Using Student Actors and Video-Mediated Reflection to Promote Preservice Teachers' Ability to Enact Responsive Teaching

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Abstract

This paper describes a teaching intervention that promotes secondary preservice science teachers' (PSTs') ability to enact responsive teaching. The intervention uses a modified version of rehearsals (Lampert et al., 2013) to enhance PSTs' ability to enact a core practice: eliciting, interpreting, and using student thinking. In the intervention, PSTs have opportunities to decompose the core practice represented in classroom video clips and to approximate the practice in rehearsals. The intervention has three unique features: (1) student actors who simulate the complex classroom interactions inherent in responsive classrooms; (2) opportunities to view and analyze how different teachers (i.e., own, peers, and unfamiliar teachers) enact the core practice; and (3) opportunities for PSTs to reflect upon their own rehearsal videos filmed from multiple vantage points in the same classroom using innovative video technology such as point-of-view (POV) camera goggles. We describe what we have learnt from analyzing the PSTs' views on the intervention in terms of their perceived learning from the intervention as well as whether and how the unique features of the intervention supported their learning. We also share the lessons learned and advice that we would like to share with other science teacher educators, especially in terms of how to better use and integrate innovative video technology such as POV footage into the teaching interventions to promote responsive teaching.

Introduction

Like many science teacher educators (e.g., Gotwals & Birmingham, 2016; Kang & Anderson, 2015; Levin & Richards, 2011), we are committed to enhancing preservice science teachers' (PSTs') abilities to enact responsive teaching. In responsive science classrooms, teachers purposefully elicit students' content-specific thinking, carefully listen to the substance of that thinking, and use the information to direct instruction on a moment-to-moment basis (Robertson, Scherr, & Hammer, 2015). Studies have shown that responsive teaching is challenging to enact, even for experienced teachers/teacher educators (e.g., Ball, 1993; Hutchison & Hammer, 2010; Maskiewicz, 2015).

Over the years, we have engaged PSTs in discussing and analyzing classroom videos taken from authentic science classrooms (i.e., videos that are not scripted or staged) to promote their abilities to enact responsive teaching. Although we have had some success using video

analysis to focus PSTs' attention on student thinking (Chan, Leung, He, Lam, & Ng, 2017), anecdotal evidence from student-teaching supervisors and PSTs themselves suggests that our PSTs have difficulty enacting responsive teaching in their student teaching. To address this problem, we have developed an intervention based on rehearsals (Lampert et al., 2013) —a teacher education pedagogy for promoting PSTs' learning of core practices (Grossman, 2018). During the teaching rehearsals, PSTs deliberately practice specific teaching moves and practices in controlled settings (e.g., a methods course) in which their peers play the role of students. These rehearsals allow novice PSTs to "learn to interact productively with students around content in a way that honors the complex and deeply relational work" (Kazemi, Ghousseini, Cunard, & Turrou, 2016, p. 18). Specifically, we use rehearsals to encourage PSTs to enact a core practice in responsive teaching: eliciting, interpreting, and using student thinking (Gotwals & Birmingham, 2016; Kloser, 2014). This core practice entails drawing out content-specific student thinking and making inferences from and responding to this thinking.

In this paper, we describe our teaching intervention and reflect critically upon its first implementation by analyzing the views of the participating PSTs. Our broader aim is to provide concrete insights into how to support PSTs' learning of responsive teaching strategies.

Literature Review

Promoting PSTs' Abilities to Enact Responsive Teaching

Science education reform has advocated for the adoption of responsive teaching in which teachers foreground attention to the substance of student ideas, recognize disciplinary connections within those ideas, and take up students' ideas (NGSS Lead States, 2013; Robertson et al., 2015). These practices are complex and challenging to enact. First, eliciting and listening to student ideas is "unnatural" work that does not develop from everyday experience (Ball & Forzani, 2009). Moreover, these practices are not simple behavioral teaching procedures (Kavanagh et al., 2019); responsive interactions cannot be scripted in advance but rather hinge on teachers' abilities to pay close attention to, analyze, and react to student thinking and to make in-the-moment teaching decisions *during* their interactions with students. Hence, a key challenge lies in how to help PSTs put the ideas of responsive teaching into practice; particularly, how to develop their ability to improvise in response to the disciplinary substance of student thinking amidst ever-changing and immediate classroom interactions.

