

Original Article

# Facilitating Demonstration and Simulation in Practice-based Professional Development

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## Abstract

This paper examines the learning process of facilitators engaging in a practice-based professional development (PD) called StoryCircles facilitator training. We observed the language used by facilitators when engaging in a demonstration<sup>1)</sup> of practice in which another facilitator leads a group of secondary mathematics teachers engaged in StoryCircles PD to consensus. Subsequently, facilitators simulate the role of teachers in StoryCircles PD to anticipate challenges they, as facilitators, may face. By analyzing facilitators' collective dialogue across the different practice-based approaches within the StoryCircles facilitator training, we highlight the adoption of others' roles within the PD context and facilitators' understanding of their own roles as a result. Findings indicate that the demonstration of a facilitator's practice was a context in which facilitators developed an understanding of their own responsibilities. Meanwhile, simulating the participants' practices allowed facilitators to better understand the role of the facilitator from the demonstration of practice, as they navigated the potential tensions arising from teachers adopting practices that facilitators deemed less desirable. This paper highlights how such situated practice-based learning experiences may be associated with facilitators' perceptions of their roles within the StoryCircles framework, offering insights into the intricacies of PD facilitator training and practice.

**Keywords:** Facilitators, Practice-Based Professional Development, Mathematics Teacher Education

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## I. INTRODUCTION

Since the early work of Stein, Smith, and Silver (1999), there has been an increased interest in the work of development of teacher educators and facilitators of professional development programs. Prediger et al. (2022) highlight this growing attention, evidenced by recent special issues in the *International Journal of STEM Education* (Tekkumru-Kisa & Stein, 2017) and the *International Journal of Science and Mathematics Education* (Berry et al., 2021). Research suggests that facilitators and teacher leaders play a crucial role in guiding the content of PD to support teacher learning of mathematics needed for teaching (Cobb & Jackson, 2011) and sharing mathematics educational ideas and innovations (Karsenty et al., 2021).

Researchers and designers are increasingly focusing on understanding what facilitators need to learn to enhance their teacher preparation programs (Borko et al., 2014). With the rise of teacher-directed professional development models, such as teacher inquiry groups, lesson study, and professional learning communities (Beisiegel et al., 2018)—acknowledged for promoting an inquiry stance on teachers' practices and collaboratively addressing teaching and learning dilemmas (Cochran-Smith & Lytle, 2009)—novice facilitators often face significant challenges. For example, novice facilitators have more difficulty leading in-depth discussions with teachers (Borko et al., 2014) and determining the appropriate level of involvement in teacher discussions (Lewis, 2016).

In the context of practice-based professional development, Borko and colleagues (2014) emphasize the need for facilitators to engage teachers in constructively critical conversations about teachers' practices. Facilitation skills such as "anticipating what teachers are likely to notice in video clips, guiding their explorations, and promoting open, thoughtful conversations are key elements to successful facilitation of practice-based PD. Guiding questions for both viewing and discussing video, prepared in advance of the PD session, can provide such scaffolding" (Borko et al., 2014, p. 184). In other comparable cases, teachers engage in reflective practice in teacher education programs by considering their students' experiences. Just as teachers benefit from this approach, we believe facilitators can enhance their skills by simulating the teachers' role in professional development. This will help facilitators anticipate the different kinds of circumstances under which their facilitation will guide their participants' learning.

In our practice-based PD context, we focus on how facilitators engage in StoryCircles facilitator training to help them prepare for facilitating StoryCircles PD, a professional development initiative for mathematics teachers. Prior research on facilitators' experience in StoryCircles PD highlights that it is particularly important to explore how complexities arise from the expectations facilitators bring from their prior experiences as classroom teachers or participants in other PD programs (Schwartz et al., 2022). Much remains to be understood about the factors challenging facilitators in practice-based PD. This research aims to explore the implicit

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1) Grossman et al. (2009) called this representation but we are using demonstration as per the Herbst et al. (2016) argument to distinguish representation to talk about artifacts (e.g., the videos themselves) and demonstration to talk about the activity (e.g., the showing of the videos to teachers).

expectations held by facilitators in the context of instructional norms typically imposed on classroom teachers. It aims to situate these expectations within the unique framework of StoryCircles, where the realization of facilitators' responsibility and purpose considers norms from various roles.

Furthermore, we position this study within the broader landscape of professional development, as we seek to gain insights into more generalizable themes. Our practice-based professional development involves training facilitators, providing them not only with the opportunity to experience StoryCircles PD as participants but also consider diverse perspectives (i.e., that of another facilitator and that of teachers). Through this process, facilitators are encouraged to reflect on their facilitation work before undertaking that work, developing an understanding and anticipation of dilemmas distinct from traditional PD practices. As they undergo this training, they may identify norms or practices inherent to StoryCircles facilitation that may deviate from traditional facilitation norms, such as the extent of facilitator involvement in helping teachers reach consensus, facilitators' sense of duty to articulate their insights to teachers, and ownership of the lesson content that teachers develop in StoryCircles PD. As the study seeks to uncover how facilitators perceive and enact their purpose within StoryCircles, we shed light on the nuances of facilitator training and practice in practice-based PD. The paper is driven by the following research questions:

1. How does the language used by facilitators when discussing their facilitation practice of StoryCircles compare during and after engaging in a demonstration of practice?
2. After simulating the role of StoryCircles PD teachers, what are facilitators' perceptions on facilitator roles and practices within StoryCircles?

