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A Teaching Practicum Model for Constructing Cogenerative Dialogue Amongst Preservice Teachers to Improve Science Teaching

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Abstract

The specific focus of this study is how a team of four preservice teachers experienced a collaborative practicum model to support the development of cogenerative dialogue and foster professional growth. Data sources included individual video club annotations and the associated group discussions facilitated by comparison of groups members selected annotations. The analysis found that participation in peer collaboration provided multiple viewpoints of shared teaching experiences that enabled preservice teachers' different ways to notice student thinking. Providing a structured framework for reflection, namely the individual video club annotations, served as the genesis for cogenerative dialogues centered on instructional change for the preservice teachers. This work's implications showcase the importance of allowing for the iterative enactment and reflection on pedagogical choices by preservice teachers early in their professional development.

Keywords:

Early Field Experience, Teacher Preparation, Collaborative Learning, Cogenerative Dialogue

Introduction

Teaching has increasingly become structured as a collaborative community endeavor (NCTAF, 2016). Collaboration among teachers cultivates improved instruction opportunities and is critical to effective teacher professional development (Darling-Hammond et al., 2017). These opportunities foster inquiry and reflection into teachers' practices and afford space for attending to dilemmas in practice (Ball & Cohen, 1999). Involving teachers in professional learning communities is one example of a collaborative learning space that can engage teachers in learning from each other's perspectives and expertise, modeling effective core classroom practices, and providing mutual support (Darling-Hammond et al., 2024). Communities of practice, another collaborative context for professional learning, have shown benefits with teacher motivation to extend the work form the community into their practice when collaborating in a community of a similar grade or grade band, or related subjects (e.g., math and science) (Gore & Rosser, 2022).

Beginning teachers should experience the kinds of teaching strategies they are expected to in their future classrooms to understand how various strategies may play out in different contexts (i.e., different grades and schools) (Hargreaves & O'Conner, 2018; Darling-Hammond et al., 2019). Drawing on what we know about the benefits of professional learning communities or communities of practice, similar experiences should be provided to preservice teachers (Hammerness et al., 2005). Additionally, including such experiences, which very likely could be required of these novice teachers to participate in at their future schools, will help preservice teachers learn early on how to manage challenges that arise in collaborative work and to practice giving and receiving feedback from colleagues (Darling-Hammond et al., 2024; Ingersoll et al., 2014). Considering this goal, this study seeks to explore how a collaborative teaching model, designed to encourage the development of a shared or cogenerative dialogue about the practice of teaching science, supports preservice teachers in offering and receiving feedback to improve lessons, as well as how this feedback is taken up by the team and put into practice. Also, what do the preservice teachers value about the iterative collaborative practicum model concerning their future teaching.

Theoretical Framing and Related Literature

For this study, we adopt a sociocultural perspective to teacher learning (Wenger, 1998) because learning to teach is understood to be derived from sociocultural phenomena (Tobin & Roth, 2006). The preservice teachers in this study work collaboratively as a teaching unit to plan, teach, and reflect on their science teaching to elementary-aged children. This work is contextualized in an informal community-based science program for children, mirroring the professional practices of classroom teachers in a shared learning environment (Lave & Wenger, 1991) of an informal community-based science program for children.

Preservice teachers should be engaged in a collaborative and social learning environment, like a professional learning community or community of practice, like classroom teachers. They must understand that sharing ideas and engaging with others in instructional practice can enhance all practices. Through co-planning, co-teaching, and co-teaching, which is the foundation of the practicum model for this study, preservice teachers can learn to position themselves as instructors in their classrooms and take on the identity of professionals working in a genuine classroom context with diverse learners. Cochran-Smith and Villegas (2015a) suggest that preservice teachers can learn from one another by exchanging ideas, articulating the reasoning behind instructional choices, exploring specific problems of practice, and reflecting on their teaching to improve student learning. The practicum model introduced in this study is designed to provide preservice teachers with space, time, and support to achieve each goal.

Cogenerative Dialogue

Cogenerative dialogue is a structured discussion among participants based on shared experiences and focused on improving teaching and learning (Martin, 2007). These dialogues are centered on implementing an activity, lesson, or assessment and allow teachers to reflect on practice. Scantlebury et al. (2008) "found that cogenerative dialogues occurred during weekly co-planning sessions amongst co-teachers and interns. For co-teaching to be successful, all co-teachers must participate in co-planning. The co-planning sessions led to the professional development of the teachers through shared ideas, reflection on past experiences, and development of collective, mutual understandings of practice" (pg. 972). Siry and Martin (2014) further demonstrated that video analysis and cogenerative dialogues offered structural support for preservice teachers in their field-based science methods course for critical reflection on their teaching to improve practice. Cogenerative dialogues between co-teachers that focus on pedagogical ideas and curricular instruction are referred to as brainstorming. In these dialogues, every voice is given equal importance, and no single voice is privileged over another (Scantlebury et al, 2008).

Co-teaching and Co-planning

Co-teaching cultivates a community of practice (Gallo-Fox, 2010) between preservice experienced teachers. In student teaching, preservice teachers get assigned to work with experienced teachers to share student learning responsibility (Gallo-Fox & Scantlebury, 2016; Soslau et al., 2019). The co-teaching arrangement has learning opportunities for both the preservice teacher (Bacharach et al., 2010) and the co-teacher (Gallo-Fox & Scantlebury, 2016). In co-teaching, the co-teaching, the co-teacher and preservice teachers commit to planning, teaching, and reflecting together, thus sharing knowledge and expertise to facilitate students' learning and strengthen their practice (Murphy & Martin, 2015). Teachers are knowledgeable and reflective professionals who work in the context of professional communities and make reasoned decisions in the service of their students (Cochran-Smith & Villegas, 2015a, p.10).

