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Co-planning among science and special education teachers: How do different conceptual lenses help to make sense of the process?

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Abstract In this study, we investigated the process of teacher co-planning. We examined two teams of high school science and special education teachers brought together to co-plan inclusive, inquiry-oriented science units as part of a professional development effort. We used three conceptual lenses to help make sense of this process: (1) characteristics of collaboration, (2) small group interactions, and (3) community discourse. Using these lenses individually and collectively, we identified strengths and limitations in teachers' co-planning efforts. A strength was that all teachers, irrespective of discipline, shared ideas and helped make decisions about the content and activities included in unit and lesson plans. A limitation was that teachers, again irrespective of discipline, discussed science education topics in their teams more often than special education ones. We found this latter finding of note as it spoke to issues of parity among teachers during the professional development. In our discussion, we argue that each conceptual lens yielded both unique and common findings on co-planning. We also provide recommendations for professional developers and educational scholars intent on organizing and/or researching co-planning among science and special education teachers.

Keywords Co-planning · Special education · Qualitative methods · Teacher professional development

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Researchers have long called for general and special education teachers to collaborate with one another to improve academic instruction for students with disabilities (Pugach and Johnson 1995). The recommendation to co-teach, in particular, is not new. Marilyn Friend (2008) defined co-teaching as when two teachers, typically one in general education and one in special education, occupy the same classroom and thus teach the same group of students at the same time. According to Friend (2007), this relationship should exemplify parity of teachers' status, meaning that the teachers have equal power in making and carrying out instructional decisions.

One essential component of co-teaching is co-planning (Murawski and Lochner 2011). During co-planning, teachers come together to develop the instructional sequences they will then carry out in the classroom. Wendy Murawski and Wendy Lochner (2011) stated, "Without co-planning, [when co-teaching,] teachers are at best working together in a parallel or reactive manner" (p. 175). Indeed, to assist new co-teachers in establishing productive working relationships, professional development targeting co-planning has been recommended (Keefe and Moore 2004). Further, teachers who co-teach state that they value co-planning (Hang and Rabren 2009), but that they are not provided adequate time to do so (Magiera and Zigmond 2005). Beyond cataloging teachers' views toward co-planning, however, researchers have focused little attention on this important aspect of co-teaching.

Within the specific field of science education, co-teaching has been suggested as a way to improve instructional practices among preservice (Siry 2011) and practicing (Martin and Scantlebury 2009) teachers. While co-planning again has been viewed as an important aspect of these co-teaching relationships (see Tobin, Roth and Zimmermann 2001, for heuristic), the process has not been examined in detail. This study's investigation of science and special education teachers' talk, actions, and products *during* co-planning, then, differentiates it from existing research. It helps to fill a large gap in our understanding of how teachers co-plan, how researchers might investigate this process, and thus, how co-planning could be improved.

To contribute new insights into the co-planning process, we investigated two school teams of science and special education teachers as they co-planned science lessons as part of a professional development experience. Specifically, during a two-week summer institute, the start of this yearlong professional development effort, participating science and special education teachers were asked (a) to come together as equal partners to develop "comfort and trust working as a team" during program activities; and (b) to co-plan "science model lesson[s]" that explicitly included both "the 5E's [instructional model of inquiry]" and "accommodations and scaffolding for special education" students. We collected video records of these two teams' co-planning sessions; fieldnotes of their sample lesson presentations; completed year, unit, and daily lesson plans; and audio records of individual interviews. These data were analyzed through three separate conceptual lenses: (1) characteristics of collaboration, (2) small group interactions, and (3) community discourse. Through our analyses, we attempted to identify the strengths and limitations of using different conceptual lenses to make sense of teachers' co-planning efforts.

Conceptual framework: viewing the co-planning process through three lenses

We view co-planning as a complex process in which individuals come together to work collectively on a given task (e.g., designing curriculum). To inform the construction of our conceptual framework, given the paucity of existing research on this topic, we first

examined the goals and activities of the summer institute we investigated to identify possible lenses through which we could make sense of teachers' co-planning process. We then reviewed related research on teacher professional development where teachers were asked to work together. Based on both our examination and review, we identified three different conceptual lenses that might prove fruitful in understanding collective teacher work: (1) characteristics of collaboration, (2) small group interactions, and (3) community discourse.

More specifically, our review of the goals and agendas of the summer institute made clear that teacher participants were part of a professional development project that viewed teacher collaboration as central to its efforts. Both science and special education teachers were introduced to and discussed Robert Garmston and Bruce Wellman's (1999) seven norms of collaboration: pausing, paraphrasing, probing, putting ideas on the table, paying attention to self and others, presuming positive intentions, and pursuing an advocacy/inquiry balance. The professional development project also explicitly included co-planning and co-teaching in its definition of teacher collaboration. As such, we selected collaboration as one lens to investigate co-planning. From our examination of summer institute activities, because teachers attending the institute worked in small groups to co-plan their lessons, we drew from literature on small group interactions as our second conceptual lens. Further, our review of the long-term goals of the larger professional development project—the ideas that teachers should work in *school* teams and that the summer institute would be followed by additional workshops throughout the academic year—suggested that professional developers intended to create sustained interdisciplinary collaborations. The third conceptual lens we used to examine co-planning, then, was discourse in teacher communities. In looking at the research associated with these conceptual lenses, we found potentially valuable methods with which to analyze teachers' collective talk and actions. We discuss each lens and the methods commonly associated with it below.

Lens one: characteristics of collaboration

As stated above, the summer institute we investigated was designed to encourage science and special education teachers to begin to unpack what it meant to *collaborate* on designing and teaching science lessons that were inquiry-based and inclusive of students with disabilities. To promote collaborative relationships among participants, Garmston and Wellman's (1999) seven norms of collaborative work were introduced. Teachers then completed and reflected on a Norms of Collaboration Inventory where they marked the frequency (i.e., rarely, occasionally, or frequently) that they used each of these norms when working with colleagues.

In our related review of research on collaboration, we found that researchers both within (e.g., Friend and Cook 1992) and outside (e.g., Winer and Ray 1994) the field of education have examined collaborative relationships. As might be expected, definitions of collaboration vary (Wood and Gray 1991): Although these definitions can be seen as complementary to one another, they emphasize different essential components. Hal Lawson (2004), for example, noted that collaboration occurs when interdependent, autonomous stakeholders join forces to solve shared problems and capitalize on important opportunities. Collaboration, he continued, encompasses several companion "c-words" vital to successful collective action: From simplest to most demanding, they are communicating, connecting, cooperating, consulting, coordinating, co-locating, community building, and contracting. Similarly, Michael Schrage (1990) defined collaboration as a purposive relationship to solve a problem or to discover/create something new. Schrage, however,

included constraints to collaborative efforts in his definition: expertise, time, money, competition, and conventional wisdom. Michael Winer and Karen Ray (1994), in contrast, conceived of collaboration as moving through four stages: envisioning results, working collaboratively, ensuring success, and endowing continuity.