## II. FACILITATORS' ROLES AND PRACTICES IN PROFESSIONAL DEVELOPMENT

We recognize that facilitators often manage multiple roles. The facilitator role encompasses various labels such as teacher educators, teacher leaders, and professional developers, and is both a challenging and essential role to play for professional development programs to be successful (Beisiegel et al., 2018; Borko et al., 2014). Additionally, professional development facilitators often simultaneously are involved in other activities (e.g., teaching school, coaching, consulting) for which they play other professional roles (Perry & Booth, 2024). Thus, the facilitators' experiences playing various roles in these other activities might inform how they take up their position as facilitators. For instance, facilitators may act "as critical friends, consultants, planners, coaches, and mentors" (Perry & Booth, 2024, p. 145) in a PD context. Frequently, they must navigate dual roles as both teacher leaders and colleagues of teachers (Knapp, 2017), using their unique position to "serve as a bridge between multiple subgroups within the larger educational system" (Margolis, 2012, p. 311).

Yet, research on facilitators' professional learning and how they learn their roles is limited (Kennedy, 2016). Because of this, studies such as Perry and Boylan's (2018) have designed professional development

focused on collaborative inquiry into practice using video observation, revealing that such observations act as a catalyst for reflection and discussion of practice among facilitators. Observing both their own and others' practices significantly enhances facilitators' learning of facilitation techniques. Perry and Booth (2024) identified some of these practices, which include treating participants as co-learners, mediating conflict, playing devil's advocate, and offering alternative, presumably better suggestions. Other studies have documented common facilitation practices from a researcher's standpoint. For example, building on teachers' ideas and conducting the discussion towards the content goal are important evidence of facilitator expertise with content-specific substantiation (Prediger et al., 2022). Furthermore, Karsenty and colleagues (2021) highlight the construct of identity, which may involve positioning oneself relative to the environment or participants, to explain facilitators' decision-making processes and evolving practices. Their research examines a range of positions that facilitators might assume and suggests that facilitators should be able to flexibly balance different identities rather than holding onto a dominant one. Assuming that experienced facilitators can flexibly balance various roles, our study aims to explore how they develop their understanding of their facilitation practice by not only simulating the practices of different roles but also negotiating their stance on facilitation practices as a result. We also highlight how the design of our StoryCircles facilitator training program led facilitators to adjust their understanding of their practices within StoryCircles PD by addressing tensions related to norms in various contexts.

### III. ADAPTATION OF THE PEDAGOGIES OF PRACTICE

Research on teaching and teacher professional development indicates that individuals are well positioned to learn new instructional practices by actively engaging with the practice itself (Ball & Cohen, 1999). Generally, practice-based PD includes activities grounded in authentic teaching tasks, providing opportunities to connect what they learn in PD with their actual classroom instructional practice (Ball & Cohen, 1999; Grossman et al., 2009). The design of practice-based teacher education (Ball & Forzani, 2009; Lampert, 2010) and the use of pedagogies of practice (Grossman et al., 2009) continue to evolve to provide "high-leverage" teaching practices (Ball et al., 2009; Grossman, Hammerness, & McDonald; 2009). Grossman et al. (2009) describe representation (hereafter referred to as demonstration), decomposition, and approximation (hereafter referred to as simulation) as three different pedagogies of practice used across professional education contexts to help novices gain critical competencies with practice. For this study, we focus on the demonstration of practices and simulation of teachers' practices.

Demonstration of practice involves showcasing the enactment of instructional practices, often through live enactments or video records. While representations of practice (Grossman et al., 2009) are the videos that record practices, demonstrations refer to the actual activities in which videos are shown so that practice can be observed and identified (Herbst et al., 2016). In practice-based PD, facilitators who have engaged

in demonstrations of practice report enhanced facilitation through the application of purposeful guiding questions and refined monitoring techniques (Borko et al., 2014). Through engagement with demonstrations, facilitators can refine their skills, enabling them to lead complex discussions on their facilitation practices.

In our StoryCircles facilitator training context, engagement with a demonstration of practice is represented through two kinds of media: video and animation. Video representations have allowed for successful and meaningful engagement in discussions about practice (González, 2011; Sherin & van Es, 2009). Video records of practice can immerse viewers in scenarios similar to real teaching contexts, providing a shared experience for the collaborative exploration of teaching activities (Borko et al., 2014). Animations, while lacking the face value of video records, allow designers more control over depicting scenarios, extending beyond how videos approximate the temporality of a real classroom. They also offer greater flexibility in representing individual students and teachers in a classroom. Engaging with video and animation can support the development of a keen sense of observation and critique, which is crucial for facilitators overseeing practice-based professional development.

Another pedagogy of practice is the approximation of practice. Approximation of practice offers an environment of reduced complexity, serving as a kind of rehearsal in teacher education (Lampert et al., 2013). Often conducted in a simulated environment, approximations of practice may include activities such as role-play and micro-teaching, which are designed to better equip educators for the full complexity of real-world teaching situations. Approximations of practice can enable facilitators of professional development (PD) to approximate facilitation practices that are responsive to the ideas of the participants in the PD.

However, in this paper, we focus on facilitators approximating or simulating teachers' practices. In our StoryCircles facilitator training context, which aims to prepare facilitators for implementing StoryCircles, it was important for facilitators to first understand what teachers of StoryCircles PD experience before developing an understanding of facilitation practices that would be responsive to teachers' ideas and fit with the norms or practices inherent to StoryCircles facilitation. Herbst and Chazan (2015) note, "Practitioners often have to come up with appropriate ways to address and relate to their clients, they have to use judgment in setting goals and matching them with means, but their actions are contingent on what their clients do" (p. 272). We believed facilitators would be capable of simulating teachers' practices, given their mathematics teaching background and their prior participation in PD, and that this could help them learn more about the StoryCircles process.