However, co-teaching is rarely translated to early field or practicum experiences because successful co-teaching. Requires an opportunity for co-planning (Carlisle, 2010). This phase of the collaborative process requires co-teachers to collectively develop a lesson that facilitates student learning and coordination of teaching duties amongst teachers (Gallo-Fox &

Scantlebury, 2015). It is in this phase that cogenerative dialogues are often born concerning all aspects of high-quality and equitable teaching centered on student learning and assessing student understanding. Co-planning amongst teachers increases the variety of pedagogical choices and assessment choices used. This phase, combined with co-teaching, is enhanced further when teachers engage in the act of reflective practice together (Thousand et al., 2007). This collective process of co-planning, co-teaching, and co-reflection gives preservice teachers agency in making evidence-based decisions regarding student learning (Scantlebury et al., 2008).

Co-reflection and the Role of Video Clubs

Video clubs allow teachers to reflect on teaching with authentic representations of practice (Sherin et al., 2009). In the preservice context, video clubs afford preservice teachers access to student thinking that they can then leverage to deepen their pedagogical content knowledge, including their understanding of science content and ideas for science learning (Hawkins & Park Rogers, 2016; Johnson & Cotterman, 2015). Each member analyzes the same video lesson, providing evidence to support claims and judgements. Others can then evaluate this evidence regarding the claims in the group for usefulness in achieving the learning goals (Barnhart, 2020; Nielson, 2015; Zhang et al, 2011). Socially, the ideas that emerge from collaborative reflections become new resources for club members (Gwyn-Paquette, 2001).

Further research is required to understand how teacher learning evolves through teacher's collective video analysis (Barnhart, 2020). Inservice teachers were thought to draw from both video analysis and professional knowledge to support collaborative discussions, however, when the focus shifted to their teaching, collaboration declined concerning critiquing instructional choices (Barnhart, 2020). Preservice teachers have been found in high frequency to uptake annotation of their peers in written lesson reflections regarding supporting students' science thinking (Barnhart, 2022). However, with both in-service and preservice teachers, opportunities are often not provided for iterative enactment and reflective analysis, which are critical to the long-term adoption of these practices (Barnhart, 2020; 2022).

Aim of Study and Research Questions

Before field teaching experiences, preservice teachers learn educational theories and techniques in methods courses. These single-site studies of teacher educators utilizing their courses and programs as research sites have contributed overwhelmingly to the field of teacher preparation practice (Cochran-Smith & Villegas, 2015a). The focus of these studies is on ways to help preservice teachers learn to interpret classroom life in rich, accurate, and complex ways, often by learning to analyze the data of practice. However, many studies in this area of research focus on how candidates discussed appropriate practices for various situations, but this discussion was rarely focused on their specific teaching tasks and techniques. Therefore, there is a need to link these two viewpoints about practice in new ways that are constructive and complex (Cochran-Smith et al, 2015b).

This study contributes to this need by investigating the extent to which four preservice teachers participating in a collaborative, authentic co-teaching context, a professional learning community or community of practice of sorts, to learn how to work with other teaching professionals (in this case peers) to develop a consensus of how to plan for and implement two hours of high-quality science activities each week for 3-weeks. Investigating how preservice teachers' ideas are integrated into a professional learning community during the early stages of professional development can assist the field of teacher education in determining how to help prospective teachers recognize key aspects of their practice and communicate these ideas. Encouraging novice teachers to voice their thoughts on reform-based practices is critical to the cogenerative dialogue. Often novice teachers lack the confidence in contributing to these important moments of dialogue with colleagues who are more experienced classroom teachers. Therefore, allowing the opportunity to develop this important practice with peers may give them the confidence to continue this work once they enter the profession. This study, therefore, seeks to explore how providing context and opportunity for developing peer-to-peer cogenerative dialogue can support elementary preservice teachers in learning to teach science. For this study, we draw on a video club structure (Sherin et al., 2009) to structure co-reflection, and a professional learning community to support the overall structure of the co-planning, co-teaching, and co-reflection (i.e. video club). The research questions guiding this study are:

> *Research Question (RQ)1: What ideas are individuals contributing to the cogenerative dialogue of the team and how are individual's contributions being taken up in co-reflection (video club) concerning the team deciding what to modify or plan for the next lesson?*
>
> *RQ2: What value, if any, do the preservice teachers share about participating in a video club-based professional learning community designed to support cogenerative dialogue for learning to teach science?*

Situating the Study

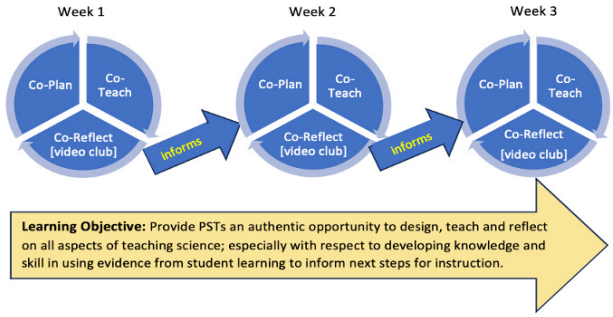
This study takes place in an advanced elementary science methods course at a Midwestern University in the U.S. The preservice teachers taking this course are juniors or seniors (3rd or 4th-year students)

completing the course as a capstone to their science concentration per their education degree requirements. A significant component of this course is a 6-week teaching practicum on Saturday mornings. The teaching practicum ran for 2.5 hours and consisted of four grade level mixed classrooms representing Grades K-8. The practicum was split into two 3-week sessions during the semester of the study to accommodate local school districts and the University's fall breaks.

The preservice teachers were divided into small teaching teams of 3-4 individuals based on their prior teaching experience and the grade levels they aimed to gain experience teaching. Each teaching team functioned as a professional learning community, including a science education PhD student who served as a content expert. Author 1 served as one of these experts for one team. Author 2 was an additional expert common to all teams as they were the faculty instructor for the entire methods course and the Saturday morning teaching practicum coordinator.