Using Rehearsals to Promote PSTs' Ability to Enact Responsive Teaching

Some educators have advocated for the use of a core practice approach to promote PSTs' learning (Grossman, 2018; Grossman, Hammerness, & McDonald, 2009; Windschitl, Thompson, Braaten, & Stroupe, 2012). These educators have argued that it is important to

provide PSTs with a continuum of opportunities to deliberately practice so that they can approximate a limited number of “high leverage” practices in increasingly “authentic” settings (McDonald, Kazemi, & Kavanagh, 2013). Accordingly, Lampert et al. (2013) developed a pedagogy of enactment called rehearsals. During rehearsals, novice teachers have opportunities to practice teaching routines in a sheltered environment before implementing these moves in “real-world” classrooms. Typically, rehearsals consist of three or four peers playing the role of students (see Stroupe & Gotwals, 2018). The teacher educator acts as both a coach and a simulated student. Just-in-time feedback in the form of pauses during rehearsals and debriefing sessions after the rehearsals are used to help examine PSTs’ teaching decisions in light of the focal moves and practices (Davis et al., 2017).

Although an increasing number of science teacher educators have used rehearsals in their teacher education classrooms, only a few have developed detailed designs for conducting rehearsals with preservice teachers (e.g., Benedict-Chambers, 2017; Davis et al., 2017; Kelley-Petersen, Davis, Ghousseini, Kloser, & Monte-Sano, 2018). We add to these limited concrete examples of how rehearsals can be used in teacher education classrooms by describing how we have adapted and refined rehearsals such that they can foster PST learning by enacting the core practice of eliciting, interpreting, and using student thinking. We analyzed the participating PSTs’ views about the teaching intervention to help us understand how we might better support PSTs’ learning of responsive teaching.

Design of the Teaching Intervention

Basic Information About the Teaching Intervention

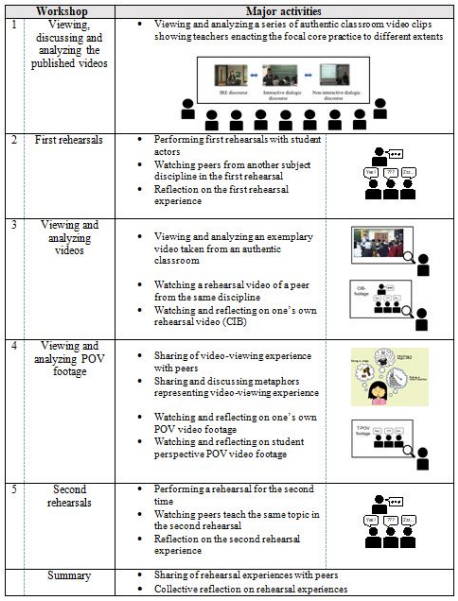
The teaching intervention consisted of six workshops (three or four hours each; totaling 21 hours) before the PSTs conducted student teaching in local secondary schools. These PSTs had little (<1 year) or no formal teaching experience in secondary schools. The design of the intervention was informed by the literature, including studies focused on

- using published videos to represent and decompose teaching practices (Blomberg, Renkl, Sherin, Borko, & Seidel, 2013; Grossman et al., 2009);
- using authentic classroom videos from local classrooms as demonstrations of exemplary practices (Wong, Yung, Cheng, Lam, & Hodson, 2006);
- using accountable talk moves (Resnick, Michaels, & O’Connor, 2010; *Appendix 1*) and talk structures (e.g., think-pair-share, partner talk) as praxis tools to promote the enactment of responsive teaching practices (Windschitl, Thompson, & Braaten, 2018);
- modeling of the relevant practices to promote PSTs’ uptake of the focal core practice (Buck, Trauth-Nare, & Kaftan, 2010);
- using own and peers’ video footage to promote reflection on and discussion of teaching practices (Chan, He, Ng, & Leung, 2018); and

- engaging the PSTs in reflecting on their experience viewing their own and peers' videos via generation of metaphors to represent their video-viewing experience and stance (Leung, Chan, & He, 2019).