## IV. METHODS

### 1. Sample

Twelve facilitators were recruited for StoryCircles PD<sup>2</sup>). All have had experience as secondary mathematics teacher leaders, with eleven having conducted professional development activities related to mathematics

teaching in the two years prior to the StoryCircles facilitator training. Their institutional roles range from professor of mathematics or mathematics education to mathematics department head in a high school. While these facilitators are experienced teacher leaders or have facilitated other PD programs, most were new to StoryCircles PD. Consequently, they might not be familiar with the specific norms or practices of StoryCircles facilitation, which may deviate from traditional facilitation norms, highlighting the purpose and need for StoryCircles facilitator training for facilitators.

## 2. Context

StoryCircles is an innovative approach to practice-based mathematics professional development, focusing on supporting secondary mathematics teachers to collectively design a problem-centered lesson that provides students with a meaningful opportunity to engage with mathematics through exploration and discussion. In particular, the mathematics teachers engage in a collaborative process of scripting, visualizing, and critically discussing a lesson (Herbst & Milewski, 2018). Using online storyboarding and annotation tools, teachers create a storyboard of a lesson that begins with a specific algebra or geometry task and leads to an intended mathematical goal.

The facilitators of StoryCircles PD lead synchronous online meetings, where they orient mathematics teachers to each other as valuable sources of knowledge about teaching. The designers of StoryCircles ask facilitators to center teachers' voices in surfacing common problems of practice that the group will explore through the sharing of the knowledge and experiences the teachers bring with them. To prepare facilitators for their roles in StoryCircles PD, which would start in September 2023, our StoryCircles facilitator training was designed as a 3-week session in June 2023. The StoryCircles facilitator training encompassed four key activities, each implementing components of the pedagogies of practice. Specifically, the first activity was a demonstration of practice, and the second, third, and fourth activities were three different simulations of teachers' practices. The activities are listed below in the sequence of their engagement (see Table 1):

**Table 1** *Sequence of activities in the StoryCircles facilitator training*

| Activity # | Week     | Synchronous or Asynchronous | Demonstration of practice or Simulation of teachers' practice | Description of the activities                                                                                        |
|------------|----------|-----------------------------|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| n/a        | 1st week | Synchronous                 | n/a                                                           | Introduction to StoryCircles facilitator training                                                                    |
| Activity 1 | 2nd week | Asynchronous                | Demonstration                                                 | Watch the video recording of a past StoryCircles meeting and identify more or less productive facilitation practices |
| Activity 2 | 2nd week | Asynchronous                | n/a                                                           | Annotate a StoryCircles meeting that focuses on improving a less desirable storyboarded lesson                       |

2) In this paper, we refer to StoryCircles PD as the practice-based PD for mathematics teachers, and StoryCircles facilitator training, a form of practice-based PD, as the training for facilitators on how to facilitate StoryCircles PD

Table 1 *Continued*

| Activity # | Week     | Synchronous or Asynchronous | Demonstration of practice or Simulation of teachers' practice | Description of the activities                                                                   |
|------------|----------|-----------------------------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Activity 1 | 2nd week | Synchronous                 | Demonstration                                                 | Reflect on activities 1 and 2                                                                   |
| Activity 2 |          |                             | n/a                                                           |                                                                                                 |
| Activity 3 |          |                             | Simulation (2)                                                | Simulate a StoryCircles PD meeting that focuses on creating a storyboarded lesson               |
| Activity 3 | 3rd week | Asynchronous                | Simulation (2)                                                | Continue to simulate a StoryCircles PD meeting that focuses on creating a storyboarded lesson   |
| Activity 4 | 3rd week | Asynchronous                | Simulation (3)                                                | Simulate a StoryCircles PD meeting that focuses on annotating a storyboarded lesson             |
| Activity 4 | 3rd week | Synchronous                 | Simulation (3)                                                | Continue to simulate a StoryCircles PD meeting that focuses on annotating a storyboarded lesson |