The preservice teachers spent time in their weekly methods course meetings in their professional learning communities to plan for and reflect on their teaching experience. To guide this process, and support the communities' cogenerative dialogue, we adopted a three-part model (see Figure 1) that had the teams co-planning, co-teaching, and co-reflecting together weekly. The structure of each component, which Author 2 designed, is described below.

Figure 1
Instructional Model Supporting Cogenerative Dialogue



Co-Planning

Planning for the teaching experience began with each professional learning community developing a unit matrix that outlined the topic, essential questions, suggested activities, and assumptions about students thinking and experiences associated with the topic of study. The preservice teachers had to sequence the topics (weeks) in an order they believed would help to develop students learning about the topic conceptually, thus building the concepts sequentially. The preservice teachers provided justification for the topics they selected for each week. The methods instructor (Author 2) reviewed the unit matrix and gave feedback and suggestions on the organization of the lessons to support student learning. The unit matrix functioned as a 'roadmap' for weekly planning.

Like the unit matrix, a template was provided to the preservice teachers to write up their weekly lesson plans. Many of the sections on the lesson plan followed the same components as the unit matrix (e.g., essential questions and predictions of students thinking and/or experience with concepts); however, the main body of the lesson plan itself followed a 5E instructional model (Bybee, 2013) as this was a format most of the preservice teachers were familiar with from their initial science methods course. Additionally, to help the preservice teachers capture aspects of their teaching for the co-reflection component of the model, they identified up to 45 minutes of instruction from their plans to be video recorded. The preservice teachers were encouraged to break up the time into 10-15 minutes increments to capture different to lead discussion and sense-making with the students.

Co-Teaching

Regarding co-teaching, the preservice teachers were required to split the 2.5 hours of instruction so that different team members could lead segments. Sometimes this occurred by different members taking on different parts of the 5E structure. Other times, it meant leading a small group through a full activity and then working with peers to summarize what each small group explored and explained to contribute to the large elaboration or application of learning that the entire class participated in.

Co-Reflection

To begin the weekly reflection process, each preservice teacher independently reviewed and coded their team's 45 minutes video, selecting timestamps and providing annotations for how they thought the code was represented in the selected video clip. They then brought these coding sheets to the video club and shared their codes with their other professional learning community members, looking for times when they coded similar and different segments for each code (again, see Appendix A). Using what they discussed through this guided process, cogenerative dialogue, the preservice teachers identified up to three suggestions for modifying their practice going into the next week that they believed would better support student thinking and/or instruction to support student learning.

Research Design

Participant Selection

During the semester of this study, 14 students were enrolled in the course; 12 identified themselves with female pronouns, 1 identified themselves with male

pronouns, and 1 identified with they/them pronouns. To accommodate the requirement of having four classrooms for the Saturday teaching practicum, the preservice teachers were divided into professional learning communities consisting of 3 to 4 individuals that were led by a PhD Science Education student serving the role of science content expert. All communities met each Tuesday evening with Author 2 for their methods course. During the practicum weeks, each Tuesday class was guided by the instructional model for cogenerative dialogue (see Figure 1).

The PhD students attended class for all co-planning aspects before the program started and when the video club portion (co-reflect phase) was complete and the communities were moving on to the lesson planning for the next week. They were not contributors of the co-teaching and co-reflection process as we wanted the preservice teachers to be independent of the content experts with identifying critical aspects of practice to modify and work on improving from week to week. Similarly, the methods instructor provided feedback broadly to the class (all teams) as Author 2 recognized essential elements in their teaching to focus on developing strategies for doing so. Author 2 only provided individual teams with specific guidance when they explicitly asked for it directly.

For this study, we selected one group to highlight and focus on their experience in the first 3-week teaching experience; as the second 3-week period, teams switched and the topic changed, but the cogenerative dialogue model did not change. We are taking a case study approach to our research design (Creswell & Poth, 2016), as we are bounded by time and number of participants within a single group (n=4). However, this one team's experience mirrors the other teams, thus we believe providing a more in-depth story of this one team's experience across the 3-weeks will provide more valuable contributions to the field about how the cogenerative dialogue model employed in this study can support novice science teacher development than a surface level analysis across multiple teams.

The team we focused on for this study taught a Grades 1-2 split class about different forms of energy. This purposefully selected team consisted of Dorothy, Nellie, Lisa, and Rene (pseudonyms). All four of these participants identified as white females and were in their early 20s. Given that this study focuses on their experience with the cogenerative model of co-plan, co-teach, and co-reflect, we do not include their content expert as a participant as they were present for only one component of this model weekly.

Data Sources

To examine how our focus group used the iterative cycle of co-plan, co-teach, and co-reflect during their practicum experience, we utilized four data sources to track their development as teachers. Table 1 describes the number of data sources collected over the 3 weeks and their usage in the practicum experience.