Table 1 (Click on image to enlarge)

Overview of the Activities in the Teaching Intervention



Workshop		Major activities
1	Viewing, discussing and analyzing the published videos	• Viewing and analyzing a series of authentic classroom video clips showing teachers enacting the focal core practice to different extents
2	First rehearsals	• Performing first rehearsals with student actors • Watching peers from another subject discipline in the first rehearsal • Reflection on the first rehearsal experience
3	Viewing and analyzing videos	• Viewing and analyzing an exemplary video taken from an authentic classroom • Watching a rehearsal video of a peer from the same discipline • Watching and reflecting on one's own rehearsal video (CIB)
4	Viewing and analyzing POV footage	• Sharing of video-viewing experience with peers • Sharing and discussing metaphors representing video-viewing experience • Watching and reflecting on one's own POV video footage • Watching and reflecting on student perspective POV video footage
5	Second rehearsals	• Performing a rehearsal for the second time • Watching peers teach the same topic in the second rehearsal • Reflection on the second rehearsal experience
	Summary	• Sharing of rehearsal experiences with peers • Collective reflection on rehearsal experiences

Table 1 gives a brief overview of the workshops. First, our PSTs viewed and analyzed a set of videos that showed inservice secondary teachers enacting responsive teaching and using talk moves to different extents. The videos were shown in quick succession with only a brief pause in between (Yip, Chan, Yung, & Lai, 2018). The videos were chosen because they captured teachers enacting the focal core practice to different extents (see *Appendix 1* for the video description and related transcripts). We purposefully selected and showed video clips capturing different quality of enactment such that it was easier for the PSTs to discern the differences in the teachers' use of the core practice. Briefly, one of the teachers selected students' incorrect ideas in the preparatory task. During the whole-class discussion, the teacher asked the students to consider why the selected student responses were wrong. The discourse was authoritative in nature (Mortimer & Scott, 2003), and the students had limited contribution to the classroom interaction (e.g., very short utterances). Another teacher selected responses representing two opposing views about an issue in the preparatory task but used a non-interactive approach (i.e., only the teacher was speaking) in her classroom discourse (Mortimer & Scott, 2003). Finally, a teacher used a voting activity to elicit student thinking in class and used talk moves to sustain the classroom conversation. For example, the teacher pressed the students for their reasoning after they had voted. The teacher also re-voiced the students' reasoning. The PSTs were asked to individually record their observations on each of the three videos. The PSTs then worked in groups to identify the video that showed the 'best' classroom interactions and the strategies used by the teacher to sustain classroom conversation. The PSTs used evidence from the transcripts to support

their views. Based on the discussion, talk moves, including those that were used by the teacher in the video as well as other talk moves (e.g., add on move, restate move), were introduced to the PSTs (Appendix 2).

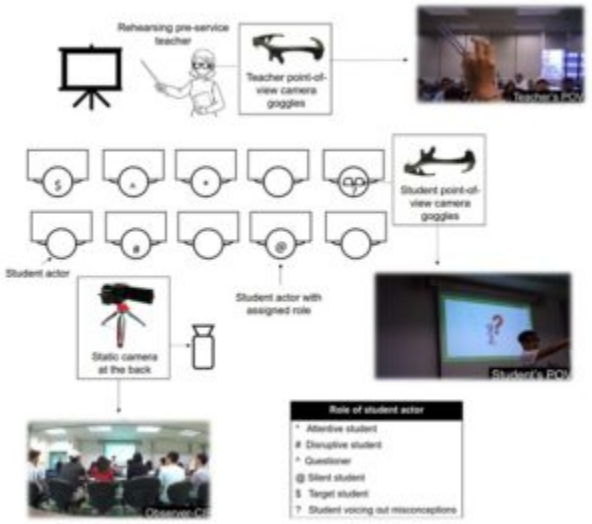
After discussing the videos, we gave the PSTs 1 hour to individually prepare for rehearsals during which they designed a short teaching segment (about 10 minutes) with an intended learning outcome we provided (see Appendix 3 for an example). The teaching segment focused on topics about which secondary students commonly harbor misconceptions. The preparation took place in a well-equipped science laboratory. The PSTs could use any of the resources (e.g., mini-whiteboards, traffic light cards, models) as teaching aids. We separated our PSTs into different content groups (i.e., physics, chemistry, and biology), each with a discipline-specific coach (the three authors). This first round of rehearsals was videotaped using multiple cameras at various locations in the classroom (see *Figure 1*), including (1) a static tripod-mounted camera in the back of the classroom (observer camera-in-the-back [O-CIB] camera); (2) a point-of-view (POV) camera goggle (Estapa & Amador, 2016) worn on the head of the PST (teacher point-of-view [T-POV] camera); and (3) a POV camera goggle worn on the head of a student actor (student point-of-view [S-POV] camera). We used multiple cameras, including POV footage to capture the rehearsal, to circumvent the limitations inherent with any video recording. As explained by Sherin (2004), a video reflects a particular point of view. A recording captured by a static camera placed at the back of the classroom can only capture teacher practices from the *third-person perspective,* and not what the teacher actually sees in the classroom (Sherin & Dyer, 2017). The POV camera goggles can be ordered from (https://www.spytec.com/inventio-hd-wide-angle-edition.html) (Spytec Inventio-HD 720p Video Sunglasses). The PSTs acted as audiences for their peers in different subject disciplines. The PSTs were assigned to watch peers from a different discipline (rather than their own) teach as they would have a chance to watch the rehearsal video of a peer from the same discipline teaching the same topic later.

