facilitate such an endeavor. Moreover, the cultivation of teachers' self-efficacy is not a straightforward process, as much of the research purports. When encountering initial failure or overwhelming exposure of knowledge, it has been shown that teachers may even experience a drop in self-efficacy (Ross, 1994; Hoy & Burke-Spero, 2005). Future evaluations on teacher self-efficacy after participants go back to their own schools and have experiences leading workshops are necessary, which has been shown to be associated witha gradual process of learning and acclimation into successful implementation. (Tcschannen & Mcmaster, 2009).

Second, in terms of research question 2 (feelings of preparedness to facilitate Modeling Instruction™ workshops by participants after the Modeling Leadership workshop), the workshop seems to have had the biggest positive influence on this goal. Throughout the data, the participants consistently reported that they had the most positive experiences in terms of their interaction with other colleagues and current workshop leaders. They felt that the workshop provided a comfortable space to network with Modelers from across the country and utilize outside personnel from other institutions to aid in their goal to be a Modeling Instruction™ workshop leader. What also emerged from this research were suggestions made by the workshop participants in terms of how to support them in

their goal to become Modeling Instruction workshop leaders. Given the limitation that post-workshop data was only collected once (on the last day of the workshop), in the following section, we incorporate the field note observations of the workshop, along with interviews with these participants (interview questions are attached in the appendix) to analyze possible reasons for teachers' changes in confidence to lead a workshop and their experiences of the Modeling Leadership workshop. In light of the current body of research on professional development and learning theories, recommendations on the next iterative design of the leadership workshop will be presented at the end.

SUGGESTIONS FOR IMPROVEMENT: LETTING THE DATA SPEAK

*Exploring Teacher Leadership Further*
   One possible reason for the decrease in confidence of leading workshops may be the mismatch between leaders' goal for the workshop and participants' expectations – as has been seen to influence reported confidence in PD of other programs (Guskey, 2000) The designers of the leadership workshop hope that existing Modeling teachers can bring Modeling Instruction™ into their personal contexts where their colleagues, principals, and future participants in their workshops can be exposed to this framework to improve their science teaching practices, increase student learning in science, and develop scientific habits of mind. For this leadership workshop, the designers narrowed their goals to develop a cohort of teachers who were meant to be able to deliver the Modeling Instruction™ workshops that they had previously attended with consistency and fidelity. In order words, participants were expected to be 'teachers of teachers' to teach via Modeling. However, because of the success of the Modeling workshops those participants had attended, and AMTAs community building, according to the interviews, those participants' professional experiences, expectations, aspirations, and goals were far beyond 'teachers of teachers' or 'workshop leaders' as general identities to adopt and then implement.
When we asked teacher participants about their past leadership experiences and the reasons they came to the workshop, they responses were quite indicative. One teacher said,
> "I have worked with some other teachers just try to show them what modeling is. And also encourage some teachers to go to the modeling workshop that I am going to be assisting with. My administrators, supervisors are happy with what's going on in my class that I think if your were there to ask them, I don't think I can tell modeling is what I do. They know what I am doing so they sort of leave me alone. That's what I am frustrating about. I hope to impact and let other teachers know what I'm doing."

Complimenting this statement, another teacher said,
> "Because I believe modeling is really the right way to teach. If I can somehow be a better leader, it would give me another way, more access to help other teachers know about modeling in my area."

The emergent theme from these quotes shows that these participants are willing to engage in the teacher leadership process as defined by York-Barr and Duke (2004), i.e., "the process by which teachers, individuals or collectively, influence their colleagues, principals, and other members of school communities to improve teaching and learning practices with the aim of increased student learning and achievement" (pp.287-288). They have also been functioning as pseudo-schools-based teacher leaders, which has been reported in multiple studies dealing with teachers that wish to lead based on a framework that has shown success with students. These roles have included assuming formal and informal leadership responsibilities (Danielson, 2007) and influencing peers and professional community through ongoing collegial interactions (Danielson, 1998; Lambert, 2003), all the while still working in classrooms in order to influence the school system for the betterment of students (Katzenmeyer & Moller, 2009). The mismatch between the participants' expectations and the goals set by the designers of the leadership workshop may explain some of the negative comments reported about the workshop. For example, one teacher emphasized,
> "Having participated in three workshops myself, and as a dedicated modeler, I was very curious to find out more about the process. However, I came away unsatisfied."