Table 1

Summary of Data Sources

Data Source	Research Question Alignment	Description of Data Source and Number of Data Points (N)
Individual annotations of team selected video segments from lesson taught.	RQ1	Each preservice teacher on the team independently analyzed the selected video segments of their teaching using VideoAnt College of Education and Human Development, University of Minnesota, n.d.). The five annotations the preservice teachers were to find instances of in the video and comment on how the clip illustrates the annotation code were provided by the methods instructor (see Appendix A). The annotations allowed individuals to think about incidences in the video on their own before coming together as a team to discuss similarities and differences in selected timestamps for the annotations. This individual to shared thinking is where cogenerative dialogue occurred. (*N* = 60; 5 annotations per week, 4 people, for 3-weeks)
Group –video of the video club discussion and a copy of each completed recording form. (Appendix A)	RQ1	Video club focused on preservice teachers learning about key aspects of their practice and understanding how to navigate from identified problems in practice to planning modifications for the next week. Video club discussions followed the same structure. The team's collective decisions were documented on this form and coded. (*N* = 2[a] video club discussion videos; 3 video club recording documents)
Synthesis Paper	RQ2	Used to examine preservice teachers explicitly stated value and usefulness of the cogenerative model (co-plan, co-teach, co-reflect) in terms of what they are learning about their teaching and methods for future professional growth. (*N* = 4;1 per person)
Final Video Project	RQ2	Used to examine unsolicited influence of cogenerative model (co-plan, co-teach, co-reflect) embedded in video club, and preservice teachers' thoughts about their future teaching. (*N* = 4, 1 per person)

a Due to technology issues, one video club video was not audible, but we were able to still analyze the discussion recording form for that week.

For the individual annotation data source, the preservice teachers were given five annotation codes to identify in the video segments their group had recorded. These annotation codes are identified on the first page of Appendix A. Their video was uploaded into an online program called VideoAnt (College of Education and Human Development, University of Minnesota, n.d.). As they watched their videos, they could stop and annotate how they thought that moment of the video represented the annotation they were coding for. To analyze these annotation responses, we created an Excel sheet using the annotation codes as the headers and pulled all group members' annotations into one Excel sheet. We created them for three weeks.

Along with everyone's set of comments to the five annotation codes, the first task of the video club (held in the weekly methods class) was to record the video segment, and time stamp for each of the five annotations. The purpose of this was for them to see how many different instances they, as a team, saw instances of the annotation code coming up in their teaching, or to recognize they were coding the same instances. This assisted them with identifying the similarities and differences section (page 2 of Appendix A), which lead to their discussion about modifications for their next week's lesson. Their discussion through the Video club form (Appendix A) and what they wrote on their document, were both added to the weekly excel document according to the annotation code headers. We then were able to apply our same coding scheme to all three data sources (individual codes, video club video and video club discussion form) to answer research questions one and two.

Data Analysis

Before starting the data analysis process, we reviewed the team's lesson plans for each week. Their plans helped provide context about the science ideas they were teaching and the structure of their activities. Additionally, the team listed in their lesson plan what segments of their teaching they wanted recorded for the 45 minutes of video. Together with reviewing the lesson plans and seeing what segments were recorded within the larger plan assisted us with understanding the annotation and video club comments. The lesson plans were not a data source, though, and thus were not coded. In the following sections, we describe the specific procedures used to analyze the data sources aligned with each research question (i.e., Table 1)

RQ1: Individual contributions during co-reflection phase and how they were taken up in co-planning.

Concerning the development of the coding schema applied, we employed a qualitative approach of thematic analysis (Glesne, 2015; Maguire & Delahunt, 2017). We used emergent coding to generate themes from the preservice teachers' annotations of their selected teaching video segments. Coding of the preservice teachers' annotations was done one learning community member at a time. Each coauthor coded the preservice teachers' annotations individually to identify themes that emerged surrounding the preservice teachers' ideas in relation to their teaching practice, identifying problems in their teaching practice. After both coauthors coded an individual, we met to discuss our codes to ensure we came to an agreement in coding and discuss any discrepancies. We identified four thematic codes surrounding their teaching practice based on the preservice teachers' annotations of their selected teaching video segments (see Table 2). It is important to note that the definition of the code is based on the interpretation or explanation for the issue (i.e., the code) the preservice teachers used in their annotation descriptions. To answer research question one, we tabulated the frequency of each thematic code for each week.

Table 2

Data Analysis Codes Applied to Individual Annotations and Video Club Data Sources

Codes	Definition Preservice teachers comments	Data Example From individual annotations
Facilitating Discussions	Teachers asking good questions or needing to ask better questions. Providing more discussion time. Involving students more in discussion and explaining their thinking.	When [the teacher] put the materials in front of the kids, they immediately started thinking of ways that they could build the car with the things they were given. This could be used to inform the types of questions that are asked when we later have a discussion on this activity.
Explicitness of Activity Focus or Learning Goals	Students not providing expected results/outcomes because they are unsure of expectations/objectives	Although the activities themselves are exciting and engaging for students to do, they also need to be aware of why we are doing these activities. What's the purpose?
Science Content or Terms	Students do not have the science language to apply to their explanations or are incorrectly using	Going through the book and discussing how we use energy in our everyday lives, students are struggling with the term kinetic energy. Prior to this discussion, students participated in activities that used kinetic energy although [it] was never mentioned.
Putting Students' Ideas at the Center	A need for listening more to students first and when they do put the Ss ideas forward first there is more engagement	When [the teacher] asked what the purpose of the boat was this got at the students' ideas and she realized she didn't have to explain the fundamentals of what a boat does.

To examine how each preservice teacher's ideas carried over and contributed to the collaborative video club component of the practicum experience, we viewed both the video club recordings and discussion forms (Appendix A). To track how each instructional modification came to light, we worked backward, starting with the three proposed and agreed upon instructional modifications. For a given instructional modification, we first consulted the video recording of the group's collaborative video club discussion to determine who suggested the instructional modification. Then, we cross-referenced the ideas expressed by the preservice teachers relating to the proposed modification to their code annotations to determine if the modification solely originated from the video club discussion or a preservice teacher's individual video annotations.

RQ 2: Value shared by preservice teachers from experiencing the instructional model for supporting cogenerative dialogue.

We analyzed two data sources to determine how valuable this practicum experience was for each preservice teacher for their teaching development. The first data source was an end of session synthesis paper that posed three questions for the preservice teachers to respond to relating to their collaborative experience and teacher development. The second source was the final video reflection assignment; if the preservice teachers found the practicum experience valuable, then we expected them to mention it here. We analyzed both data sources for each preservice teacher's thoughts relating to this practicum experience and their teaching development.