After the first rehearsal, the PSTs viewed and analyzed an exemplary video taken from a local classroom showing a teacher teaching a junior science topic (grade 7). We purposely delayed the exposure to the exemplary footage to encourage our PSTs to compare and contrast their own enactment of the focal core practice with that of the accomplished teacher. The PSTs then reflected on their peers' rehearsal videos (same subject discipline) and their own rehearsal videos (first the O-CIB footage, then the T-POV footage, and finally their S-POV footage). The PSTs completed a Video Reflection Task (see Appendix 4) while watching each video. The task required the PSTs to list the salient aspects in the video in the form of noticing statements (Roller, 2016). We used open-ended prompts rather than structured analysis prompts or an observation framework (e.g., Santagata, Zannoni, & Stigler, 2007; van Es & Sherin, 2002) to determine what the PSTs were *naturally attuned* to notice in different types of video material (Lam & Chan, 2020; Chan et al., 2020). After

viewing the videos, the PSTs reflected on the experience of viewing their own and their peers' videos by generating metaphors to represent their video-viewing experience and stance (see the details in Leung et al. (2019)).

Figure 1 (Click on image to enlarge)

Video Camera Positions and Design of the Rehearsal Activity



The PSTs had an opportunity to rehearse the same topic again (i.e., a second rehearsal). In this round, the PSTs acted as audiences for the rehearsals of their peers in the same subject discipline group and were tasked with completing an observation record form that focused on how the PSTs who were rehearsing enacted the core practices (see Appendix 5). In the final workshop, the PSTs collectively reflected on what they had learned from the workshops and constructed a summary of 'Tips to enact the core practice effectively' collaboratively using a Google Docs document.

Unique Features of the Teaching Intervention

The teaching intervention had three unique features that are worth further elaboration.

(1) Involvement of student actors. Each rehearsal involved 8 to 10 student actors who were PSTs from a different science education program and in their junior year of study. We chose to include more student actors to better simulate the complexity of classroom interactions as a typical secondary classroom normally comprises much more students. They did not assume the role of a rehearsing teacher but enacted different student roles (*Figure 1*), including target students (Tobin & Gallagher, 1987), silent students (Jones & Gerig, 1994), and students with disruptive behavior (see Appendix 6). We purposely created student roles that expressed partial understandings and/or misconceptions to stimulate PSTs' in-the-moment teaching decisions and reactions in response to emergent student thinking. This design also simulated the complexity of classroom interactions, as challenges and tensions are inherent in responsive classrooms (Maskiewicz, 2015).

Rather than having teacher educators pause during rehearsals, the student actors were prompted immediately after the rehearsals to describe what they had learned from the PSTs' instruction and to provide suggestions to improve their learning of the concepts. Our aim was to focus the PSTs' attention on the impact of their instruction on student learning because prior studies have revealed that novice teachers only form a general impression of what happened after instruction rather than focusing on student learning or the effect of their instruction on student learning (Chung & van Es, 2014; Rosaen, Lundeberg, Cooper, Fritzen, & Terpstra, 2008). These student actors' comments acted as immediate feedback to trigger PSTs' reflection on their rehearsals in addition to feedback from their coach.