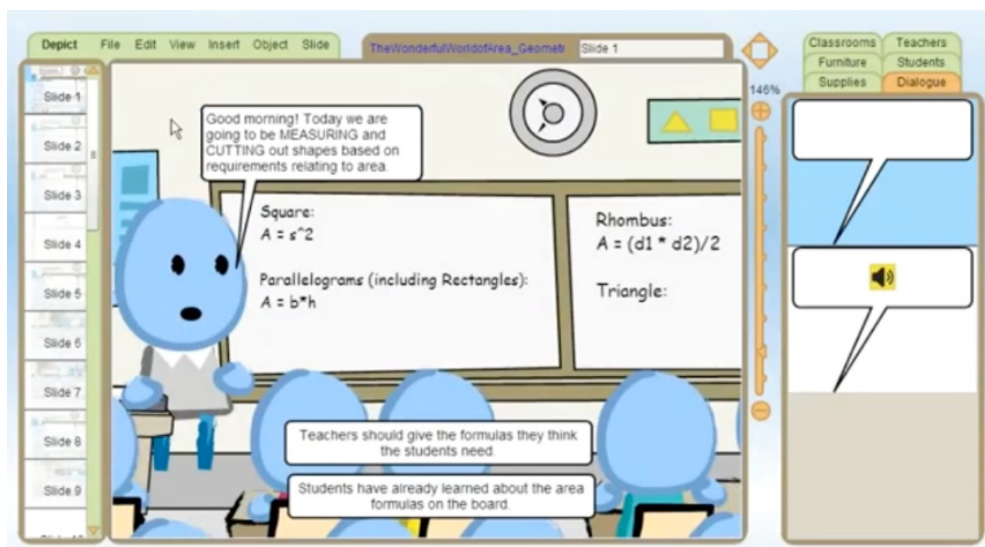
### 3. Data sources

In activity 1, the demonstration of facilitation practice, participants of the StoryCircles facilitator training viewed a segment of a video from a previous StoryCircles PD meeting. They were tasked with observing and identifying facilitation moves by a StoryCircles PD facilitator that were either more or less productive and explaining their justifications. The activity featured a video purposefully selected for its seemingly less productive facilitation moves, showing a StoryCircles PD facilitator pushing an idea that appeared to invalidate and discourage what the teachers in the StoryCircles PD were asking for. We deemed this less productive because it deviated from a main component of the StoryCircles framework, which is to prioritize teachers' voices (Brown & Herbst, 2023). The lack of emphasis on centering teachers' voices is evident when the StoryCircles PD facilitator in the video questions whether the rhombus formula is really necessary in the lesson storyboard and then goes on to elaborate why she herself wouldn't include it. A teacher directly responds to the StoryCircles PD facilitator, "Why are you so against it?" with "it" referring to the decision the participants previously made: "Teachers should give the formula they think the students need," as illustrated in the caption of a frame of the lesson storyboard representing formulas, which the facilitator chooses to question the formula's need to teachers (see Figure 1).

In addition to identifying the less productive facilitation moves, participants of the StoryCircles facilitator training also identified other facilitation moves as more or less effective. During the following synchronous meeting where they discussed activity 1 (see Table 1), participants of the StoryCircles facilitator training collectively reflected on their justifications for why they considered certain facilitation practices in the video as more or less productive, their own roles as facilitators, and the challenges they might face as facilitators in StoryCircles PD.



**Figure 1** A moment from the video in activity 1 where a facilitator pauses on a storyboard frame featuring formulas, particularly questioning the teachers' decision to include the caption: "Teachers should give the formula they think the students need."



In activity 2, participants in the StoryCircles facilitator training simulated how StoryCircles PD teachers would annotate a storyboarded lesson, which they had observed participants discussing in activity 1. This storyboard was intentionally designed by the StoryCircles designers to represent a less desirable version of a lesson, which was problem-based but not student-centered. If the goal is for teachers to learn from practice and one another, annotating less desirable lesson representations can be more beneficial than providing idealized so-called best practice examples. Such an approach encourages teachers to share ideas openly and leverage each other's insights for improvement (Brown et al., 2024). Although this paper does not analyze activity 2 in detail, we recognize its importance in the sequence of activities. This is because, when participants of the StoryCircles facilitator training reflect on the subsequent simulation of StoryCircles PD teachers' practices in activities 3 and 4, they draw on their experiences from activities 1 and 2, including the reference to less desirable lesson representations, to address and improve less effective teacher practices.

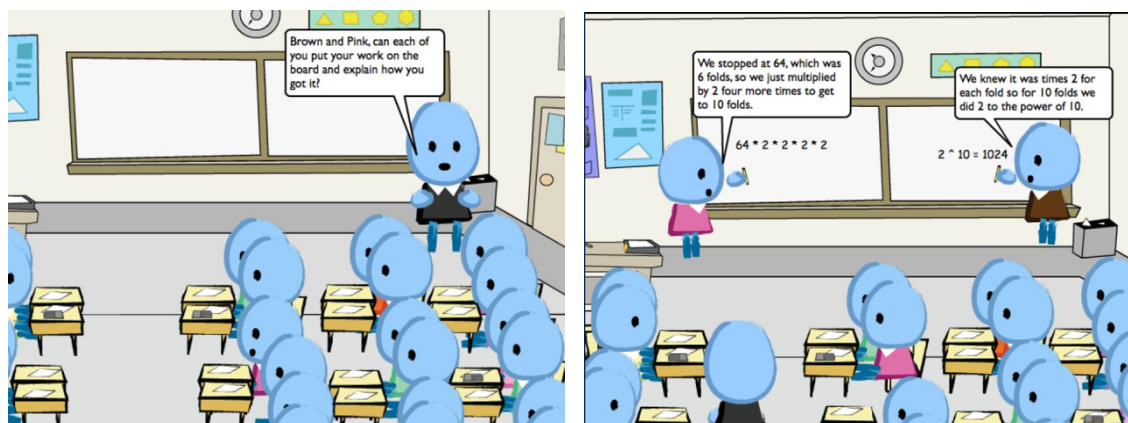
Activities 3 and 4 are simulations of StoryCircles PD teachers' practices on which we focus our analysis. In these activities, participants in the StoryCircles facilitator training simulate StoryCircles PD activities as if they were teachers of the StoryCircles PD and anticipate challenges they might face as facilitators of the StoryCircles PD. In activity 3, participants of the StoryCircles facilitator training simulate the process of composing a storyboarded lesson, and in activity 4, they simulate annotating completed storyboards to improve them. Participants in the StoryCircles facilitator training who simulate StoryCircles PD teachers' practices also occasionally assume the roles of characters in the storyboard, similar to how teachers in StoryCircles PD role-play characters (e.g., the teacher in Figure 2a and the students in Figure 2b). In the



subsequent synchronous meeting, facilitators reflect on their experience of simulating teachers' practices and discuss how this experience might impact their own facilitation practices.

**Figure 2** Examples of different characters in the storyboarded lesson used in activity 4

- a. A frame from a lesson storyboard where a teacher character is providing an instruction.      b. Proceeding frame from the lesson storyboard where student characters are explaining their work.