Findings and Interpretations

We begin with a summary of the themes identified within the individuals' annotation comments, which are also shared in the video club. To address RQ1, we provide an audit trail of which ideas, as noted in the video club discussion as strengths or weaknesses in the prior lesson, the team selects to move forwards in planning for the next lesson. To answer RQ2, we share what each member of this collaborative team states they will take from this experience into their future teaching.

Individual's Contributions and Incorporation into Weekly Modifications

Across the grade 1-2 team, 25 instances of the four distinct themes were coded in the individual preservice teacher annotations. Of the 25 codes, explicitness of activity focus or learning goal was most prevalent (9 of 25), with putting students' ideas at the center (6 of 25) and facilitating discussions (6 of 25) second. Science content or terms was the least coded theme across the four preservice teachers' individual annotations with 4 of 25 instances. There was one combination code of putting students' ideas at the center and science content or terms and this was counted as a separate code from the others, thus establishing a 26th segment of data coded.

Examining the preservice teachers at the individual level more closely, Dorothy's responses in her annotations had five coded instances, and of these, two different codes of the four types were represented. Dorothy's coded comments initially appeared in her discussions during video club, and it was not until Week 3 that her annotation codes identified comments related to the coding scheme. Nellie responded in her annotations with seven comments representing the four distinct codes. She solely had one segment that was given the combined code of putting students' ideas at the center and science content or terms. This double-coded segment occurred because she saw a moment in the video for an opportunity in a future lesson to support content learning by leveraging students' ideas. Six instances with codes were identified for Lisa, representing three out of four codes. The most consistent codes for Lisa were science content or terms (weeks one and two) and explicitness of activity focus or learning goal (weeks two and three). She made a comment associated with the code, putting students' ideas as the center in week one, but nothing related to it after that week. Lastly, Rene received eight coded instances across the 3-weeks in her individual annotations and of these putting students' ideas at the center was consistent across the 3-weeks.

We found that Rene consistently made comments in the video club discussion that made it to the list of modifications each week. However, these comments often originated with Rene, and her teammate Dorothy often synthesized the teammates' comments based on something Rene shared. Therefore, Rene and Dorothy often agreed about modifications to put forward as Rene would initiate the idea and Dorothy would build on it and synthesize the idea for the purpose of recording. This trend in team coding and how the contributions to modifications were raised are illustrated in the audit trails described below.

Audit Trail - Week One

The group recorder for this week was Dorothy. From her synthesis of the first week's video club discussion only one of the three modifications listed related to specific changes in the preservice teachers' pedagogical practice. There were two other modifications associated with establishing classroom norms (i.e., expectations for classroom behavior) and classroom arrangement (e.g., distracting furniture and crowded), but for the purpose of this study we focus our attention on modifications only that specifically have to do with improving methods of instruction to support student learning.

The first modification, 'creating questions to guide learning that go along with our lesson', develops throughout the video club discussion. First, Lisa shares her annotation about an instance of students struggling, in which she wrote:

> *As we are going through the book and discussing how we use energy in our everyday lives, students are struggling with the term kinetic energy. Prior to this discussion, students participated in activities that used kinetic energy although 'kinetic energy' was never mentioned. Dorothy had to prompt them with the first letter, but still students were not making the connection. I think that we responded well to their attempts/guesses but eventually she had to just tell them what it is. If I had to do anything differently, I would place the focus not on identifying the correct term, but rather on the way energy was used. The point of this discussion was for students to brainstorm how they use energy in their everyday lives, so if they were making the connection that energy requires movement, I would be satisfied. I think that this age, the term is less important while the concept of, in this case, energy, is what is important. [Coded Science Content or Terms and Putting Students' Ideas at Center]*

Similarly, Rene annotated the same moment in the video as students are struggling. She writes, "I think that the students are struggling when asked if they remember what kinetic energy is. The reason that I think this is because when they were asked, they didn't say anything and were just kind of looking around or playing with the grass." From her examination of the same video clip, Rene also annotated later in the video a moment as needs improvement with the rationale,

> *It wasn't terrible but maybe it would have been more beneficial to ask the students if they think we can get energy from water. rather than saying "did you know". That way, rather than just telling the students something, we will be able to get their ideas behind that information. Maybe for next week we could have a more detailed list of questions for all portions of the lesson, so we don't forget any of them. [Coded Facilitating Discussions and Putting Students' Ideas at Center]*

Rene brings this latter idea to the video club to discuss with her group. A conversation ensued among the four group members about how each of them agreed with her comment about questioning, as they also recognized moments in the videos from that week that the questions being asked were not necessarily addressing the ideas they were hoping the students would share out. From this discussion, Dorothy, the recorder for the week, summarizes the following comment on the video club discussion form as the rationale for the team to create questions to guide students' learning better. "We all noticed that when it came to our discussion portion, it was difficult to come up with questions on the spot. This made the flow of the lesson somewhat choppy and out of order."

Audit Trail - Week Two

The group recorder for this week was Nellie. From her synthesis of the video club discussion, two of the three modifications related to the preservice teachers' pedagogical practice. This week's third modification was also not pedagogically related but focused on a piece of technology not working correctly. The two modifications associated with teaching included a) providing more constant discussion throughout activities and b) being more explicit with instruction. Concerning the first modification, Nellie, the recorder for this week, summarized that the group "noticed in the video that the students were more invested in the actual activity and now how it related to energy." For the second modification, the reason was given, "some students were not engaged because they did not fully understand what to do. For example, working together on designing the house."