We also found recommendations from two studies on collaboration in school settings that resonated with our research context. First, Mary Burbank and Don Kauchak (2003) researched teams of preservice and inservice teachers collaborating on action research projects; they highlighted the importance of attending to the various needs of team members, particularly when those members are at different stages of their teaching careers. Our study's participants represented a range of needs in terms of what they hoped to gain from their collaborations with others, as well as a range of experience both in terms of the number of years teaching and in terms of the level of experience teaching science to students with disabilities. Second, in an investigation of a 2-year collaborative partnership among researchers, classroom teachers, and district support personnel, Deborah Butler, Helen Novak Lauscher, Sandra Jarvis-Selinger, and Beverly Beckingham (2004) discussed the need to assist teachers in developing meaningful collaborations with colleagues that could be maintained without outside support. Similarly, the goal for the professional development program we investigated was to foster meaningful collaborative relationships that would continue once participants returned to their school sites. The summer institute (our research context) was a "kick-off" to these sustained interdisciplinary collaborations.

Further, our review of the collaboration literature yielded information about the research methods used and the lessons learned about the nature of collaborative relationships, in particular, the characteristics of collaboration associated with "successful" partnerships. Scholars (e.g., Pugach and Johnson 1995) have drawn from reviews of existing literature and/or from their own experiences conducting professional development to identify characteristics of successful collaborative efforts. Marilyn Friend and Lynne Cook (1992), for example, drew from their review of existing research, their own ongoing collaboration, and their experience facilitating the collaboration of others to identify nine characteristics of successful collaborations; they grouped these nine into two larger categories. Prerequisite characteristics for collaboration include (1) voluntary participation, (2) equal authority to contribute and equal power to decide across individuals, (3) common goals, (4) collective responsibility for carrying out tasks, (5) the sharing of individuals' resources, and (6) collective accountability for outcomes. Emergent characteristics—characteristics that are both prerequisites and outcomes of the collaborative process—are (7) valuing the collaborative process, (8) increased trust, and (9) a greater sense of community.

Anne-Marie Dooner, David Mandzuk, and Rodney Clifton (2008) and Faridah Pawan and Jeremy Ortloff (2011) were exceptions to this practice of drawing from existing literature and/or personal experience to identify characteristics of collaboration. Dooner et al. (2008) used Karl Weick's (1979) four developmental stages of collaboration to understand the conflicts that emerged as seven teachers from one suburban middle school engaged in a 2-year professional development project; they conducted both individual and focus group interviews, as well as collected teachers' journal entries. In their investigation of collaboration between English as a Second Language (ESL) teachers and content area teachers, Pawan and Ortloff (2011) drew from Danielle D'Amour's (1997) Model of Structuring Interprofessional Collaborations which identifies interactional and organizational factors that can shape collaboration; they utilized these two types of factors to frame their data analysis of interviews with and observations of ESL teachers, content area teachers, and school administrators. Pawan and Ortloff also identified six activities

associated with collaboration from their review of additional literature, which were used as codes during a second layer of analysis of interview data.

Finally, through our literature review, we identified data sources and analytic methods commonly used to investigate collaboration. We found interviews were routinely conducted in studies investigating collaboration in school-based settings (Butler et al. 2004). Written materials (Burbank and Kauchak 2003) and, in one case, observations (Pawan and Ortloff 2011) were sometimes collected in addition to interview data. We also found some researchers, like Dooner, Mandzuk, and Clifton (2008) and Pawan and Ortloff (2011), drew from another scholar's organized framework to structure their analysis. In the end, given our research purpose and the kinds of data we collected, we decided to use five of Friend and Cook's (1992) nine characteristics of successful collaborations to analyze our data from a collaborative lens. Our rationale for selecting these characteristics for our analysis are discussed in detail below.

Lens two: interactions in small groups

While useful, the above studies on collaboration do not represent the only way scholars have investigated teachers' collective work; a few (Watson and Marshall 1995) have examined teachers working in small groups as well. David Johnson and Roger Johnson (1999) defined cooperative efforts as more than simply putting individuals in a group. Members, they continued, must work together to maximize their own and each other's learning. They also must perceive that they can reach their task goals if and only if their fellow members reach their goals as well. Elizabeth Cohen (1994) defined groupwork as "working together in a group small enough so that everyone can participate on a task that has been clearly assigned" (p. 1). As did Johnson and Johnson (1999), Cohen noted that members need each other to complete their task. Equally important, she continued, a small group must be allowed to work without direct supervision; the group should be in charge of its process and product.

We found that both Johnson and Johnson's (1999) and Cohen's (1994) definitions of groupwork resonated with our investigation of co-planning because the task presented by professional developers to participating teachers was to integrate topics in science and special education. The clearly assigned co-planning task also provided the context for individuals to draw on both their own and their colleagues' strengths and experiences. However, unlike Cohen's definition of groupwork, in our study, teachers did not adopt and enact a predefined list of roles during their co-planning process.

Because most research on small groups has focused on student learning in K-12 classrooms (Slavin 1991), we surveyed such studies to identify both useful research methods and important lessons learned. We discuss three key sets of findings here. One, individual contributions and group processes are shaped by the kinds of roles assigned and/or taken up by members (Cohen and Lotan 1995). Gail Richmond and Joanne Striley (1996), for example, analyzed fieldnotes, audiotapes, and videotapes of small groups of students conducting laboratory investigations in a 10th grade integrated science course. The researchers found three social roles emerged in each of the six groups studied: leader, helper, and noncontributor (active and passive). Further, they found group leaders served clear gatekeeping functions: A leader largely determined who engaged in her or his group task and what that engagement looked like.

A second important finding from research on small groups is that the kind and frequency of individuals' contributions to a group task is determined, in part, by the individual and, in part, by their fellow group members (Anderson, Thomas and Nashon 2009). As part of a

larger study of a sixth-grade life science classroom, for example, Julie Bianchini (1997) examined the ways students' views of themselves and each other as "smart" and "popular" shaped opportunities for participation in and learning from small groups. The researcher administered a brief sociometric questionnaire to determine students' status (a combination of perceived smartness and popularity) in the classroom, recorded the frequency and distribution of on-task talk in small groups using two observation instruments, videotaped small group interactions, examined students' answers on pre and post unit tests, and interviewed a subset of students. Despite the teacher's targeted efforts, across small group discussions, students who themselves and others deemed high status talked significantly more than either their middle or low status counterparts.

A third, almost obvious lesson from this work is that what students say and do during groupwork shapes what they learn as a result. In the study by Bianchini (1997) discussed above, for example, the frequency of talk was linked to learning: Those students who talked more during groupwork made greater gains on unit tests pre to post. David Anderson, Gregory Thomas, and Samson Nashon (2009) found that the guarded nature of small group discussions meant little science was learned on a field trip to a protected ecological reserve. These researchers conducted an instrumental interpretative case study of three small groups of year 11 biology students; they wrote fieldnotes, collected audio and video recordings, and conducted two rounds of group interviews. In these retrospective group interviews, students reported choosing to keep thoughts to themselves in order to maintain their group's social harmony. Despite participating in highly collegial and collaborative groups, because members intentionally avoided proposing or critiquing an idea if it would create group tension, students rarely engaged in meaningful science learning.