To analyze the various interactions in activities 1, 3, and 4, we examined the asynchronous comments the facilitators made and synchronous dialogue of the facilitators. This involved retrieving annotations from the respective storyboards and transcripts from the video recordings. We segmented the data according to the sequence of activities (see Table 1) and coded the language used by facilitators for each comment or each turn spoken.

#### 4. Data analysis

To identify a framework for examining how facilitators develop their understanding of their facilitation practices, we consider how the context of the StoryCircles facilitator training enables facilitators to communicate with each other while assuming multiple roles and perspectives. To foster productive and high-quality discourse in teacher professional development, Zhang and colleagues (2011) emphasize the importance of "dialogic discourse" (p. 348), which involves the interaction of multiple voices, perspectives, and modes of communication, leading participants to co-construct a shared understanding. The engagement of facilitators in StoryCircles facilitator training provides diverse perspectives and opportunities for role-taking, such as observing a facilitator's moves and simulating the roles of participants. As facilitators develop their understanding of facilitation practices while assuming these various roles, they engage in communication with other facilitators, negotiating meaning and building upon each other's interpretations.

We utilize a linguistic framework to examine communication among facilitators and explore their perceptions

of facilitation practices within practice-based professional development. Drawing on Halliday's (1978) systemic functional linguistics, which views language as a "system for making meaning through which language users both reflect and constitute themselves as social agents" (Eggins & Slade, 2004, p. 57), we focus on the interpersonal metafunction. Specifically, we analyze the linguistic systems of person, polarity, and modality to examine how the tokens in the language used by facilitators relate them to their audience. By analyzing their communication, we gain insight into their expectations of the various roles and relationship between roles, such as the dominance of certain roles or how roles are initiated in interactions (Eggins & Slade, 1997; Halliday & Matthiessen, 2004). This analysis reveals how facilitators may relate to or deviate from the expected norms of facilitation or instructional practices in StoryCircles.

In systemic functional linguistics, the person of a clause is indicated by the use of pronouns, which represent the author in relation to the audience. The first-person pronoun signifies the author's personal involvement with the claim, whether "I" as an individual or "we" speaking on behalf of a community, or sometimes with ambiguity regarding the referent of "we" (Herbel-Eisenmann & Wagner, 2007). The use of "we" instead of "I" can also indicate an effort to involve the audience in the claim (Herbst & Kosko, 2014). The second-person pronoun "you" may refer to the audience if directed at them (Herbel-Eisenmann & Wagner, 2007), or it may be used ambiguously when the referent is unclear (Rowland, 1999), while a third-person pronoun provides a clear reference.

Polarity distinguishes between affirmation (positive polarity) and negation (negative polarity). Polarity can help us understand the speaker's stance and opinions towards a certain practice. In comparison, the use of modality in language can facilitate negotiation or discussion of that stance, rather than simply stating a viewpoint or position (polarity).

Modality has been described as the "range of different ways in which speakers can temper or qualify their messages" (Eggins & Slade, 1997, p. 98). For example, Herbst & Kosko (2014) used the linguistic system of modality to identify statements in the discourse that involve the communication of a stance, where modality then engages the audience in the negotiation of that stance. The audience is invited to comment on, concur, or disagree with the earlier proposition. We can also see, in various international research in education, how modals have been used to position themselves to their audience. For example, Stevens (2004) shows that "changing roles of participants within a discourse can symbolize the hardening or softening of one's stance. For example, suggesting that someone may consider your idea versus saying that someone must consider your idea marks particular differences in one's positioning of themselves in a discursive role." In other words, as the speaker invites others into the conversation, the use of modality can reveal their level of certainty or opening and closing opportunities for discursive exchange around various roles in StoryCircles.

For our analysis, we use Halliday and Matthiessen's (2004) four categories of modality: probability, usuality, appropriateness<sup>3</sup>, and desirability. Probability conveys the likelihood of a process, while usuality indicates how typical a process is. In contrast, appropriateness conveys whether the process is deemed appropriate

(or if the speaker feels obligated), while desirability conveys whether the process is desirable (or if the speaker feels inclined). Probability and usuality utilize lexicogrammatical choices to provide means to temper statements about what purportedly is the case (Eggins & Slade, 1997; Herbst & Kosko, 2014), while appropriateness and desirability provide means to temper statements about what ought to be the case (Herbst & Kosko, 2014). The table below (Table 2) provides examples of each modality type. Each modality type was further distinguished by affirmation (positive polarity) and negation (negative polarity), and the perspective of the process is conveyed in relation to the person it is about (i.e., "facilitator," "participant," "teacher," "students") or the person whose perspective is taken (i.e., "I," "we," "she").

**Table 2** *Examples of the use of modality in activity 1*

| Modality        | Examples of <u>negative polarity</u>                                                                                                                                           | Examples of <u>positive polarity</u>                                                                                                                                                                                                                                                                              |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Probability     | 2a. The facilitator says she is pushing an idea which seems like it <b>may invalidate</b> what the teachers are asking for                                                     | 2b. [The facilitator] pushes teachers to accept one way of doing the problem—it's good to acknowledge the diversity and then come to discussion that <b>there could be</b> ways to solve without using square root 18. I think teachers are not yet in agreement with multiple solutions, <b>possibly maybe</b> . |
| Usuality        | 2c. <b>Again</b> , <u>takes away</u> from teachers' directing the conversation.                                                                                                | 2d. <b>Generally</b> , the group seems ready to take cues from the facilitator's demeanor and tone. This feels problematic. I also wonder about the <b>frequent use</b> of "I want to go to slide..." by the facilitator. Shouldn't the group do more deciding?                                                   |
| Appropriateness | 2e. This was a bit of a problem throughout... Some feedback to the facilitator <u>to watch</u> providing input and rather solicit it, instead, <b>might be in order here</b> . | 2f. [The facilitator] <b>should</b> ask teachers for their opinions—what if teachers had the misconception and it didn't get addressed                                                                                                                                                                            |
| Desirability    | 2g. She <b>wanted</b> the teachers to focus <u>less on</u> the formulas, which I think is more in line with the problem-centered approach.                                     | 2h. The teacher says he <b>likes</b> it because it builds on prior knowledge and the facilitator asks "What prior knowledge?"                                                                                                                                                                                     |