This was similarly experienced by another teacher,
> "In all honesty, I was disappointed in this workshop. I never felt that I understood the goals of the workshop, and I didn't feel we were given enough information about how to organize, plan, finance, etc. a workshop."

These interviews show that the participants were not satisfied with just being a workshop leader as a role one adopts

to their repertoire of 'tools of the trade,' but aspired to know every detail about running a workshop so that they can go back to their own schools and districts to run professional development to influence their peers.

Conversely, it is necessary to point out that some activities during the workshop had great potential to improve participants' teacher leadership capacity. For example, in one of the activities, workshop leaders presented a few scenarios about how participants may react to Modeling pedagogy, or transforming their personal teaching practices, negatively. Then the participants discussed how they may react to that and how to use learning theories to convince them. This activity should have helped improve participants' skills to communicate and work with adults – one of the goals set down by the Modeling Leadership workshop. Another example of such a scaffolded activity, as mentioned above, was that during the workshop participants also shared stories of interaction with AMTA leaders and peers, of student learning, and of their personal teaching. They worked in groups of 3 or 4 to prepare a mock workshop session where they acted as workshop leaders, while other participants acted as teachers in the mock Modeling Instruction™ workshop. Throughout these activities, the Modeling Leadership workshop facilitators also modeled how to build collegial collaborating community. This compliments suggestions for PD provided by other organizations with goals similar to those of STEMteachersNYC and the AMTA. As pointed out in the Teacher Leader Model Standards (TLMS) (Teacher Leadership Exploratory Consortium, 2011), collaborating with peers has shown to be a critical factor of teacher leadership. Therefore, collaboration is seen not just as a group of teachers getting together; but, rather, that collaboration should be an on-going process of engaging with others in ways that models the practices and interactions that leaders may encounter in their experiences engaging with teachers when they experience new and novel pedagogical frameworks for teaching and learning.

As shown above in this research, and in the reported literature, teacher leadership and professional development are intimately and inherently intertwined. Teachers who wish to assume leadership roles need to organize professional development programs where they are able to collaborate and foster specific bodies of knowledge with other teachers that seek to assume such roles, as well. At the same time, the leading experience needs to not only help them grow as leaders and reinforce their leadership skills; these leadership workshops should emphasize that "professional development is both a cause and an outcome of teacher leadership" (p. 170). (Poekert, 2012). With the constraint of budget, it is realistic to set a narrow goal for the five days of this leadership workshop. However, it is also essential to employ online sessions to manage and support teachers' aspirations for teacher leadership broadly, as well as to address the needs of the participants of such workshop – just as you would address the needs of your students when teaching diverse populations that come into classrooms with highly variable experiences and exposures to teaching and learning experiences.

*Defining and Fostering Greater Fluency in Adult Learning*

The Modeling Leadership workshop brought a wide-variety of teachers together, with a wide-variety of needs that, as shown above, led to specific expectations beyond the scope of the goals of the workshop facilitators. Since people learn through experience, and they interpret new experiences in reference to their previous experiences that are proximal to the context in which they are placed for new learning (Dewey, 1938; Illeris, 2002), adult learning has remained a challenge in terms of meeting the needs of all that are present in such PD contexts (Merriam, Caffarella, & Baumgartner, 2007). In order to address this problem, the Modeling Leadership workshop facilitators sought to successfully situate diverse experiences through sharing experiences in Modeling Instruction™ workshops by fostering mock and authentic interactions with Modeling Instruction™ workshop leaders, which all participants had shared in common. They also created opportunities for participants to observe experienced workshop leaders in action and practice running workshops in front of their peers in the workshop. Taylor (2000) and Brookfield (2000) found that such a "learning by doing" model can be very effective, as learners can actively experience what they learn; but, the needs of all participants – i.e., related to their perceived expectations of the PD – need to be met in ways that foster a sense of compatibility between the workshop goals and the participants' needs.