(2) Opportunities to watch and analyze different teachers' enactment of the focal core practice. The teaching intervention gave PSTs opportunities to see how the same core practice was interpreted and enacted differently by different teachers. Video is an ideal medium for capturing and conveying the richness and immediacy of the classroom because it allows viewers to observe in-class teaching and learning as if they were physically present (Brophy, 2004). Different types of video (own, peer, published) were used in the intervention because each type has different affordances and limitations (Zhang, Lundeberg, Koehler, & Eberhardt, 2011). The published videos presented the focal core practices and the use of talk moves by different teachers for the PSTs' analysis; the PSTs' own videos served as a mirror to stimulate PSTs' reflection on their own enactment of core practices; and the peer videos provided a window into other novice PSTs' enactment of core practices in the same topic. First, the PSTs had a chance to watch several videos showing in-service teachers enacting the same core practice to different extents. They also had a chance to watch their peers' rehearsal videos and their own rehearsal videos. Finally, they observed their peers' rehearsals live. This design is based on the belief that teaching is a complex endeavor (Hammerness et al., 2005) and that the same practice can be enacted very differently in different classroom situations. PSTs may benefit from seeing variations of the same practice in different contexts and situations because it can widen their repertoires for enacting the core practice.

(3) Examining the rehearsal experience from multiple vantage points captured in videos. In the intervention, the PSTs had opportunities to examine three types of footage of their own rehearsals: O-CIB, T-POV, and S-POV footage (see *Figure 1*). New technologies such as wearable POV cameras have allowed access to teachers' *first-person perspective*, offering what Umphress and Sherin (2014) have called *perspective coherence*. POV footage can preserve "what is accessible and potentially relevant to actual participants as they construct their own trajectory of participation through an activity in a setting" (p. 222). Few studies have harnessed the affordances of this type of footage to promote teacher learning (for an exception, see Luna and Sherin, 2017). We believe this type of footage offers unique physical access to the participants' interactions with student actors that are central to responsive teaching. We also speculated that it would be worthwhile for PSTs to watch footage from *student perspectives* because they rarely have a chance to see their own

teaching through a student's eyes. We therefore filmed the teaching rehearsals using three different cameras placed at different locations (*Figure 1*). These video clips collectively captured the complexity of classroom interactions from multiple perspectives, allowing the PSTs to witness how responsive teaching practices and interactions were enacted from both the teachers' and students' perspectives.

Intervention Outcomes

The nine PSTs (pseudonyms used below), who voluntarily participated in the study, completed their views on the teaching intervention via an anonymous written survey (Appendix 7). We reflected on our implementation based on an analysis of the PSTs' views.

PSTs' Perceived Learning

The PSTs perceived themselves as having an enhanced ability to enact the core practice of eliciting, interpreting, and using student thinking after attending the workshops (Before: M = 2.4, SD = 0.9; After: M = 5.0, SD = 0.7)[1]. The following are reasons for their changes in rating:

> Before the workshops, I did not have much idea about how to elicit, interpret, and use student thinking as contributions to the lesson. … During the rehearsals, I tried to use these learned ideas to teach, and I found that this method of instruction helps students to learn better and provides a better environment for teaching and learning. (Final Survey No. 9)
>
> Before joining the workshops, I could elicit student thinking using very narrow guiding questions. Such methods elicit the teacher's thinking rather than that of the students. Therefore, rarely did I interpret and use student thinking. However, after joining this workshop, one big change I have made is to ask broader guiding questions when eliciting their thinking and to further elicit student thinking based on their previous responses, while interpreting their responses by simply rephrasing them. (Final Survey No. 6)
>
> Before joining the workshop, I was less able and confident to use students' thoughts to continue my lesson since I was not quite sure when would be a good time to open up discussion for the students. After joining the workshop, I've learned more ways to elicit students' thinking and to use their ideas to continue the discussion during the lessons, like using the talk moves. (Final Survey No. 8)

The first comment suggests that the workshops introduced to the PST a new method of instruction. More encouragingly, the comment indicates that this PST started to recognize the value of using the core practice for creating "*a better environment for teaching and learning*." Other PSTs wrote comments indicating that they refined their practices for eliciting student thinking. The second comment is an example of such comments. The PST perceived

him/herself asking higher-quality, more open-ended questions that opened up students' opportunities to think. It is also worth noting the affective outcomes, as represented by the third comment above. The comment also highlights the role of talk moves (a praxis tool) in enhancing the PST's confidence in leveraging student thinking to continue instruction.