## V. RESULTS

### 1. During the demonstration of practice

First, we report our findings in response to the first research question: How does the language used by facilitators when discussing their facilitation practice of StoryCircles compare during and after engaging in a demonstration of practice? In particular, we focus on the facilitation practice of centering teachers' voices, which helps guide participants to consensus on how to improve the lesson storyboard.

During the demonstration of practice in activity 1, facilitators individually identified 153 facilitation moves: 86 moves labeled as more productive, 65 labeled as less productive, and 2 moves labeled as both more and

3) Halliday and Matthiessen (2004) called this obligation but we are using appropriateness as per the Herbst and Kosko (2014) argument that modality types provide different interpretations of the notion of a norm with appropriateness – appropriateness being a "way to assert a norm in the sense of what participants hold each other accountable to do" (p. 522).

less productive. After coding for the four categories of modality—probability, usuality, appropriateness, and desirability—we found the following: In the less productive moves, there was the most use of appropriateness (20 moves), followed by usuality (11 moves), probability (8 moves), and desirability (3 moves). In the more productive moves, there was the most use of appropriateness (11 moves), followed by desirability (9 moves), probability (5 moves), and usuality (1 move). The 2 moves labeled as both more and less productive were coded as desirability and appropriateness (see Table 3).

While appropriateness was the most used category (32 instances) to communicate facilitators' stances on whether facilitation moves were more or less productive, their stance was mostly affirming (positive polarity) the appropriateness of the facilitation moves. There were only 5 instances of negation (a facilitation move is not appropriate) compared to 27 instances of positive use (a facilitation move is appropriate). The person being referred to was often the facilitator in the demonstration (21 out of the 32 instances). Even when facilitators described a facilitation move as less productive, they generally used positive polarity to suggest what the facilitator in the demonstration should be doing instead.

**Table 3** Number and examples of the use of modality across more and less productive moves in activity 1

| Less productive moves (n=65) |                                                                                                                                                                                      | More productive moves (n = 86)                                                                                                                                                 |                                                                                                                                                                                                                                                              | Both (n = 2)    |  |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--|
| Modality                     | # Example quote                                                                                                                                                                      | # Example quote                                                                                                                                                                | # Example quote                                                                                                                                                                                                                                              | # Example quote |  |
| Probability                  | 8 3a. tells teachers <b>possible</b> student strategies                                                                                                                              | 5 3b. focusing on authentic responses which <b>can be</b> challenging for newer teachers                                                                                       | 0 n/a                                                                                                                                                                                                                                                        |                 |  |
| Usuality                     | 11 3c. <b>There are a few places</b> where they speak over each other. Is there a way to create norms for when people will speak online or how to know not to speak over each other? | 1 3d. <b>Again</b> , the facilitator is empowering the participants to make the final decision on the issue at hand.                                                           | 0 n/a                                                                                                                                                                                                                                                        |                 |  |
| Appropriateness              | 20 3e. Some feedback to the facilitator to watch providing input and rather solicit it, instead, <b>might be in order here</b> .                                                     | 11 3f. Here she drew the teacher-participants' attention to what students <b>were expected to do</b> to put more clarity to the discussion.                                    | 1 3g. [the facilitator's] <b>task is</b> to encourage the teachers to voice their ideas based on their own experiences. She <b>should</b> minimize sharing her own ideas. However, she opened a new and fruitful discussion by sharing her experiences.      |                 |  |
| Desirability                 | 3 3h. A question here might have been better. You <b>want</b> the group to come to a conclusion about the perceived error.                                                           | 9 3i. By saying that she <b>enjoyed</b> the discussion, [the facilitator] indirectly expressed how she <b>valued</b> all the participants' opinions—even if they were opposing | 1 3j. On one hand, the way the facilitator seemed to push her own ideas on the group was less productive. On the other hand, she <b>wanted</b> the teachers to focus less on the formulas, which I think is more in line with the problem-centered approach. |                 |  |

### **1) Less productive moves communicated with appropriateness and usability**

A common theme of what participants of the StoryCircles facilitator training deemed appropriate can be illustrated in the example quote in Table 2, section 2f. Participants of the StoryCircles facilitator training who made this comment suggests that the StoryCircles facilitator should ask teachers for their opinions. Similarly, the appropriateness of a facilitator centering teachers' voices is illustrated in the use of negative polarity in Table 2, section 2e. Participants of the StoryCircles facilitator training expresses a negation viewpoint using "to watch" (or to avoid) while suggesting, with "might be," the appropriateness, using "in order here," of what the facilitator in the video was demonstrating: giving too much input.

The use of appropriateness when describing less productive moves was supplemented by the use of usability - the next most used modality type after appropriateness. Participants of the StoryCircles facilitator training communicated with usability to describe what was typically happening in the demonstration. For example, in Table 3, section 3c, usability is evident in describing what commonly occurred ("there are a few places") in the video recording ("speaking over each other"), leading to subsequent reflection by the StoryCircles facilitator on creating norms to prevent this behavior.