Across these studies of small groups reviewed above, observing interactions between actors was a common source of data (e.g., Anderson, Thomas and Nashon 2009). Interviews were conducted by a subset of researchers as well (e.g., Bianchini 1997). Observational data were then routinely analyzed to identify participants' roles (e.g., Richmond and Striley 1996) or frequency of talk (e.g., Bianchini 1997). For the purposes of our study, we determined that viewing co-planning as collaboration would facilitate the identification and definition of broader actions (Lawson 2004), stages (Winer and Ray 1994), characteristics (Friend and Cook 1992), and/or factors (Pawan and Ortloff 2011) involved in such interactions. Viewing co-planning as groupwork would more narrowly focus our analysis on the specific action(s) taken by teachers in teams. As such, we viewed these two lenses of collaboration and small group interactions as complementary; by using both to inform our analysis, we expected to gain a richer understanding of the co-planning process.

Lens three: discourse in teacher communities

While each lens described thus far would allow us to make meaningful claims about our teacher participants' co-planning process, we thought that neither informed investigation of the *substance* of our participants' talk. In addition, as previously stated, the long-term goal for the larger professional development project was to foster meaningful collaborative relationships that would continue once participants returned to their school sites. For these reasons, we decided to include a third conceptual lens in our study: teacher discourse in professional learning communities. To clarify, we thought the construct of discourse in community would prove useful in analyzing our data, but given the short duration of the summer institute, we neither assumed nor looked for evidence of a fully formed teacher community.

Marilyn Cochran-Smith and Susan Lytle (1999) defined a teacher community as members who meet regularly over an extended period of time, self-identify with each other, share common values and goals, and orient to a common task. In such communities, they continued, teachers investigate their individual and collective beliefs and practices, deepen their understanding of subject matter, attempt to enhance student learning, and critique their own and each other's efforts. Ralph Putnum and Hilda Borko (2000) made the definition of a teacher community more complex: They added the ideas of simultaneous membership in multiple communities and of different communities nestled inside of each other. They noted, for example, that a preservice teacher and the experienced teachers and teacher educators with whom he or she works form "a type of 'mini-discourse community' within which the preservice teacher is enculturated into the teaching profession" (p. 10). Their notion of a mini-discourse community underscores the importance of examining how relationships among a small group of collaborating teachers within a larger teacher learning context are formed. In our study, teachers were expected to construct two levels of community over the course of the yearlong program: A school team constituted a small teacher community; all teachers who participated in the professional development project, one large teacher community. The notion of a mini-discourse community also suggests the need to examine carefully teachers' talk and products in context. As such, in our study, we sought to identify themes in teachers' oral discourse during co-planning, as well as in the written unit and lesson plans they produced as a result.

As with our lenses of collaboration and small groupwork, we identified key lessons learned from and common research methods employed in previous studies of communities. Several researchers have argued that communities do not exist a priori. Maria Lucia Castanheira, Teresa Crawford, Carol Dixon, and Judith Green (2001), for example, studied both transcripts of teacher and student discourse and textual artifacts to describe how a community (in their case, a classroom community) was formed. Pamela Grossman, Sam Wineburg, and Stephen Woolworth (2001) collected multiple types of data to document the formation of a community composed of high school English and social studies teachers: Data included records of teacher interactions during meetings; artifacts used, produced during, or completed as a result of the professional development; and individual interviews with teacher members. A central component of their analysis was the identification of themes in teachers' talk during meetings. Teacher participants needed to abandon superficial niceties and establish group norms before a safe and collaborative environment could be created. Teachers also needed to construct a common interdisciplinary language before work on an integrated curriculum could constructively proceed. Like these two sets of researchers, we examined teachers' talk during co-planning sessions to identify salient themes. Like the teacher community studied by Grossman and colleagues, the teams of teachers examined in our research included teachers from different disciplines.

Other researchers have documented the benefits of membership in teacher communities. Their findings typically emerged from qualitative analysis of teacher interviews, field observations, and artifacts; in the case of Elham Kazemi and Megan Franke (2004), transcripts of audiotaped community meetings were also analyzed. Codes were inductively constructed and synthesized to identify patterns in the data. Reported benefits of teacher communities include a shift in their focus from their own teaching to student learning (Kazemi and Franke 2004). Teachers who participate in professional learning communities also describe positive changes in their specific instructional practices, as well as in their general abilities to meet the needs of their students (Butler et al. 2004).

Across these studies of teacher communities, the types of data collected often included teacher interviews and artifacts, like in studies of collaboration, and transcripts of teachers'

interactions, like in research on small groups. Researchers of teacher learning communities then analyzed the substance of teachers' talk to identify salient themes. As such, we viewed this third kind of analysis as yet another means to investigate and capture the complexities of the co-planning process.

Research design and methods

The purpose of our study was to make sense of teachers' co-planning process; we made no attempt to track changes in teachers' views or practices related to co-planning over time. We asked: What did the co-planning process look like when viewed through each of our three conceptual lenses? For each lens, what were the strengths and limitations of the co-planning process? More specifically, for each lens, what mis/connections emerged across teachers' words and actions during co-planning, their views of collaboration discussed in individual interviews, and/or the actual curricular materials they produced?

Research context: the professional development project

Our study of science and special education teachers' co-planning efforts was conducted in 2008. It was situated in a professional development project organized by an Institute of Higher Education (IHE) with a long history of supporting and training science teachers in urban public schools. The project had three goals: one, to examine both scientific inquiry and strategies to differentiate science instruction to meet the needs of/engage all students, including students with disabilities; two, to forge collaborative relationships between science and special education colleagues within same school teams; and three, to facilitate the co-planning of science units to be co-taught in school team members' classrooms. These goals were interrelated: If the high school science and special education teacher participants learned what inquiry-based science instruction looked like in an inclusive classroom setting (Goal 1) and developed a collaborative rapport with colleagues from their school sites (Goal 2), then they would be more likely to implement the type of instruction promoted during the yearlong program (Goal 3).

The project was divided into two stages: an initial 2-week summer institute and a series of 2-day follow-up seminars during the academic year. We focused our investigation on the initial summer institute because half of the teachers' time was devoted to the co-planning and co-presenting of lessons. Teachers were not given the same uninterrupted planning time in the follow-up seminars held during the academic year. We again clarify that one goal of the larger professional development project was to *begin* the process of community building among teacher participants during the summer institute. As such, we used the lens of discourse in teacher community as one of three to inform our analysis of co-planning (e.g., Grossman et al. 2001). However, we neither claim that a teacher community can be built in 2 weeks nor that we documented the process of our participants forming a teacher community during our investigation.

During the first week of the institute, professional development activities focused on collaborative co-teaching and teaming models, science as inquiry, and special education. To model co-teaching strategies, four facilitators—three practicing high school science teachers and one assistant principal with previous experience as a resource specialist, classroom teacher, and school psychologist—co-planned and co-presented daily activities. To promote teacher collaboration, teachers engaged in team-building activities at the beginning of each day and reviewed Garmston and Wellman's (1999) seven norms of

collaborative work. To deepen teachers' understanding of inclusion, the activities, readings, and homework assignments highlighted the program's goal to "increase the quality of [teachers'] understanding and practices scaffolding and differentiating science content" for all students. For example, teachers examined what kinds of information are included in a student's Individualized Education Plan (IEP) and how to identify effective strategies for differentiation. Further, to help teachers integrate inclusion and inquiry, teachers engaged in and then debriefed model lessons, reviewed sample classroom activities with associated student work, and discussed readings on topics in science and special education. Finally, during this first week, the facilitators, daily institute agendas, and materials emphasized that science instruction should be designed so that *all* students could engage in inquiry. Facilitators and teachers defined and discussed terms such as inquiry, differentiated instruction, scaffolding, and accommodations. Overall, the IHE facilitators spent more time and placed more emphasis on science topics than special education topics during days 1 and 2 of the institute; however, in days 3 through 5, science and special education topics were covered equally.