Table 2 (Click on image to enlarge)

PSTs' Views of the Usefulness of the Activities in Enhancing Their Learning of the Focal Core Practice

Activity			Rating of usefulness: Total PST: (n=9) Mean (SD)	Score* (PST) #
Viewing, discussing and analyzing other teachers' videos	(a)	Viewing, discussing and analyzing a series of published videos showing teachers enacting the core practice to different extents	3.8 (0.7)	3 (2)
	(b)	Viewing and analyzing Mr. Mak's video (an exemplary video)	3.8 (0.7)	0 (0)
Viewing and reflecting on one's own rehearsal	(m)	Reflecting on your rehearsal experiences	4.8 (0.7)	5 (2)
	(d)	Viewing and reflecting on your rehearsal video	4.2 (0.7)	9 (5)
Viewing peers' rehearsal	(c)	Viewing and analyzing your peer's rehearsal video	4.2 (0.4)	7 (4)
	(n)	Watching peers teach other topics in the first rehearsal	4.3 (0.7)	2 (1)
	(o)	Watching peers teach the same topic in the second rehearsal	4.7 (0.5)	5 (2)
Viewing and reflecting on POV footage	(e)	Viewing and reflecting on your point of view (POV) video footage	3.8 (0.8)	0 (0)
	(f)	Viewing and reflecting on student perspective point of view (POV) video footage	3.9 (0.8)	0 (0)
Performing rehearsals	(j)	Performing rehearsals with student actors	4.9 (0.3)	10 (4)
	(k)	Responding to student actors with different roles	4.7 (0.5)	2 (1)
	(l)	Rehearsing for the second time	4.9 (0.3)	13 (6)
Collective reflection on video-viewing and rehearsal experiences	(g)	Sharing of video-viewing experience with peers	4.3 (0.8)	0 (0)
	(h)	Sharing and discussing metaphors representing video-viewing experience	3.3 (0.7)	1 (1)
	(i)	Sharing of rehearsal experiences with peers	4.4 (0.7)	0 (0)
Support from facilitators	(p)	Theoretical input (e.g., principles and strategies) by the facilitators	4.3 (0.7)	6 (3)
	(q)	Modeling of the core practice by the facilitators	4.8 (0.4)	0 (0)
	(r)	Feedback by the facilitators on rehearsals	4.7 (0.5)	4 (2)

* 1 = Not at all useful; 2 = Slightly useful; 3 = Somewhat useful; 4 = Very useful and 5 = Extremely useful.

The PSTs chose those activities that they perceived to be most influential on their learning (see Appendix 7). The top-ranked activity was given a score of 3, the second-ranked activity was given a score of 2, and the third-ranked activity was given a score of 1. The number in the brackets refers to the number of PSTs who chose this activity as one of the three influential activities.

PSTs' Views on the Unique Features of the Intervention

Table 2 shows PSTs' rating of the usefulness of the activities in the workshops. Thirteen of the 18 activities received ratings of between 4 (very useful) and 5 (extremely effective). All nine PSTs ranked *performing rehearsals* (i.e., items j, k, or l) as one of the top three influential tasks in facilitating their learning (Score: 25). The following quotations illustrate some of the reasons they found performing rehearsals with student actors helpful:

> When I was preparing for the first rehearsal, I focused a lot on my presentation flow, which was a bit teacher-centered. I was so panicked when dealing with questions raised by the student actors with misconceptions. And the lesson couldn't run smoothly. Therefore, I learned the lesson that I should also research the common misconceptions of students before the lesson, so that I can respond better next time. (Final Survey No. 7)
>
> [For my most important learning], maybe I have learned how to react to the unexpected behaviors of students and to the students with roles, well, learned how to respond to them, the disruptive ones, silent ones, and those kinds of students who will answer a lot of questions. (Paul, Verbal Reflection during the rehearsal workshop)

These comments highlight an important feature of the rehearsals. They gave the PSTs opportunities to practice dealing with the complex and immediate classroom interactions inherent in responsive classrooms. Their comments also make clear that this was possible because of the “scripted” roles specifically assigned to the student actors, who expressed unexpected student ideas or acted in ways that stimulated in-the-moment decisions and reactions from the PSTs. As a result of their rehearsal experience, the PSTs learned to predict the students’ thinking during the lesson planning and to develop strategies to cope with different types of students. Some PSTs pinpointed the importance of having a *second* chance to rehearse.