Another emergent theme was that given the diverse content background present among the participants there were also negative responses that related specifically to how an 'uneven playing level' had made it difficult to interact with the other Modeling Leadership workshop participants, and that this was not mediated positively by the workshop facilitators. Some participant responses exemplify this theme:

"several participants kept talking about workshops they had already led. This made it very difficult to find common ground with other participants,"

"Teachers in general are a pretty varied bunch. One thing I noticed about this group was that several people

seemed VERY confident about their skills and approach, dare I say obnoxiously so, while others were not heard from much at all. The leaders of the workshop didn't address this effectively."

Another issue emerged here that relates to participants' experiences in other science education communities. One participant mentioned that,

"... I brought an issue to the workshop and raised it with one of the leaders in a private conversation. He readily agreed it was an important issue, but he never brought it up for group discussion. It involves the use of the terms "model" and "modeling" almost as jargon in the STEM 'bandwagon' era. I've been in other workshops (for example, an NSTA workshop) and heard other science teachers use the term "modeling" to describe what they do in their classrooms, but they are not using it in any sense of AMTA usage."

As seen in the literature, Lieberman and Miller (2014) explicate that "connection to the world" and "evolution" are two attributes of communities of practice that can influence how a community participant feels about their role and position in said community. As Modeling Instruction™ is a community of practice, it is essential for it to connect to the broader field and keep abreast of the field to create value of those diverse experiences in order not to 'shut-out' those participants who may draw on multiple experiences to make sense of their experiences within these Modeling Leadership workshops. With the release of Next Generation Science Standards, "modeling" is more frequently used than ever before, thus, the conversations around the connection between Modeling Instruction™ and the NGSS are essential for STEMteachersNYC and the AMTA to be connected to the larger reforms in science education. It is with this in mind, that another theme emerged from this data.

*Emphasizing Dialogue through Modeled Practice*

The bulk of the time during the five-day workshop was allocated to dialogue facilitated by the workshop leaders. These dialogues happened in two phases. During the first phase, participants in a group of three to four had conversations within the group and documented main points of their conversations on a white board. In the second phase, these smaller groups reconvene in a large, whole-workshop group to share their conversation 'findings' to co-construct understanding through their individual, small-group, and collective dialogues pertinent to leading Modeling Instruction™ workshops. Different from the traditional one-way information transmission model of professional development that has been shown to only lead to more superficial understandings of the content emphasized in such a PD model (Seymour & Osana, 2003), dialogues are found to encourage reflection and transformation (Wood, 2007). During this workshop, leaders valued different views, at times, which Wiesner & Mezirow (2000) have pointed out is an essential factor to create collegial conversations. One participant was exemplary in emphasizing the nature of dialogue emphasized in the Modeling Leadership workshop:

"I learned most about discourse management. I found that the group we had and the way we looked at the things from a leader perspective is very valuable because it put me in a place I have never been at before. So just plug in that leader wall and talking about things differently and help me think about things differently, especially in the ability to lead and participate in this course. I felt like I made a big change, maybe half way through the week, I'm listening a lot more, not talk as much but listening more that I found it's really easy to talk, you know it's really easy to say what you think you know. But actually listen to other people and then hopefully lead them and participate in the discussion in a deeper level is much more a good thing."

The dialogues this participant had from a leader perspective during the workshop transformed the way he thought about leading and the importance of such a dialogic process emphasized and modeling within Modeling Instruction™ workshops. Additionally, he reported that he realized the importance of listening and that this could be achieved through imitating workshop leader's' actions. However, effective dialogue should also aim to find agreement and arrive at a collective judgment that is seen as beneficial to all participating within the community creating the dialogue (Mezirow, 2000), which was, at times, not embodied within the Modeling Leadership workshop, as explicated by one participant:

"We concentrated more on understanding teachers' problems and hesitations in using MI [Modeling Instruction]. There was less emphasis on the question of what is a model, though it was discussed in context of instruction. We talked about whether a model has to be predictive, and what happens when the model 'breaks'. But that wasn't the focus, and I think people still differ in that definition of what is a model."