The second week of the institute was devoted to teachers working in teams (where possible, with the other teachers from their school site) to develop a yearlong science curriculum plan, a unit plan, and lesson plans. Teachers were asked to design lessons that embodied the type of instruction promoted during the summer institute: scaffolded, inquiry-based lessons that provided all students the opportunity to learn science. They were given templates to use in their design process (described in more detail in the first set of findings). Teachers were expected to co-teach the lessons they designed during the school year. They were also encouraged to share their lessons with colleagues back at their school sites.

Participating teachers and researchers

Twenty teachers (14 science teachers and six special education teachers) from 13 local public high schools volunteered to participate in the IHE summer institute. The IHE encouraged schools to send teams of science and special education teachers who taught similar science content so that the co-planning of lessons would be productive. Therefore, our criteria for participant selection were that (1) individuals were part of a school team and (2) the team included at least one special education and one science teacher. However, only seven of the 13 participating schools sent teams. Some teams included both science and special education teachers; other teams, only science teachers.

Table 1 provides an overview of the two school teams—the five teachers—purposefully sampled (Patton 1990) for this study. These five teachers represented the only interdisciplinary school teams as described above; therefore, these were the only five individuals who met our selection criteria. Three teachers, Manuel, Lynn, and Juan, worked at Wellington High School, an urban public high school with approximately 2,100 students. (Teachers and their schools were given pseudonyms.) The other two teacher participants, Christopher and Robert, taught at Northglenn High School, a school similar in size and student demographics to Wellington.

At both Wellington and Northglenn, some students who receive special education services attend general education classes. Other students with disabilities attend classes outside the general education program with a teacher holding an education specialist instruction credential; Juan and Robert taught these classes. Juan and Robert had taught subjects other than science in previous years. During the summer institute, they were

Table 1 Teacher participants

Participant	Experience	High school	Department
Manuel	1	Wellington	Science
Lynn	1	Wellington	Science
Juan	3	Wellington	Special education
Christopher	17	Northglenn	Science
Robert	13	Northglenn	Special education

preparing to teach biology for the upcoming school year—Juan for the second time and Robert for the third time.

The two researchers in this study, Lauren Swanson and Julie Bianchini, were both former high school science teachers. Swanson assisted in securing funding for the professional development project, attended planning sessions with facilitators to familiarize herself with the project's organization and activities, and collected all data. Bianchini participated in the analysis of data and the writing up of findings.

Data collected

Informed by our reviews of literature for the three conceptual lenses guiding our investigation of co-planning, we collected multiple types of data. As commonly cited in the studies reviewed above, we collected observational data (captured by video and through the writing of fieldnotes), as well as participant interviews and written artifacts. Each type of data is described below.

During the second week of the summer institute, participating teachers were video recorded for 3 days as they worked in teams, using the templates IHE facilitators provided, to design lessons. Ten hours of video records were collected across the two teams; this was the total amount of time provided by the facilitators to co-plan lessons. Those segments in which teachers collectively engaged in on-topic conversations were then transcribed in full. On-topic conversations included discussions about lesson design, different types of instructional strategies, examples of curriculum materials created in prior years or by other teachers, students and their learning, and school context. Transcribed segments were bounded by the topic of conversation; when the topic changed, a new segment was begun. Transcribed video segments ranged in length from 30 s to over 15 min. In total, 22 segments were analyzed for the Northglenn teachers during their co-planning sessions; 25 segments, for the Wellington teachers.

Also during the second week of the institute, individual interviews were conducted with each of the five participating teachers. Interviews were held prior to the start of the day's activities, ranged from 20 to 30 min in length, and were recorded. Interview questions were grouped by topic: teacher information, curriculum planning, description of students, inquiry-based science instruction, and ideas about and experiences with collaboration. As stated above, co-planning and co-teaching were explicit and central elements of the IHE's definition of collaboration. When teachers were asked about their views of and experiences with collaboration, however, none discussed these elements. Targeted follow-up questions (Spradley 1979) were used to elicit specifically views regarding co-planning and co-teaching. These teacher interviews were transcribed in their entirety.

We also collected participating teams' yearlong curriculum plans, unit plans, and multiple lesson plans. Science and special education teachers were expected to contribute equally to the design of lessons. The yearlong plan included all science units to be covered in a course, as well as the time allotted to cover each unit. A completed unit plan included both daily lessons and a culminating task (a project to be completed by students at the end of the unit as a summative assessment).

For the unit and lesson plans, teachers were asked to use two detailed templates provided by the IHE facilitators. The structure of each template clearly resonated with the IHE's models of science inquiry, teacher collaboration, and instruction for all students, including students with disabilities (again, these are described further in the first set of findings). Using these templates, the Wellington teachers designed a physiology/immunology unit that spanned fourteen class periods. The Northglenn teachers, Christopher and Robert, designed a chemistry unit on the atom and periodic table. Robert was scheduled to teach biology during the upcoming school year; Christopher, chemistry. At the beginning of their co-planning sessions, Christopher and Robert agreed to plan a chemistry unit since they both had taught the subject and, in Robert's case, would be teaching the subject again in the future. Their unit spanned 13 class periods.

Finally, Swanson wrote fieldnotes on the teams' lesson presentations: Each team presented a unit overview and one exemplary lesson to fellow participants during the final 2 days of the institute. Teachers were asked to co-teach their exemplary lesson as they would for their own students. These presentations were not recorded on video at the request of many of the summer institute teachers.

Analysis of data

Table 2 provides an overview of our three approaches to data analysis. As had other researchers investigating collaboration (Pawan and Ortloff 2011), we began our own analysis of co-planning through a collaborative lens by selecting a framework. We reviewed the literature cited in our conceptual framework above and decided to use Friend and Cook's (1992) characteristics of successful collaborations to organize our analysis, rather than that of Weick (1979) or of Garmston and Wellman (1999), because Friend and Cook worked in the field of special education, foregrounded process, and included characteristics routinely noted by other researchers. Although Friend and Cook (1992) identified nine characteristics, given the purpose and scope of our own study, we examined five. We did not investigate (1) the voluntary nature of collaboration because all teachers self-selected to participate in the yearlong professional development project. We also did not include (8) increased trust or (9) a greater sense of community, because research (Grossman et al. 2001) makes clear that building communities in which members trust one another takes time; the 2-week summer institute bounded our study of co-planning. Finally, we merged the characteristics of (4) collective responsibility for carrying out tasks and (6) collective accountability for outcomes because the two were tightly intertwined for our science and special education teacher participants: Teachers were asked to co-plan lessons that they then co-presented and turned in.

Next, we examined transcripts of the video recorded co-planning sessions to determine how participating teachers exhibited (or failed to exhibit) the following five characteristics of successful collaborations: individuals have equal authority to contribute and equal power to decide; collaboration centers around common goals; participants share responsibility for tasks and for their outcomes; participants share their own resources (e.g., curricula and classroom materials); and participants value the collaborative process.