> Real situations for me are for putting theory into practice, and teaching the same topic can made me re-think the last rehearsal and use the last [rehearsal] experience to modify my new one. (Final Survey No. 4)
>
> After observing students’ responses at the first rehearsal, I found that my lesson was clear, but not engaging. Therefore, I changed my approach, to elicit student questions that are more related to our daily lives, and the responses were good. So, I will change my questioning style in order to engage more students in my future lesson. (Final Survey No.11)
>
> By confirming that the students felt comfortable answering my guiding questions and that they felt the pace of discussion was steadily moving forward with their input being valued, the feedback right after the second rehearsal from the student actors helped me consolidate my knowledge of how to enact core practices. (Final Survey No.8)

It can be inferred from the above comments that giving the PSTs the opportunity to rehearse the *same* lesson a second time had at least two advantages. First, the PSTs were able to turn what they learned from reflecting on their first rehearsals into concrete actions. Second, PSTs verified whether these changes actually had the expected impact on student learning. It is worth noting that the student actors’ just-in-time feedback was instrumental in reinforcing PSTs learning. Their comments reaffirmed productive changes (e.g., using more relevant scenarios to elicit student thinking, valuing student input) made by the PSTs. Encouragingly, the initial evidence suggests that the PSTs will apply what they learned in their future teaching practice (e.g., *I will change my questioning style … in my future lesson*).

To summarize, the PSTs highly valued the chance to rehearse with student actors who played different roles to simulate complex classroom interactions that triggered PSTs’ in-the-moment teaching decisions and reactions. The student actors gave just-in-time feedback on what they had learned from the rehearsing PSTs across two rehearsals. This design was perceived as beneficial by the PSTs.

Six of the nine PSTs identified watching peers teach, either live or on video (Score: 14), as one of the three most influential experiences, as expressed in the following quotations.

> [When watching my peers teach live in rehearsals], I can observe the classroom as a whole. I can learn from my peers about the pros and cons of their pedagogies. … We can actually discuss together our pedagogical decisions. (Final Survey No. 3)
>
> The peers provided me with a lot of new teaching ideas. It was great that I can compare my lesson with my peers' lesson immediately (when watching them live). And I could understand more about the students' needs and feelings by really acting as a student. (Final Survey No. 7)

Both PSTs quoted above reported that watching their peers rehearse live allowed them to learn from them. The PSTs got a holistic feeling of the classroom and accessed their peers' pedagogical decisions in the post-rehearsal reflective discussion. Watching peers teach the same topic triggered meaningful comparisons between the PSTs' own practice and the peers' practice, as evident in the comment, "I can compare my lesson with my peers' lesson immediately." We also have evidence that the PSTs believed that watching their own video and their peers' videos *in tandem* promoted their learning.

> After analyzing my previous rehearsal video, I saw room for improvement. Repeatedly watching it reminded me to keep the good things that I did and avoid making the mistakes that I had made before. I could also learn from my peer by watching and analyzing her video. By knowing what my peer did, I could know how she interpreted the core practice, and could compare my interpretation with hers. (Final Survey No. 4)

The PSTs not only described the affordances of watching their own videos to identify strengths and weakness (e.g., Gaudin & Chaliès, 2015), they also noted that watching peers teach was particularly helpful for making meaningful comparisons between different interpretations of the core practice.

Interestingly, although the PSTs perceived viewing other teachers' enactment of the core practice as helpful, we found that the PSTs did not rate watching others' teaching (i.e., published videos) as highly (items (a) and (b): 3.8 out of 5) as viewing their own video (item (d): 4.2 out of 5) or peers' videos (item (c): 4.2 out of 5), even though we used authentic video cases taken from local secondary classrooms. It seems that watching peers teach was a more motivating experience for PSTs. There are two possible reasons for this: first, the peers might have developed a rapport during the methods course; and second, both self and peer videos concerned teaching of the same content. The PSTs might, therefore, have considered their own and their peers' videos as being more relevant to their learning. Overall, the PSTs were highly positive about the chance to analyze various enactments of core practices, in the form of both video records and live observation.

Contrary to what we had envisaged, the PSTs did not perceive viewing their own POV footage, including the teacher's POV and the student's POV, as particularly useful to their learning (M = 3.8 out of 5 and M = 3.9 out of 5 respectively). None included watching POV