Again, for the first modification about providing more focused discussion throughout the lesson, this idea originated when Lisa shared her video annotation for needing improvement. She wrote,

> *My hope is that students should not think that these stations are simply arts and crafts time where they are creating these exciting things, but there is no purpose behind them. I think this is where teachers should be explicit with their students about the 'why' behind the activities/lesson. [Coded Explicitness of Activity focus or Learning Goal]*

From this idea presented by Lisa, Dorothy bridges the idea to something she annotated from watching the videos with respect to eliciting students' ideas. She referred to something her science methods instructor had shared with them in class about needing to consider asking questions directly (1:1) with students and not always just big class discussion. It was from this notation that Dorothy raised the idea about needing to have smaller discussions throughout an activity to gauge the students thinking more and not just wait to the end. Nellie summarized these ideas together and wrote the modification of more constant discussion throughout activities.

The second modification from the group in week two was the need for more explicit instructions with the activity's goal. This idea originated from Rene's annotation for the students are getting it, which she stated,

> *I feel like the students are starting to get the idea of how exactly to build their house. Before, there were many different ways they could make a house but after Dorothy explained to them that the solar panel goes on top, they knew that they had to make a roof for it. [Coded Explicitness of Activity Focus or Learning Goal]*

In this example, Rene thought her teammate's explanation to the students helped to give the students some direction for how to design things, but she also notes in her discussion with the group during video club that she thought there were still other times throughout the lesson that week that there was some

confusion by the students and suggested this with her needs improvement annotation, "Maybe next week we can be more explicit with the directions in order to get them to work in a team/ group." This idea shared by Rene launched a discussion suggesting they agreed with Rene's assessment. In fact, Dorothy notes that she thought it should be added to the modifications list. As the recorder for week two, Nellie summarized the group's discussion by recording, "students were not engaged because they did not fully understand what to do. For example, working together on house."

Audit Trail - Week Three

For the final week, the group recorder was Lisa. From her synthesis of the video club discussion three modifications related to the preservice teachers' pedagogical practice; however, two were very closely related. For reporting purposes, they were combined as one modification associated with pedagogical practice. The two modifications identified for week 3 focused on providing support through modeling and examples of the task for the students (i.e., explicitness of activity focus or learning goal) and improving class discussion by navigating between students' ideas and connecting ideas from students to construct an explanation of the science concept (i.e., facilitating discussions).

It is important to reiterate that these modifications from the third week would not be implemented by this group in a subsequent lesson the following week, as the preservice groups were rearranged, and new teaching groups formed for the second session of the Saturday teaching practicum. These four preservice teachers would not remain together for the second session, they shifted to other grade levels and different topics were the focus of session two. However, this third video club allowed the group to reflect on how the final week of teaching in session one went, and what they may take with them into their next teaching experience.

For the first modification, the group labeled the modification as "preparing a model" and described the reason for this as, "Students seemed to be struggling trying to build their cars to get them to move, so by having a model they would have an example of what to do." From this reasoning it is evident the team believes by the end of the three weeks that explicit instructions about the activity or goal of the lesson is needed to guide students and perhaps this is best solved by the teachers providing the students with a model they can follow.

This modification was initiated with an individual comment made by Nellie, where she stated in her video annotation as a needs improvement, the following,

> *During the majority of this video, the one student is constantly complaining that he is unable to build a car that would work. He is whining and feeling defeated. Although I tried to say things to help and I tried to ask questions to make them think different ways, it was not working. I am not sure what could have been done differently, but it was hard to watch him be so frustrated and not know what more I could have done to help him. [Coded Explicitness of Activity Focus or Learning Goal]*

She then offers the following solution to this problem she is viewing in the video, "Maybe if we have a model of one and showed how it worked to everyone in the beginning, they would have been able to understand more what was expected and some ideas to make the car." When Nellie shared this example in the video club, Dorothy said she supported the idea, too. However, this was not something she noted or wrote about in her own individual video annotations.

The second modification, around improving facilitating discussions, was derived from two different group members individual video annotations. First, associated with the eliciting students' ideas' annotation, Rene noted,

> *I think that the students' ideas were elicited when Dorothy put the materials down in front of the kids, they immediately started thinking of ways that they could build the car with the things they were given. This could be used to inform us of the types of questions that are asked when we later have a discussion on this activity. [Coded Facilitating Discussions]*

On a similar note, Dorothy provided the following needs improvement video annotation based on her viewing of a 4-minute clip where the preservice teachers and students were sitting in a circle discussing what they learned from the car building activity. She said,

> *We still need to manage our time better. Towards the end we ran out of time for the discussion, we also had to rush making and testing the cars. Next time we need to give ourselves more time for each section, so we do not have this issue again. [Coded Facilitating Discussions]*

Lisa summarized the group's discussion around these two comments as needing to manage time better to allow for more in-depth discussions.

Summary of Contributions to Cogenerative Dialogue

Regarding contributions by team members in week three, there was an emphasis on making the activities and goals more explicit for the students. This theme was carried from week two to week three and raised by all group members. Additionally, there was an emphasis in week 3 on facilitating discussions, which was initially raised by Rene but taken up in the video club discussion by Dorothy and Nellie.

Looking across the three weeks, the team focused their comments for modifications mainly on the

ideas of facilitating discussions, and through better questioning, but also modeling or providing directions that were more explicit towards the activity focus or learning goal. It is important to note however, that although students' ideas at the center and science content codes did not come through as part of the modifications, they did appear to serve as anchors or reasons for why the preservice teachers should consider modifications to facilitating discussions and explicitness about activity focus and learning goals. For example, in week one, these codes (students' ideas at the center and science content) came through in individual annotations by Nellie, Rene and Lisa. They came through again in week two for Rene and Lisa and in week 3 for Rene and Nellie. Despite these codes not being evident in the descriptions of the modifications for instruction from week to week, it is apparent the preservice teachers noticing of students ideas, comments, and actions in the video associated with these two codes did factor into the group's discussion and were taken up as part of the collective consensus about what modifications to make in the next lesson.