### **2) More productive moves communicated with appropriateness and desirability**

Participants of the StoryCircles facilitator training frequently used desirability to illustrate more productive moves. For example, one participant remarked on the importance of lesson ownership and encouraging divergent thinking, restating what was said in the StoryCircles facilitators: "This is our depiction. We can do whatever we want," and adding themselves, "A good reminder about ownership of the work and the thinking." Another participant commented as seen in Table 3, section 3j. This once again underscores the significance of encouraging diverse thinking which is a desirable facilitation move.

We also observed that the use of desirability often lacked a high degree of certainty, as evidenced by phrases such as "indirectly expressed" (see Table 3, section 3j) and "I think she wanted to" (see Table 2, section 2g) when interpreting the desirability of the facilitator's actions in the demonstration. Phrases such as "seems like" and "might be" were noted throughout participants' descriptions of less and more productive moves, indicating a lack of high certainty in their perception of facilitation moves. This observation is important for comparison with our subsequent findings.

### **3) Tension between appropriateness and desirability to describe facilitation moves**

There were also two instances—identified by one participant of the StoryCircles facilitator training — where facilitation moves were identified as both more and less productive (see Table 3, sections 3g and 3j). A common theme in these instances was the lack of prioritization of teachers' voices. This issue was noted as problematic because the facilitator in the demonstration was "pushing an idea which seems like it may invalidate what the teachers are asking for." Using desirability, a participant of the StoryCircles facilitator training described this move as appropriate because the facilitator's desire for teachers to focus

less on formulas was "more in line with the problem-centered approach." We see a potential tension perceived by the participant of the StoryCircles facilitator training between the appropriateness and desirability of initiating facilitation moves, as well as the tension between effective facilitation moves and the goals of StoryCircles.

## 2. After the demonstration of practice

### 1) Tension between appropriateness and desirability to describe facilitation moves

The conversation in this segment began with a tension between desirability and appropriateness. One participant of the StoryCircles facilitator training, drawing on their experience as a former high school teacher, expressed their passion for content. They mentioned that because of this desire, as a facilitator, they "tend to want to give [teachers] something to talk about." However, they noted that in StoryCircles, "it feels more like it has to be their storyboard and the facilitator's job is to encourage them to have that conversation." This recognition of the challenge is complemented by their ability to navigate multiple roles: as a teacher, teacher leader, and StoryCircles PD facilitator. Furthermore, the recognition that the lesson storyboard should be the participating teachers' storyboard contrasts with the observation made during the demonstration that naming the storyboard as "ours" (inclusive of both the facilitator and participants) is more productive. The use of phrases like "tend to want to" and "it feels like" softens their level of certainty and invites others with similar dilemmas into the conversation.

Another participant of the StoryCircles facilitator training suggests that facilitators can invite teachers to discuss "how they usually teach this topic in the classroom and what kind of issues students face and how they address it." This approach to discussing normative teaching practices (using usuality) provides a basis for another participant to contextualize this practice within the StoryCircles framework. They explain: "The problem-based classroom really is about the teacher unveiling what the student work is. In a way, where the teacher is no longer the owner of all the knowledge. And so in our situation I think that to be a facilitator, I'm not the owner of the knowledge, but rather I'm going to leverage what my teachers are saying and doing so that I can bring that to light and surface it as leveraging for the learning."

Comparing the second and third sentences of this quote reveals a similar use of appropriateness ("owner of the knowledge") and negation ("no longer" or "not"), highlighting the parallel responsibilities of the teacher and the facilitator. The transition from the third-person pronoun, which indicates an observational stance on teachers, to the first-person pronouns and future tense ("I'm going to") reflects a higher degree of certainty in expressing their own beliefs about their role as a facilitator that fits within the problem-based context in StoryCircles.

This tension between desirability and appropriateness continues to be negotiated among the participants of the StoryCircles facilitator training. For example, one participant describes the temptation to direct the discussion during the demonstration (desirability), despite the need for teachers to collectively design a

problem-centered lesson (appropriateness). Consequently, they conclude that "we should resist" the practice of directing the discussion. Another participant acknowledges the tendency and desire for teachers to follow the facilitator's lead (desirability) but emphasizes the importance of resisting the urge to let their "own" personality take up the conversation (appropriateness). Both participants stress the facilitator's responsibility to avoid these practices, highlighting the importance of not giving in to the temptation to direct or dominate. As noted above, their use of the first-person pronoun reflects their understanding of their own role as facilitators in StoryCircles.

## **2) Comparison between during and after the demonstration of practice**

The comparison of language used by facilitators when discussing facilitation practices within StoryCircles during and after observing a demonstration of practice reveals notable shifts in communication patterns and clarity in facilitator responsibilities. During the demonstration, the most frequently employed modality types were appropriateness, usuality, and desirability. Facilitators often communicated positive polarity or affirmation of the facilitator's responsibility, even when discussing less productive moves. A tension between desirability and appropriateness was recognized by at least one participant during the demonstration. However, after the demonstration, this tension was extensively discussed among five participants of the StoryCircles facilitator training. There was an increased clarity regarding facilitator responsibilities, referencing both the desirability and appropriateness of facilitation practices, and the problem-based approach in StoryCircles. Additionally, participants demonstrated more certainty in their language, illustrated by their use of first-person pronouns and negation, indicating a stronger grasp of what to avoid and what their roles and the expectations are within the StoryCircles framework.