Table 2 Overview of lenses, data collection, and analyses

Lens	Types of data	Analytic process
Collaboration	1. Teacher interviews	1. Examined teachers' definitions of collaboration and views on its value.
	2. Videotapes of co-planning sessions	2. Determined the presence or absence of key characteristics of collaboration.
	3. Fieldnotes of presentations	3. Identified how teachers held themselves and each other accountable for outcomes of the collaborative process.
Small group interactions	1. Videotapes of co-planning sessions	1a. Counted number of speaking turns for each teacher during co-planning.
		1b. Determined types and frequency of group roles adopted by each teacher during co-planning.
	2. Teacher interviews	2. Identified potential reasons a given teacher adopted some group roles more than others.
Community discourse	1. Videotapes of co-planning sessions	1. Analyzed content of teacher talk during co-planning.
	2. Curricular materials produced during co-planning	2. Determined ways discourse themes from co-planning were evident in the curricular materials produced.
	3. Fieldnotes of presentations	3. Determined ways discourse themes from co-planning were evident in final presentations.

Drawing from the work of Pawan and Ortloff (2011) and Burbank and Kauchak (2003), we triangulated these findings with transcripts of individual interviews and our fieldnotes of lesson presentations. We coded all transcripts and fieldnotes by each characteristic; if an utterance or exchange exhibited multiple characteristics, we coded it multiple times. Table 3 summarizes our analysis of teacher collaboration.

As suggested earlier, this first analysis (viewing co-planning as collaboration) yielded a broad understanding of teacher participants' efforts to co-plan science curricula that met the needs of students with disabilities. However, to delve deeper into the interactions among participants, to better highlight the complexities of co-planning, we moved to analysis of co-planning through the lens of small group interactions. To inform this second analysis, we reviewed the studies discussed above in our conceptual framework, for example, studies by Cohen and Lotan (1995) and by Bianchini (1997) on disparities in frequency of talk among group members. Research by Richmond and Striley (1996) suggested the importance of attending to types of group roles adopted by members. Further, Anderson, Thomas, and Nashon (2009) made clear that retrospective interviews can yield important insights into the reasons individual members decide to talk (or remain silent) during groupwork.

We then conducted two types of analyses to make sense of science and special education teachers' co-planning process through the lens of small group interactions. One, across all video segments of co-planning sessions, we determined the frequency of individuals' talk (much like Bianchini 1997): We counted the number of speaking turns each teacher took, calculated individuals' turn taking percentages, and compared them to one another. We operationally defined a "turn" as any instance in which a participating teacher spoke to his or her colleagues during the co-planning sessions; when more than one individual spoke at the same time, each person's contribution was counted.

Table 3 Five characteristics of collaboration

Characteristic of collaboration	Types of statements/activities/interactions by characteristic
Equal authority to contribute and equal power to decide	1. Proposing an idea to the team.
	2. Discussing an idea as a team.
	3. Making a decision (i.e., how it is made and by whom).
Common goals	1. Articulating a goal of the co-planning process.
	2. Articulating a goal for the curricular materials produced (e.g., what an activity or lesson should look like).
Sharing responsibility for tasks and outcomes	1. Working individually and collectively to create year, unit, and lesson plans.
	2. Taking collective ownership of an idea, activity, or lesson plan generated during the co-planning process.
	3. Sharing the stage when presenting their example lesson and answering questions from colleagues during final presentations.
Sharing one's own resources	1. Providing other team members with one's own lesson plans, activities, or other educational materials.
Valuing the collaborative process	1. During individual interviews, identifying the benefits and/or challenges of collaborating.
	2. During individual interviews, sharing personal experiences with collaboration.
	3. During individual interviews, discussing expectations for what one has or will gain from collaborating with fellow science education and special education colleagues.

Two, similar to Richmond and Striley (1996), we identified four group roles teachers adopted during their co-planning groups (see Table 4 below): taskmaster, source, sounding board, and co-creator. These roles were neither defined for teachers by the IHE facilitators nor determined by researchers a priori; rather, they emerged from our analysis of the video data. The transcripts of all co-planning sessions were reviewed several times in order to identify roles. These roles were discussed and agreed upon by both researchers. Once roles were identified, the transcripts were coded on two separate occasions; any discrepancies were discussed and resolved. Each participating teacher's role(s) was coded during each segment. Two role codes for an individual teacher occurred during 16 of the 47 segments; during these 16 segments, the teacher adopted the roles of both source and taskmaster. We found three patterns in the kinds and frequency of roles teachers adopted during co-planning. We then reviewed teachers' interviews for possible reasons for the take up or avoidance of particular roles.

To understand both the nature and substance of teachers' talk and actions during co-planning, to delve even further into the complexities of the co-planning process, we conducted a third analysis using the lens of community discourse. To do so, we returned to our review of research on professional learning communities that investigated the substance of teachers' conversations. We took up Putnam and Borko's (2000) suggestion to view our two school teams as mini-discourse communities. We then reexamined the methods Grossman et al. (2001) and Kazemi and Franke (2004) used to analyze teacher discourse in communities. We found that these researchers triangulated themes that arose from their detailed analysis of community discourse with other types of data collected.

For our own analysis, then, we examined transcripts of teacher discourse from our two mini-discourse communities. We identified the main topic of conversation for each

Table 4 Teachers' group roles during co-planning sessions

Role	Definition	Example
Taskmaster	Decides what the team will work on and in what order. Divides work up within the team.	*Lynn in the role of taskmaster* L: Okay. If I get the articles, can I email them to you and you can make copies? Print [them] out and copy [them]? M: Yes. L: And then if I make the graphic organizer can you copy that as well? L: Okay. So I will do that today. M: Just tell me how many. L: Yeah I'll do that. So then your [lab activity] won't need any copying because they will do that in [their science] notebook[s]. M: Yep.
Source	Shares a strategy, lesson, or activity with other team members.	*Lynn in the role of source* L: I just called [the unit] natural selection. Ok. you know what I did? I switched [the material on natural selection] with [the material on the topic] history of life…. So [the topic] history of life is not that long, so all [my students] kind of did was just touched on fossils [such as] looking at different fossils and the different eras. So that's why I just put [the topic history of life] first and then segued into [the topic] natural selection so that's the big [emphasis].
Soundboard	Listens to the source and responds.	*Robert in the role of soundboard* C: They have a card on each element and they have to identify solid, liquid, gas. What are some of its properties? What's one interesting fact? R: Have them walk around? C: Exactly. Gallery-walk kind of deal R: Yep. That's cool
Co-creator	Participates in co-creating a new activity, lesson, or strategy with other team members.	*Christopher and Robert in the role of co-creator* C: How do we know what we know? Black box analogy. Sub-atomic particles. We could hold up a black box. We could hold up a shoebox with something inside and have a student come up. How do you know? Okay, then. That's the second day. R: I like doing the whole black box activity. I think we should put it in. C: So let's do it then. So we can do that—do that as the second part of that day. And then the notes—the notes on the atom the beginning of the third day? Or do you want to do. R: I think they should do the black box. C: On the third day? R: I think they should do the black box. I say that's more an engaging activity. C: Okay, so… R: Do that first, and then do your notes, and then do the small little group discussion the second day with their peers. C: Okay.

segment transcribed. Segments were categorized into one of five topics: science content, special education content, teachers and teaching, students and learning, and lesson purpose or design. After segments were grouped by main topic, we examined the substance of teachers' conversations for emergent themes. Over time, emergent themes were eliminated, synthesized, and/or refined into two. Teachers' products—their year, unit, and lesson plans—and our fieldnotes of final lesson presentations were then used for triangulation—for supporting or disconfirming evidence in light of these two themes.