The participant remembered the details of the conversation on what a model is, however, he also recognized that as a potential workshop leader he needs to be even more familiar with the theories underpinning the pedagogy and he wished to spend more time on that until a consensus is reached. This tells of a dialogic interaction that did not come to fruition, and needed more time to draw out consensus on this topic. Thus, while the pedagogy of the Modeling

Leadership workshop sought to strongly impact participants' behavior when they become workshop leaders, the modeling of this process may have sent mixed messages as to what aspects are important in this dialogic interaction. Morevoer, as people learn from observing others (Bandura, 1977), and the process of Modeling Instrcution™ workshops focus on 'modeling the model' (Boda & Li, 2015), it is important for workshop leaders to intentionally plan their actions during the workshop, as the participants are very likely to imitate their actions. Finally, another theme emerged from the data that is useful for understanding how to improve the Modeling Leadership workshop from the perspectives of the participants.

*Community Building*

Teachers in this Modeling Leadership workshop self-reported most positive experiences that emerged from the community building process emphasized in the PD. Modeling Instruction™ is a research-based reformed pedagogy, supported by NSF during 1989-2005, and since its first workshop for physics teachers, more than 6000 teachers from 48 states have attended Modeling Instruction™ workshops in physics, chemistry, biology, and physical science. One reason that AMTA has been successful in building a network of teachers has been because it populates its community with practitioners and researchers who share the same teaching and learning beliefs. As Lieberman and Miller (2014) describe networks as "boundary-crossing" organizations that "provide a neutral space for teachers from different settings to meet for the sole purpose of collaborative work and to learn from each other," this notion of community as foundationally an act of network building becomes pertinent to any sustainable model of PD. As a new venue to promote teacher professional learning, grass-roots networks such as STEMteachersNYC and AMTA sidestep the hierarchies and bureaucracies of traditional within schools and institutional-based professional development programs. Thus, AMTA shares the common characteristic of active networks, including strong sense of commitment to an innovation, a sense of shared purpose, a mixture of information sharing, psychological support, leadership by an effective facilitator, voluntary participation, and equal treatment of members (Parker, 1979).

The leadership workshop, and the activities during the workshop, helped build up "weak ties" between its participants, which has been described by Granovetter (1973) as crucial for building, connecting, and networking between communities. These weak ties can not only hold networks together, but also encourage people to step out of their comfort zones to try out new ideas and new roles. When people in communities share similar experiences, such as those participants in this workshop who had attended at least two Modeling Instruction™ workshops, they are able to leverage their experiences as connection points for further discussion, Large amounts of time spent in the workshop was on sharing participants' experiences in their first Modeling Instruction™ workshops, their personal interactions with Modeling Instruction™ workshop leaders, how Modeling Instruction™ transformed their practices, and the subsequent effect their adoption of Modeling Instruction™ had on their students' learning. Even though these participants didn't present these aspects in the interview data collected, during the sharing of anecdotal stories recorded within the field notes, the collegial atmosphere among the participants permeated the workshop. Research( Collins, 2001; Marzano, 2003; Bryk et al., 2010) from both educational field and corporations have shown the importance and impact of such a organizational culture as that of the one emphasized by Modeling Instruction™, especially collegiality among members in terms of their willingness to change.

This cohort of participants in the Modeling Leadership workshop was a professional learning community (PLC) within a large teacher network. One big idea behind professional learning communities is "community of practice" (Lave & Wenger, 1991). Those participants were introduced to the community of Modeling leaders as novices and were learning to become full members of the community. Wenger (2015) described community of practice as "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly". Through interactions, they "develop a shared repertoire of resources: experiences, stories, tools, ways of addressing recurring problems-in short a shared practice. " During the workshop, activities including mock leading workshops, reflection after leading workshop, discussing ways to address resistance from teachers to reform their practice, and preparing an elevator speech to promote Modeling Instruction, all serve the purpose of developing a shared practice. According to this community of practice perspective to professional development, the community building process needs to be sustained over time to maintain the sustainability of improved practice of participants (Birman, Desimone, Porter, & Garet, 2000). The alternation between constructing new knowledge through interactions and applying that learning in other contexts to gain ownership of the new knowledge in a practical way is essential for the sustainability of internal motivation and improved practice ( Raphael, Vasquez, Fortune, Gavelek, & Au, 2014). After the workshop, opportunities need to be created for participants to see they

themselves view Modeling Instruction and leadership have changed or see they change other teachers' practice, which may help make the gaining of ownership visible to them.