## **3. After the simulation of the teachers' practices**

We also report our findings in response to the second research question: After simulating the role of StoryCircles PD teachers, what are facilitators' perceptions on facilitator roles and practices within StoryCircles? While simulating the roles of teachers in StoryCircles PD, participants of the StoryCircles facilitator training considered both the teacher and students represented in the storyboard (see Figure 2), as teachers in StoryCircles PD would role-play these characters as well. This allowed participants of the StoryCircles facilitator training to discuss how to improve what the teacher and student were doing or saying, or how they were interacting with each other in the storyboard. In addition to considering the teacher and student roles, the participants also assumed the role of the facilitator. They decided to voluntarily step back from the simulation to highlight an interesting facilitation challenge: "making sure that all the [teachers] have the same conception of what the student work is showing." They noted this facilitation practice as challenging "because I feel like there might be a little bit of a difference" in how teachers conceptualize student work.



### 1) Tension between appropriateness and the less desirable storyboard

We highlight a segment of the synchronous and collective dialogue among participants of the StoryCircles facilitator training following their simulation of StoryCircles PD. The conversation began with a participant of the StoryCircles facilitator training discussing how a less desirable but normative (in her context) teaching practice in the storyboard—where the interaction between characters was teacher-centered—relates to her own context. The participant explained that having a strong teacher voice in the classroom was common in her setting because students were not very vocal. The participant then expressed, "I do want [teachers] to have [this new kind of experience]. I want to have a conversation about giving students a voice and letting them speak," inviting other participants to engage with her observations.

Another participant of the StoryCircles facilitator training noted, "I think consensus is always a challenge... enforcing the group to reach consensus is hard," recognizing the difficulty of guiding teachers to reach consensus without imposing their own views, while acknowledging the appropriateness of this facilitation practice in the context of StoryCircles. A different participant responded to this challenge, saying, "Sometimes, reaching consensus can lead to [a less desirable outcome]. Just painful for us to go through this as we might be tempted to push teachers." This participant expressed a concern about preventing teacher consensus about a lesson, as it might lead to the representation of a less desirable teaching practice, as a reason for potentially deviating from the facilitation practices deemed appropriate within StoryCircles.

As illustrated above, participants of the StoryCircles facilitator training grappled with potential tensions arising from teachers recommending practices depicted in the storyboard that the facilitator might consider less desirable. Another participant explained that tensions arise in deciding which teaching practices to consider: "We need to recognize that teachers come [from different backgrounds, with] some being more comfortable with teacher-centered [approaches]. So, it might be difficult to help reach consensus because they hold different beliefs."

### 2) Comparison between during demonstration and after simulation

Recall that, through the demonstration of practice, the participants of the StoryCircles facilitator training identified the need to avoid directing the discussion, as shown by the StoryCircles PD facilitator who pushed teachers not to use formulas. However, the recognition of various teaching practices, including those deemed less desirable, contributed to the participants' awareness of another tension: balancing between the facilitation moves labeled appropriate (e.g., minimizing their input) and concerns about the less desirable outcomes that could realistically emerge from those kinds of moves (e.g., decisions to represent teacher-centered practices in the storyboarded lesson). By simulating various roles in the activity, the participants in the StoryCircles facilitator training were able to appreciate different perspectives held by teachers and anticipated that a less desirable consensus among teachers might tempt facilitators to counteract it. This experience was comparable to how the participants in the StoryCircles facilitator training described the temptation felt by the StoryCircles PD facilitator to impose their own opinion, a practice initially deemed less productive.

The design of the sequence of activities enabled participants to consider multiple perspectives and representations of practice in the storyboard, facilitating discussions on how facilitation practices should align with more desirable (e.g., problem-centered) approaches and avoid less desirable (e.g., teacher-centered) ones.

## VI. CONCLUSION

Through their engagement with the practices of various roles in the StoryCircles facilitator training, facilitators developed a clearer understanding of and sense of responsibility for their own roles within the StoryCircles framework. In particular, by articulating and negotiating their understanding of these practices, facilitators gained a nuanced perspective on their responsibilities. They considered the norms and practices that mathematics teachers face regarding their obligation to the discipline (mathematics) and the responsibilities facilitators have regarding their obligation to their discipline in PD (inquiry on practice). Within the StoryCircles framework, facilitators learned to contextualize the tension between temptation and responsibility in their roles, aligning with the problem-based approach and addressing less desirable representations of practice.

Engaging in the demonstration of practice led to shifts in beliefs about facilitation, particularly regarding lesson ownership, which changed to being primarily the responsibility of mathematics teachers rather than including the facilitator. Simulating teachers' practices in StoryCircles PD allowed facilitators to better understand the practices of the StoryCircles PD facilitator by navigating other tensions regarding teacher practices that facilitators deemed less desirable. Facilitators' learning process through demonstration and simulation also resulted in an increased level of certainty about the appropriateness of their role and a broader understanding of the potential tensions associated with certain facilitation practices.

From the standpoint of practice-based PD design, the combination of individual and collective reflection on practice, along with purposeful engagement with practices demonstrated (in video) and represented (in storyboard) as less desirable, enabled facilitators to critically examine the various roles involved in StoryCircles. This examination also included evaluating the researcher's standpoint and the design's intentions, which were perceived as representing what a facilitator described as a "deficit view of the teacher." Furthermore, the facilitators' ability to reference the practices and norms of various roles was advantageous as they acted as observers (in demonstration) and consumers (in simulation) of practice-based PD. This made the analysis of coding modality, polarity, and persons complex (given the multiple role changing and referencing involved) but also rich with data for us to see the progression of their noticing and learning, which invites and confirms their stance on facilitation practices. These opportunities for such reflection are invaluable for facilitators aiming to balance effective facilitation in professional development with fostering a collective discussion among teachers towards a problem-based approach.

## CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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