We clarify for readers that Swanson consulted with IHE facilitators both during and after the institute to determine the purpose of activities implemented, directions and resources provided to teacher participants, and curricular products they generated. However, the facilitators relied on their own daily pre- and post-surveys completed anonymously by the teachers throughout the first week of the summer institute, as well as their own observations of the teachers' progress through the templates during the second week to make modification to the professional development effort. Indeed, at the conclusion of each day of the institute, the facilitators met to debrief the day's activities, review teacher surveys, and make any necessary changes to the following day's agenda. Swanson was present for all these meetings, but the facilitators' comments were not recorded as a source of data. In short, while Swanson consulted with the facilitators during the summer institute, she did not provide input into how the program should be run.

Instead, Swanson presented preliminary research findings to the IHE director and facilitators for feedback once the entire yearlong professional development program had been completed; at that time, the IHE was planning the second iteration of the program for a new group of science and special education teachers. Member checking (Lincoln and Guba 1985) was only conducted with one of the five teacher participants during our analytic process. One teacher participant who had since become a facilitator attended this presentation; therefore, he was able to provide feedback to Swanson as well. All feedback was incorporated into subsequent analysis and presentations of research findings.

Findings

We present our findings on the process of co-planning in three parts. Findings are organized by conceptual lenses used: collaboration, small group interactions, and community discourse.

Findings from our analysis using the lens of collaboration

In our first analysis, as stated above, we examined individual teacher interviews, transcripts of co-planning sessions, and fieldnotes of lesson presentations to determine if and how teacher teams exhibited five characteristics of successful collaborations. These characteristics include equal authority to contribute and equal power to decide, common goals, shared responsibility for making decisions and carrying them out, shared resources, and valuing the collaborative process. Each characteristic is discussed in detail below.

Equal authority to contribute and equal power to decide

Both teams used a consensus model to determine lesson design and content: Teachers would propose an idea, discuss it with one another, and then collectively decide how to proceed. Within teams, individual teachers differed in the kinds and number of ideas they

proposed. Two science teachers (Lynn and Christopher), in particular, offered more suggestions for activities and assignments than their teacher colleagues. However, no one teacher's ideas were routinely rejected. Further, no one teacher dominated his or her team's decision-making process.

The following excerpt, for example, was taken from the beginning of the Wellington teachers' co-planning process. Lynn, a science teacher, suggested her team revise her biology course syllabus for their yearlong plan.

Lynn: So what I did. I'll kind of show you what I usually do. I changed it a little bit but. So the first week is welcome, preview activity, Cornell notes [structured note taking]. This week I did welcome, Chapter 1 stuff, which is just introduction [to the course].
Manuel: Yeah.
Lynn: And then, I did like kind of [a] scientist's research project, how to use a microscope, syllabus quiz. So a lot of just intro stuff.
Manuel: Right, because you still have people [students] coming in and out [i.e., enrolling or dropping the course].
Lynn: And we only have 3 days anyway [that first week]. So, the second week, that's when I started macromolecules.
Manuel: Macromolecules. Why don't we do that again?
Lynn: Okay.

Lynn proceeded to outline the remaining units and chapters in her biology course for team members. She included discussion of major activities and assignments as well. Juan and Manuel asked clarifying questions and expressed their desire to use what she had created. As such, the decision to use these course materials was made by teachers as a collective. A similar initial conversation occurred between the two teachers from Northglenn, Christopher and Robert.

Common goals

We also found our participating teachers held common goals. There were no disagreements within teams about what products they should design (yearlong, unit, and individual lesson plans). Possible reasons for this shared product goal were (1) the teachers read the informational flyer and knew the expected products of the summer institute before they agreed to attend, and (2) the teachers readily adopted and used the detailed unit and lesson templates provided by the IHE facilitators during the institute. In particular, the templates guided the teacher teams through the co-planning process using a series of prompts: Seven prompts guided the unit planning and ten prompts, the planning for individual lessons. For both unit and lesson plans, prompts followed a similar progression. First, teachers were asked to select key content standards and inquiry skills (from the state science standards) from which to develop learning objectives. Then, teachers were prompted to list the formative and summative assessments used to monitor student learning with respect to these learning objectives, to align their plan with the 5E instructional model of inquiry and research on student learning, and to explain the type and sequencing of lessons (for the unit plan) and activities (for the unit and lesson plans). Finally, prompts guided teachers to detail their instructional practice. More specifically, in both templates, teachers were asked to provide a list of all "research-based strategies" used to support student learning. Teachers were also asked to explain how they would "incorporate accommodations, collaborative-model teaching and/or co-teaching." We note that the positioning of prompts

related to science education at the beginning of the template and those related to inclusion at the end might have encouraged teachers to discuss science education topics more often than those of inclusion. We also found the wording of the last prompt, specifically the use of "and/or", noteworthy as it might have worked to deemphasize the importance of attending to inclusive instruction in the teachers' co-planned materials. Although all three topics were emphasized during the first week's activities, teachers could interpret this prompt to mean that that they did not have to address all three in the curriculum materials they co-planned.

In addition to agreeing on *which materials* they should produce during co-planning, we found that teacher participants agreed on the *key constructs* those materials should foreground. Both teacher teams focused on science as inquiry and, to a lesser extent, strategies for differentiating instruction, including the use of accommodations, for students with disabilities. Because teachers agreed on the *key constructs* they intended to cover during their yearlong, unit, and lesson planning, we viewed this agreement as additional evidence for shared goals.

Christopher and Robert, for example, began their co-planning process by outlining their yearlong curriculum plan. They then turned to the planning of their chemistry unit on the atom and periodic table. Neither questioned whether such yearlong and unit plans were necessary to design.

Robert:	My opinion is (pause) we [have] two ways to do [plan the unit]. We could look at the [district approved text] book and see what the book does. That is what they [the IHE facilitators] like. They would like it, so it's going to fit into [the template]…
Christopher:	Yeah, [the textbook's activities are] kind of constructivist, or at least try to be.
Robert:	Right. So we could go with that, tweak that.
Christopher:	Uh-huh.
Robert:	We could go with what [the lessons] you have [developed for your own science courses]. I just don't want you to feel like, "Oh, I'm giving all my stuff [to Robert]."
Christopher:	I don't, I don't mind at all. I don't mind sharing it. I just don't know if the way I do it [teach my science course] is going to fit [the IHE's] vision.