In general, based on the comments and discussions made above, we would like to give the following suggestions to the facilitators of these Modeling Leadership workshops:

- Setting higher expectations for those potential teacher leaders and defining more explicit (and measurable) goals for the five days, while focusing on implementing them with fidelity;
- Developing a framework or domains of knowledge that a workshop leader is required to know- Leadership Pedagogical Content Knowledge.
- Utilizing technology to allow participants to engage in activities online. Those activities include, but are not limited to reading and discussing Modeling theoretical and conceptual articles, ways of addressing recurring problems, logistics of running a workshop, and expressing and resolving participants' individual opinions and concerns. This will also make it easier to manage the nature of the diverse discussions by grouping participants based on their experiences, grade level, and subjects.
- Taking good use of the five face-to face days to give participants more opportunities to practice as workshop leaders, critique, and reflect on their practices as a group.
- Supplying the participants with tangible sources from which to gather resources, if this is expressed as a need from the participants. Establishing a forum as a shared repertoire of resources for workshop leaders, including stories, tools, logistics to run workshops, ways to apply for grants, cases of addressing recurring problems.
- Creating spaces for participants to continue interacting with each other and reflect their practices, especially after they have experience as workshop leaders.

Based on the data collected, and the analysis of the themes that emerged from that data, the facilitators of this leadership workshop should take into consideration the suggestions that were provided by the workshop's participants for modifying future Modeling Leadership workshops to meet the needs of the participants that attend them. In doing so, the facilitators of these leadership workshops could emphasize principles of PD literature more broadly as being responsive to the participants in these workshops, as well as in teacher leadership literature wherein teacher leaders need more nuanced support beyond some of the goals set down by the leadership workshop to efficaciously and confidently feel prepared to embrace their new identities as Modeling Instruction™ leaders.

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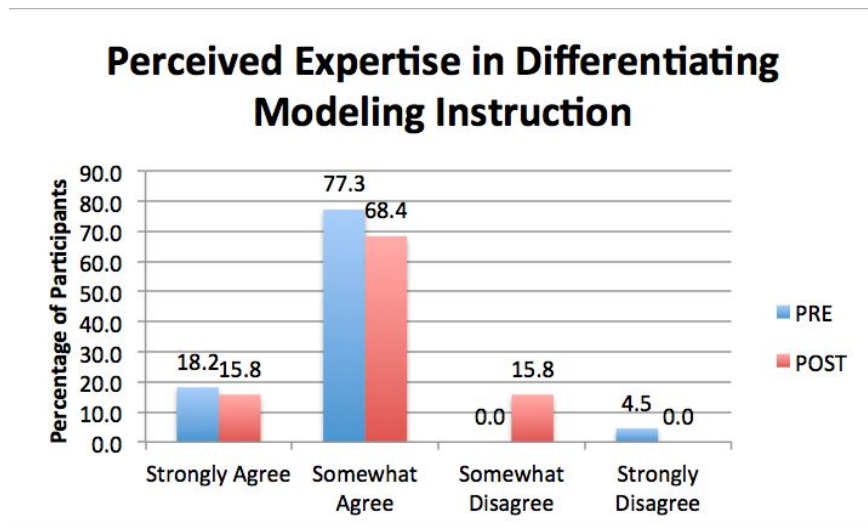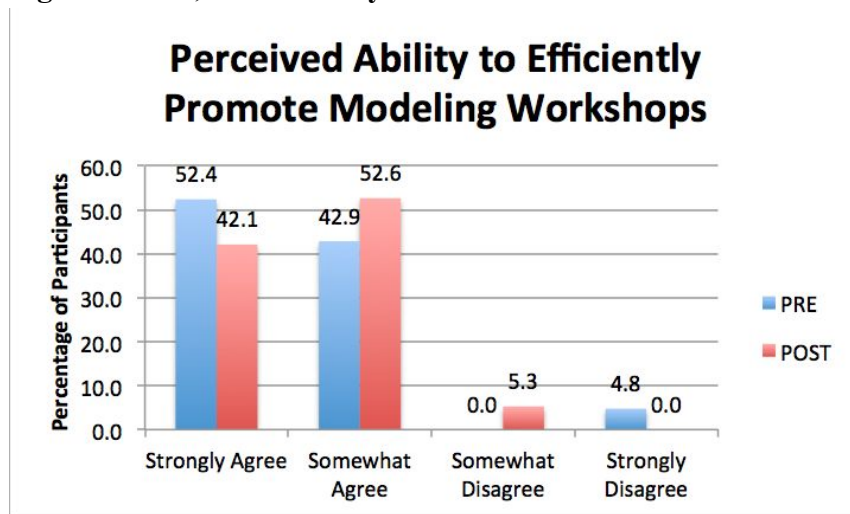
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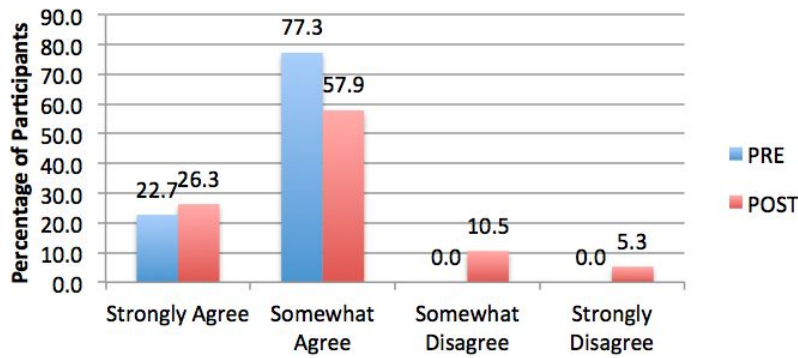
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**Appendices I: Figures 6 - 11, Self-Efficacy Scales**