Preservice Teachers Perceived Value of the Experience

This section is focused on the findings related to the second research question. In the synthesis paper data source, three questions were presented to the preservice teachers regarding various aspects of their collaborative experience and how it has influenced their present and future teaching. The end of semester video reflection assignment intentionally did not ask the preservice teachers directly about the components of this video club/collaborative experience. The aim was to see if they valued the experience to some degree on their own that there are aspects of it that they would want to carry into their future teaching. We report on individuals' experiences, sharing what they reported about the co-reflection experience of the video club, and what, if anything they are taking away from this experience to consider for their future teaching (i.e., end of semester video reflection). We conclude with key takeaways from the team.

Dorothy

Dorothy focused on the collective consensus the group discussed from watching the videos to improve their team instruction. Concerning using video as part of the co-reflection process, she noted, "By watching over these videos, we were able to catch those moments that we had missed before and were able to come up with solutions for the next time that we taught." She also noted how peer feedback from watching the same videos provided her with constructive feedback to help her improve on aspects of her own teaching. She explained,

> *Constructive criticism is essential for bettering your teaching practices and strategies...I really appreciated the video club as well as the peer feedback. Videos can help you to see certain flaws in your teaching, but having another set of eyes and ears is very beneficial as well. This way you are expanding on the possibilities of what you could practice and how you can become better. In the future I would love to continue doing these videos and allowing colleagues to watch them and give me any feedback that they may have."*

Dorothy held a positive view towards the video club saying in her final video reflection, "Video clubs are the best thing to ever happen, and I will continue to use something similar in my future teaching." She also reiterated in the video reflection, unprompted, about how she valued receiving feedback from her peers to help develop her teaching.

Nellie

Like Dorothy, Nellie discussed the benefits of video club discussions from the perspective of what it offered them collectively as a team when co-planning and co-teaching. She shared,

> *By watching the videos each week, making the annotations, and then talking about our findings, we were able to find ways to cater more to the students' needs. We were able to recognize where some students struggled as a way to reinforce ideas the next week, and then build off of them.*

Additionally, Nellie found the video club to be a confidence booster. As she explained,

> *when the lessons were hard to teach, it was hard to remember the good things that happened but being able to look for positive moments [in the video] and then talk about it with the group allowed for us to recall that there were a lot of positive moments during the lesson. A lot of the time, we chose different time stamps for the positive moments which was interesting to see and allowed us to be happier with the end results.*

Regarding this last sentence precisely, Nellie noted in response to a couple of the synthesis paper questions that she found it helpful to have everyone view the videos independently and bring their timestamps to share with others. This allowed her to see different perspectives about the annotations and helped her to become a better teacher to see these instances in action in different ways.

In her final video reflection assignment, Nellie expressed a positive view of the video club experience, saying, "discussing strengths and weaknesses with peers helped me to recognize things I didn't notice before, become more confident in myself, and create even better lesson plans.

Lisa

Lisa also expressed the importance of having different perspectives on teaching and pointed to this in her synthesis paper as a positive aspect of the video club experience. For example, in her response to the question about how the weekly video club helped her to recognize, interpret, and address students' thinking she wrote,

> *Our discussions during video clubs allowed each of us the chance to explain our reasoning behind why we chose these moments as positive or whatever category it may be. Although we identified different points, we were still able to agree on what areas we wanted to grow in for the following weeks.*

Furthermore, Lisa explained the value of the cogenerative dialogue for her when she shared,

> *It is difficult for me to reflect on my own teaching because I am too close to the situation, but another teacher would be able to point out different things that I could work on. A video reflection would be helpful if my colleagues cannot observe my teaching because I could take a step back and actually watch myself and point out places that did not go how I expected.*

It is important to note, however, that although she found value in co-reflecting on her practice, she did not necessarily use this information to co-plan and co-teach from week to week. Perhaps she does not see the collaborative approach to co-planning and co-teaching as something accessible to her as a classroom teacher.

Rene

From her synthesis paper, Rene focused her comments on the benefits of peer collaboration in planning and teaching, and what the structure of the video club offered the team concerning doing this work. She stated,

> *If we didn't have the video club then I believe that my group would have somehow come to the consensus that we needed to change something for the classes to run smoother but I don't think we would have gotten to the point that we did. The brainstorming might not have been as thought out with the ways in which we can improve.*

Additionally, in response to the question of what features of the video club she might carry on with into her future teaching, she once again reiterated the importance of talking with others. Clearly, she noted she did not feel watching video of her teaching would be as useful. In her words, "Unless required, I doubt that I will likely use the video route for reflecting on my practices. I feel like the recording of videos would not help as much as talking with others."

When it came to her final video reflection, Rene talked extensively about her team's teaching experience, what they were teaching the students related to the concept of energy, and ow their team shifted from prioritizing definitions to conceptually working with the process of how things move and use energy to move. These ideas follow those she shared in her annotations and the video club discussion about modifications. However, in the video reflection assignment, she does not directly mention this learning from the co-planning, co-teaching, and co-reflection experience.

Overall, the team members valued the opportunity to get different perspectives on the lessons taught by each of them watching and talking about different instances of the same codes. The idea of peer collaboration to improve instruction provided them with different ways to notice student thinking, build their confidence, and provide feedback to each other on their teaching. While the specific features of the video club experience – co-plan, co-teach, and co-reflect – may not have come through in each member's reflections about the experience or their end of semester reflection video, it is apparent that the video club experience did help them with improving their teaching from week to week in the semester. It is uncertain whether a similar structure will be incorporated into their future teaching unless they actively seek it out.