Equally important, Christopher and Robert understood that their goal was to create curricular plans that aligned with the IHE's vision of good teaching—that the lessons they created and presented should foreground science teaching as student-centered and inquiry-oriented. It is less clear to what extent Christopher and Robert thought their unit should be inclusive of students with disabilities—also part of the IHE's vision. In any case, as Robert explained, the pair had two options: They could use the sequencing of activities either from the course textbook or from Christopher's lessons as a starting point. Christopher worried that the lessons he used in his own course did not closely resonate with the IHE's goals. In the end, Christopher and Robert agreed to use Christopher's lessons as the basis of their unit plan and make adjustments when necessary to better align those lessons to fit the template provided.

Shared responsibility for tasks and outcomes

As with the first and second successful characteristics of collaboration, we found teachers in both teams shared responsibility for designing their curricular materials during the co-

planning process. Teachers in both teams also took ownership of the completed set of curricular materials produced, regardless of which team member proposed or actually designed a given lesson, activity, or assignment. Within a given team, when preparing for their presentations to colleagues at the conclusion of the summer institute, each teacher took responsibility for a portion of the presentation. In planning for their final presentation, for example, Lynn reviewed with Manuel and Juan what each would prepare and ultimately present from their co-planned lesson.

Lynn: So our lesson—the 5E's [the inquiry instructional model requested by IHE facilitators]. Juan, you're going to work on the "Engage" and then "Explore" (pointing to Manuel), how pathogens spread.
Manuel: Okay, yeah.
Lynn: And I'll do the "Elaborate." And then the "Evaluation" piece is just like a haiku.
Manuel: Yes.
Juan: Yes.
Lynn: And then the. What is that? [For the] "Explain" part, we can maybe use this kind of stuff (pointing to materials on the table) or give [students] a graphic organizer as they take notes.
Manuel: Exactly.
Lynn: That might be okay. Or, in their Cornell notes, have [students] do a concept map.

Similarly, our review of fieldnotes of teams' presentations confirmed that teachers indeed traded off presenting parts of their co-planned lesson. Teachers also appeared knowledgeable of all facets of curricular materials presented (e.g., they were able to provide a rationale for different pedagogical choices). This is noteworthy in light of the unequal sharing of curricular ideas highlighted above in characteristic one, namely, that two of the science teachers shared more lessons and assignments than their colleagues.

Sharing one's own resources

Despite the unequal sharing of resources by teachers in both teams, each teacher did share at least one activity. Most teachers also shared physical materials (from CDs, to flash drives, to access to a photocopy machine), as well as stories of lessons learned from previous teaching experiences. As stated under characteristic one, two science teachers, Lynn and Christopher, offered more suggestions for activities and assignments than their teacher colleagues. Still, the third science teacher, Manuel, did share some resources. For example, he discussed his previous experiences teaching the topic of meiosis during summer school. Manuel explained why he did not explicitly teach mitosis as an introduction to meiosis. (Manuel taught chemistry during the school year and biology during summer school.)

Lynn: The kids need to know [mitosis] to do meiosis, which is here [in the biology standards]. Right? Gamete formation and meiosis.
Manuel: You know what? I jumped right to meiosis [and the kids] got it.
Lynn: They got it? Okay. So I spent some time on mitosis making a flipbook and a cell cycle [visual aid] and stuff.
Manuel: [The students] cover mitosis in grade seven.
Lynn: Yeah, they are supposed to.

Manuel: I just—I'd remind them. You know, I just [dove] into meiosis but along the way I remind[ed] them [of mitosis].

Manuel also shared a lab on the transmission of diseases and a culminating activity in which students simulate a dinner conversation with Charles Darwin. The transmission of diseases lab was included in his team's final presentation.

The two special education teachers also shared resources with their teams. Juan, for example, provided several suggestions on how to connect the subject matter to students' lives, recommended a group presentation strategy, and offered an idea for a culminating task. These latter two resources were included in his team's presentation (these are discussed in more detail in a subsequent analysis). Robert, the special education teacher in the Northglenn team, shared with Christopher both an activity focused on the Bohr model of the atom and a handout to scaffold lecture notes for students.

Valuing the collaborative process

In their interviews, all five participants stated they saw inherent value in collaborating with colleagues, our fifth successful characteristic of collaborations. The two special education teachers, Juan and Robert, talked primarily about the benefits of collaboration. Both regularly collaborated with colleagues from other disciplines. They described their interactions with science teachers, in particular, as helping to deepen their own subject matter knowledge and as providing them with ideas for instructional strategies and activities. Even prior to the summer institute, for example, Juan routinely sought help from his science colleague, Manuel, when he did not understand the biology material he was expected to teach. "I'm not strong in science and he is," Juan explained.

When discussing interdepartmental collaborations, neither Juan nor Robert focused on the challenges of cultivating or maintaining collaborative relationships. Instead, both expressed a desire to continue to collaborate with their science colleagues. Juan liked to observe his science colleagues' instructional practices and to analyze lessons through the lens of a learner to identify potential areas of difficulty for students with disabilities. He thought he could benefit from watching his science colleague, Lynn, present a biology lesson. He explained, "She's the biologist. I can learn a lot more from her and I can identify what problems [students might have] because I'm going to be a learner myself."

The three science teachers in this study also discussed benefits to collaboration in their interviews. However, unlike Juan and Robert, they described few collaborative activities with colleagues outside of their own department. Lynn, for example, stated that collaborating was the "one key thing that helped [her] survive" her first year of teaching. She collaborated often, but only with other science teacher colleagues.

Also unlike Juan and Robert, the science teachers identified myriad challenges to collaboration. Manuel, for example, stated that he only collaborated with other science teachers during professional development time designated by his school's administration: He used these opportunities to "bounce ideas" off of science colleagues, as well as an assistant principal who used to teach chemistry. Manuel was the only chemistry teacher at Wellington High School, he clarified, and had no one else to plan chemistry lessons with.

> [Collaborating is a challenge because of] having to meet your own standards. You want to make sure you cover your own bases… Just trying to get your [own] job done takes up all your energy, all your time.

We note that although Juan, a special education teacher, discussed collaborating with Manuel, Manuel did not mention collaborating with any colleagues outside the science department.

Findings from our analysis using the lens of small group interaction

Using our second lens of small group interactions, as explained in our methods section above, we performed two separate analyses of the 47 segments transcribed from recordings of the co-planning process. Within each small group, we determined the frequency of talk by teacher and identified the types and frequencies of group roles teachers took up. We also examined teachers' individual interviews for possible reasons some roles were adopted more often than others.

Turn taking

We found that no one teacher took a disproportionately large or small number of speaking turns in comparison to his or her colleagues. Across their small group conversations, for example, Christopher, the science teacher, took 530 turns (51 %) speaking while Robert, the special education teacher, took 500 turns (49 %). Christopher took 30 more turns than Robert, in part, because of one conversation they had with a facilitator: Christopher did much of the talking during that segment.

The Wellington teachers, Manuel, Lynn, and Juan, showed more variation in the number of turns each person took speaking during the co-planning process; however, we cannot argue one person dominated the group's conversations. As did Christopher, Lynn and Manuel, the two science teachers, spoke more often than Juan, the special education teacher. They took 460 (34 %) and 416 (38 %) turns speaking, respectively. Juan spoke 336 times (28 %).