footage as one of the three most influential learning experiences. The data led us to re-examine our assumption about the *added* value of engaging PSTs in viewing and reflecting on POV footage. At the outset, we thought that by engaging our PSTs in viewing and reflecting on their rehearsals via other classroom perspectives made available in the two POV clips (i.e., first-person teacher's POV and first-person students' POV) would be beneficial to their learning. We believed that analyzing the interactions and responses from multiple viewpoints would help the PSTs to reflect on their enactment of the core practice from the perspectives of multiple actors. The responses from the PSTs led us to wonder whether that was the case. In hindsight, we see that POV footage is an extremely information-dense medium; it does not only capture rich images of the classroom events, but also the motions and actions of the actor. The information-dense footage may easily lead to cognitive overload (Erickson, 2007). More problematically, the rich information might have side-tracked our PSTs and shifted their attention to the motions/actions of the actors away from the focus of the interactions between the multiple actors in the classrooms. We might have under-estimated the difficulties of adopting the perspective of the respective actor simply by watching a POV clip and did not provide sufficient support and scaffolds to guide our PSTs to notice the interactions in the POV footage that were salient for analysis. This difficulty led us to question whether a static camera placed at the back of the classroom could capture sufficient detail and render the POV footage unnecessary.

Unanticipated Benefits and Missed Opportunities

To our surprise, the student actors were very active in the rehearsals. Some even spontaneously expressed ideas that were not within the misconception list given to them. Three junior PSTs, who participated as student actors but not as the rehearsing teacher, enjoyed the workshops so much that they even emailed us describing what they had learned from being the student actors. Below are their views:

> I think it's really great as I can observe different teaching styles by different teachers. Their pedagogies are well enacted, and they are very different from the pedagogy used in traditional secondary school lessons. This is one special point about the workshops that I did highly appreciate. (Student Actor 1)
>
> I can see different ways of teaching during the rehearsals and have a chance to compare these ways to identify which one is better or more suitable for me. (Student Actor 2)
>
> Since I usually acted as a questioner, I encountered various ways used by the rehearsing teachers to respond to my questions. I could discern how these different ways really affected my learning progress and my willingness to ask questions. From the workshops, I also discovered a better way to answer students' questions – encouraging other students to address the question to stimulate further discussion. (Student Actor 3)

The three comments suggest that the experience of being involved in the rehearsals of different rehearsing PSTs can, by itself, an educative experience for the junior PSTs even they were not exposed to the theoretical ideas of core practice or talk moves. Although we anticipated that the student actors might benefit from the list of students' common misconceptions given (see Appendix 3), we did not envisage that they would learn new pedagogies from the rehearsal experience. In retrospect, we should have capitalized on this opportunity to promote their learning. For example, we may provide structured reflection prompts to guide them to reflect on the different ways of enacting the core practice that they had experienced in the rehearsals and how these nuances in approaches had impacted on their learning from the different rehearsals. To illustrate the interactions between the student actors and the rehearsing PST, readers may refer to Appendix 8 for a vignette illustrating the classroom interactions that occurred during rehearsals and the reflective discussions held after the rehearsals.

Conclusions

We described in detail our unique design for a teaching intervention using rehearsals to promote PSTs' learning of a core practice: eliciting, interpreting, and using student thinking. We found that our PSTs perceived themselves to be more competent in enacting this complex core practice after the intervention. Specifically, they considered the carefully designed rehearsal experiences, particularly the involvement of student actors and the opportunities to view different teachers enacting the same core practice, as important in enhancing their learning. We offer the following advice to other science teacher educators based on our critical reflection:

1. Involve junior PSTs as student actors who play different roles. This can make rehearsals a more 'authentic' experience for the senior PSTs. Alternatively, the PSTs might serve as student actors for the rehearsals of PSTs from other disciplines.
2. Provide opportunities for PSTs to see how the same core practice can be manifested in practices by different teachers. This can expand the repertoires of the PSTs in terms of how to enact the core practice.
3. Although wearable POV cameras offer unique affordances such as allowing access to teachers'/students' first-person perspective and how different actors participate in classroom interactions, POV footage is information-dense and can be cognitively overloading, particularly for novices. When both static and POV footage are used. Educators are advised to critically consider the unique affordances of POV footage in relation to static footage. Do not underestimate the difficulties of learning from POV footage. Provide sufficient support and scaffolds to guide our PSTs' observation in the POV footage.
4. Have junior PSTs reflect on their experience of being a student actor, as being a student actor can be an educative experience in and of itself.

We hope that by constantly improving our intervention, we can cater to the learning needs of our PSTs and better support their learning to enact the complex practices of responsive teaching. Visit this page https://tdgfootage.wixsite.com/mysite for on-going updates of the project progress and resources.

Author Note

[1] We choose not to use a pre-post design but administered the survey one time that included retrospective items. It is because we believed it would be difficult for the PSTs to self-evaluate their ability to enact core practice without first understanding the meaning of the focal core practice.

Supplemental Files

Appendices-1.docx

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