Discussion

Cogenerative dialogues occur when co-teachers discuss teaching and learning issues and collectively generate solutions to any problems (Scantlebury et al., 2008). Evidence from this study shows that the individual annotation component of the co-reflection phase of the instructional model catalyzed to collaboratively identify and co-generate agreed upon modifications to include in the co-planning and co-teaching components for the following week. The video club structure guided the preservice teachers in interpreting the individual annotations they brought to the community for discussion. By first requiring the preservice teachers to compare their timestamps and annotations, group members were able to notice when they agreed on moments, had discrepancies in their annotations that offered different perspectives for consideration, or made similar comments but at different points in the video, giving more evidence about their practice.

Each of the five pedagogical modifications suggested by the team to improve their teaching could be traced back to someone's video annotation and through the video club discussion. The sequenced video club structure of synthesizing individual annotations naturally guided the preservice teachers to identify issues surrounding their teaching and collectively generate solutions to problems in their practice (Scantlebury et al., 2008). Additionally, with the practicum structure allowing the preservice teachers

to teach multiple weeks, and oversee all aspects of planning and instruction, the team's cogenerative dialogue also had time to develop; leading to richer and more productive discussions (Siry & Martin, 2014).

Another important finding from this study is how the instructional model for supporting cogenerative dialogue provided an opportunity for equitable contributions from the preservice teachers (Gwyn-Paquette, 2001), not only with identifying issues in their practice but suggestions for modifications to improve practice. Through developing a cogenerative dialogue, the preservice teachers learned to take up the different instances identified by individuals and come to a mutually agreed upon set of 2-3 pedagogical modifications for the next co-planning discussion. Results show that all group members contributed essential ideas about improving teaching at least once across the three-week session. During the discussions, we noticed that some members' ideas were adopted more frequently than others. However, we observed that sometimes other members agreed with their peers' comments because they might have missed a relevant moment in the video, but they still shared the same perspective. Additionally, sometimes members' ideas overlapped, which gave the team more evidence that a teaching issue identified by more than one member needed addressing. These instances helped the team recognize the value of having multiple perspectives watching the videos to identify key areas of strengths and weaknesses in the planning and teaching phases (Barnhart, 2022; Johnson & Cotterman, 2015).

A crucial component of learning to develop a cogenerative dialogue in support of improving practice is that all voices are heard (Scantlebury et al., 2008) and are open to recognizing differences in perspectives about the same teaching moments. The shared sense-making of instances identified in the videos and the negotiating of ideas for modifications observed in this study indicate the equitable opportunity the instructional model provided (Nielsen, 2015). The structure of the co-reflection aspect of the model specifically guided the reflexive process necessary for cogenerative dialogue to lead to change in practice (Siry & Martin, 2014).

Conclusion and Implications

Participation of preservice teachers in cogenerative dialogue within a community of practice requires structured reflection opportunities. Adhering to situating learning theory can support this; preservice teachers can learn together through a shared practicum experience that is iterative over three weeks. For preservice teachers to engage in the professional practice of communicating with other teachers, known as cogenerative dialogue, it must focus on improving an aspect of their development as educators drawn from their own teaching experiences (Siry & Martin, 2014). Lastly, the preservice teachers must be allowed to enact improvements to practice by becoming aware of their tacit decision-making (Darling-Hammond et al., 2019; Johnson & Cotterman, 2015).

We acknowledge that this study was sampled from a single instance of the advanced science education methods course and focused on one specific learning community. This approach was necessary given the richness of data and following the modification origination trail. Future research could expand and investigate the nature and trends developed from the cogenerative dialogue across multiple communities of practice to identify early roadblocks to improvement in preserve teachers' improvement in practice.

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Appendix A

Weekly Video Club Protocol – EXAMPLE

Discussion Set-up

Begin with recording in the table the time stamps selected for each of your individual selections for each of the 5 codes (If you posted a code more than once, just select your favorite to share).

Code Used in Individual Video Watching and Annotation	Video Timestamps (all group members – put initials)
STUDENTS' IDEAS ELICITED and explain how you think this information is being used to inform the instruction in the lesson (or not).	
STUDENTS' ARE STRUGGLING with an idea presented and explain how you know this. What are the students doing to indicate this? Also, share your thoughts on whether or not you think the students' struggles were handled effectively in that moment, and if not, what would you do differently.	
STUDENTS' ARE GETTING IT with an idea presented, and explain how you know this. What are the students in this example doing to indicate this?	
POSITIVE MOMENT you noticed happening in the lesson (and is not one of the moments already listed above) and describe what was going on and explain why you think this was a positive moment.	
NEEDS IMPROVEMENT MOMENT you noticed happening in the lesson (and is not one of the moments already listed above) and describe what was going on and explain why you think this is a moment that to improve on. Provide a suggestion for improving on this for next week.	

CORE OF DISUCSSION

Looking across these collective timestamps for EACH code, are there similar time periods selected for where each code was represented, or were there many different times selected?

- If similar --- why do you think you several of you were drawn to this incidence? Go back and read through what you noted as your annotation and see if you identified similar things.
    - Repeat this discussion for EACH code with similar timestamps selected by team members.
- If there are differences --- why do you think you are selecting different incidences in the lesson for the same code? What are key aspects of EACH selected moment by group members?
    - Are there perhaps similar explanations but different moments recorded in the lesson?
    - Are you interpreting codes differently; thus giving varied explanations for the incidence?

CONCLUSION

From talking through the different coded segments in the videos, and understanding both similar and different explanations for these selections, what have you learned from watching your unit TOGETHER as a team and what are you thinking about adding/modifying to your instruction next week?

- List 2-3 modifications you'll be doing in the table below AND state your reason(s) for it, meaning what in the discussion today is motivating you to make this modification your team's planning for next week?

Modification	From your discussion, what is the reason for the modification?