## Perceived Ability to Efficiently Promote Modeling Workshops

Percentage of Participants

| | Strongly Agree | Somewhat Agree | Somewhat Disagree | Strongly Disagree |
|---|---|---|---|---|
| PRE | 52.4 | 42.9 | | 4.8 |
| POST | 42.1 | 52.6 | 5.3 | 0.0 |

## Perceived Expertise in Differentiating Modeling Instruction

Percentage of Participants

| | Strongly Agree | Somewhat Agree | Somewhat Disagree | Strongly Disagree |
|---|---|---|---|---|
| PRE | 18.2 | 77.3 | 0.0 | 4.5 |
| POST | 15.8 | 68.4 | 15.8 | 0.0 |

## Perceived Ability to Plan Modeling Workshops



A bar chart comparing PRE (blue) and POST (red) percentages of participants:
- Strongly Agree: PRE 22.7, POST 26.3
- Somewhat Agree: PRE 77.3, POST 57.9
- Somewhat Disagree: PRE 0.0, POST 10.5
- Strongly Disagree: PRE 0.0, POST 5.3

## Perceived Ability to Manage Logistics of Modeling Workshops



A bar chart comparing PRE (blue) and POST (red) percentages of participants:
- Strongly Agree: PRE 59.1, POST 47.4
- Somewhat Agree: PRE 31.8, POST 52.6
- Somewhat Disagree: PRE 9.1, POST 0.0
- Strongly Disagree: PRE 0.0, POST 0.0
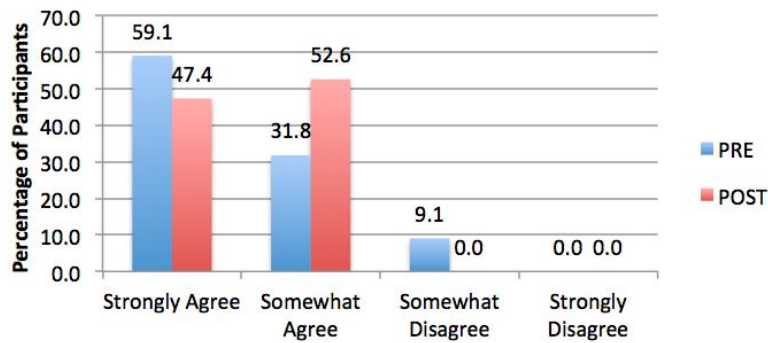
## Excitement of Participants to be Modeling Workshop Leaders



A bar chart comparing PRE (blue) and POST (red) percentages of participants:
- Strongly Agree: PRE 100.0, POST 89.5
- Somewhat Agree: PRE 0.0, POST 10.5
- Somewhat Disagree: PRE 0.0, POST 0.0
- Strongly Disagree: PRE 0.0, POST 0.0

**Perceived Ability to Build Modeling Skills with Other Teachers**
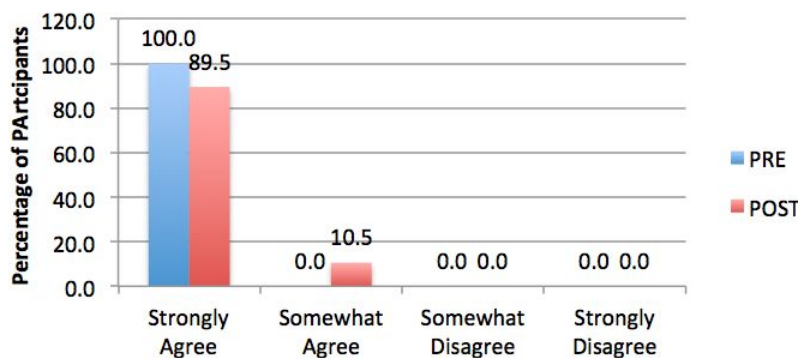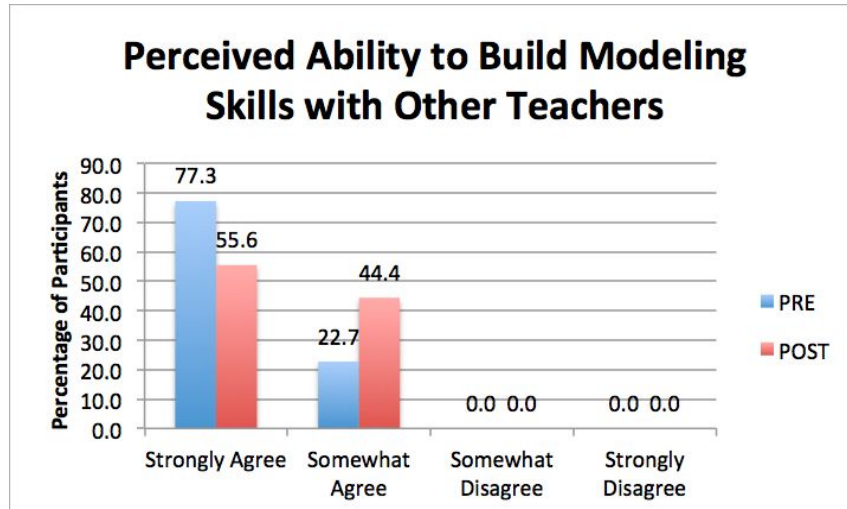
**Appendices II**　　　**Interview Questions**

1) How would you define teacher leadership?
2) What contributions have you made as a teacher leader in your school, district, and community?
3) Are your colleagues and administrators aware that you are using Modeling instruction in your department? Has your use of Modeling instruction influenced discussions about teaching and learning in your department?
4) What are some examples of good leading that you've experienced in the past? Why was this 'good' leadership to you?
5) What inspires and/or encourages you to lead? Are there any specific experiences that have inspired/encouraged you?
6) In what ways did this workshop support your future goals of being a leader in Modeling?
7) What advice would you give teachers (or other members of the school community) who want to become more involved in teacher leadership?
8) In what ways has the workshop influenced your thinking about how to help other educators understand what a model is and how to help students use models in their thinking
9) Can you provide some examples of ideas or experiences from this workshop that caused you to think about Teacher leadership in general (or, better, Modeling instruction in particular) in a different way?
10) How has this workshop gotten you to think about the importance of a teacher network, in particular how you could use the AMTA to your advantage in your current professional position?