Small group roles

To begin to look at the kinds of substantive contributions teachers made in their groups, we examined teachers' take-up of the following four roles: taskmaster, source, soundboard, and co-creator (see Table 4). When a teacher adopted the role of taskmaster, for example, he or she led the group—deciding which tasks to do, in what order they should be completed, and/or which group member(s) should work on a particular task. A teacher adopted the role of source when he or she shared a strategy, lesson, or activity. Those who listened and/or reacted to the source adopted a third role of soundboard. Typical responses of a soundboard were "I like that," "yeah," and "okay." Finally, when teachers were involved in constructing a new activity, lesson, or strategy with another, they adopted the role of co-creator. As co-creators, teachers actively generated something new. Often, one teacher began with an activity that he or she had previously implemented; this activity was then substantially revised in consultation with other group members. Instances where one teacher presented an activity and another teacher responded favorably or indicated that the activity should be included in the group's lesson were not coded as examples of co-creating. In other words, a teacher could not occupy the roles of soundboard and co-creator at the same time.

We identified three patterns in teachers' take up of roles in their small groups (see Table 5). Each is described below using excerpts from the Wellington teachers' co-planning sessions. Similar patterns were found across both teams of teachers; however, we

Table 5 Group roles by percentage adopted for each participating teacher

Participant	Group role			
	Source (%)	Soundboard (%)	Taskmaster (%)	Co-creator (%)
Lynn	40	20	17	23
Manuel	15	62	0	23
Juan	35	35	7	23
Robert	25	38	4	33
Christopher	32	21	18	29

chose to use excerpts from one to create a more cohesive description. The first pattern we found was that two of the three science teachers, Lynn and Christopher, adopted the roles of taskmaster and source more frequently than the special education teachers in their teams. Lynn, for example, regularly adopted the role of taskmaster when synthesizing her group's decisions and progress. She also took up this role when she clarified who was responsible for each part of the lesson the group presented at the end of the institute. Further, Lynn served as a source when she opened the co-planning session by outlining the yearlong pacing plan she had developed for her biology course the previous year. Indeed, her biology pacing plan served as the basis for all plans the Wellington group created during the institute. (Relevant excerpts are found in our first analysis of co-planning as collaboration, as well in Table 4 above.)

We clarify for readers that although Lynn adopted the roles of taskmaster and source more often than either Manuel or Juan, she did not dominate the co-planning sessions. The analysis of speaking turns presented above made clear that all three teachers participated in their group's conversations. Further, Lynn neither insisted that all of her activities be included in the group's final plans, nor refused to incorporate the ideas of her colleagues into particular lessons. In the excerpt below, Lynn adopted the role of taskmaster when she suggested that her group begin planning for their physiology/immunology unit by deciding on their culminating task. She later adopted the role of soundboard when Juan suggested using a Build-A-Body activity as the culminating task.

Lynn: Do you think what could be helpful is planning the physiology unit? We know the [state science] standards. Let's fine tune the culminating task, for example, the [sample culminating task presented by the IHE facilitators] and then we'll scaffold it [for students] if we want them to do a brochure of the human body. [The students] need to know what the human systems are. They need to know about this and this and this. So let's come up with a culminating task.

Juan: Build-A-Body. Like Build-A-Bear. [Build-A-Bear is a store where children can select, stuff, and dress their own stuffed animal.] Build-A-Body. What do you need to function? And tell us the system, what it does. I was thinking something of that nature.

Manuel: That's good, that's good.

Lynn: Build-A-Body. Okay. So what's your idea?

Juan: Taking the Build-A-Bear concept. We could have a cut out [of the students] thrown on the floor on butcher paper and cut them out and we start building their systems there. You [the students] have to explain which one it is, identify the organs and their functions. And these are posters we could put up all around the room.

The second pattern we identified related to group roles was that all five teachers adopted the role of co-creator roughly 20–30 percent of the time, particularly toward the end of the co-planning process (see again Table 5). In the following excerpt, Lynn, Juan, and Manuel worked together to design an assessment rubric. The rubric was to be used to evaluate a haiku assignment—a formative assessment—in their physiology/immunology unit. Haikus are unrhymed poems that are three lines in length. Each line must contain a specific number of syllables.

Juan: [A scoring] rubric of [one to] four [points]?
Manuel: Yes.
Juan: Right? So, [students will] identify if it's a virus or disease, its pathway into you, and its effect [in their haiku].
Manuel: Yes.
Juan: I think if the haiku identifies those three points, that's a four. If it identifies two points, a one.
Lynn: I think also give them some points on.
Manuel: Creativity and following the right format.
Lynn: And also for right format so we can say [we] agree with the English teachers.
Manuel: The [English Language Arts] standards.
Juan: Oh.
Lynn: And like the five, seven, five syllables [required for each line in a haiku]. I'd give them points on do they have the right haiku things. And then is it creative, is the content accurate, and even like neatness, and all of those things too. So it [the scoring rubric] could just be five categories of four [points, for a] total of twenty points.
Manuel: Okay.

A third pattern that emerged was that each teacher's primary role(s) in the group reflected a strength or preference in collaborations with colleagues discussed in his or her interview. Juan, for example, adopted the roles of source and soundboard more often than taskmaster or co-creator (see again Table 5). These two roles resonated with his description of how and why he collaborated with members of the science department provided in his interview. More specifically, when adopting the role of soundboard, Juan referred to Lynn and Manuel as scientists and asked them to clarify terms such as protozoa that were used in the unit they were planning. During his interview, as conveyed in our first analysis, Juan noted that he worked with science teachers in order to clarify science concepts he found confusing, as well as to get ideas for science activities.

When adopting the role of source in co-planning sessions, Juan often shared what he thought were opportunities to connect science content to students' everyday lives. Juan related the human body to different features of a car (e.g., engine, coolant); connected homeostasis to TV and movie celebrities on crash diets; and discussed "Engage" activities (based on the 5E instructional model of inquiry) that dealt with salmonella outbreaks. In his interview, Juan stated that making connections between science content and everyday life was one of his strengths as a teacher.

> I try to find something that will connect [science] with them [my students]…. That's my biggest asset, I think…. Culturally, I know where most of my kids are coming from. I try to find things that they will identify with.

In looking across the findings from our second analysis, we found that a teacher's frequency of talk (i.e., turn taking) was not indicative of the type(s) of role(s) he or she adopted during the co-planning process. For example, Manual took the most turns (38 %) during conversations with his colleagues, yet adopted the role of soundboard (62 %) much more often than that of source or taskmaster. Lynn, on the other hand, took 34 % of the turns during her team's conversations, yet adopted the role of source most often (40 %). Such findings highlight the importance of examining the frequency of talk and the take up of roles since the two appear independent of one another among the teachers investigated here. For Manual and Lynn, both participated similarly in their team's conversations according to their respective number of turns; however, each participated in these conversations in very different ways as reflected in the group roles they adopted most often.

Findings from our analysis using the lens of community discourse

Using our final lens of teacher community, again as stated above, we analyzed the video records of teacher interactions, fieldnotes of final presentations, and individual teacher interviews to more closely examine the substance of teachers' oral and written discourse during the co-planning process. We identified two themes.

Teachers discussed science education topics more often than special education ones

One, as suggested in our first analysis using the lens of collaboration, we found that both teams of teachers spent more time discussing topics in science education than those in special education when co-planning. Indeed, the vast majority of conversations recorded were dedicated to science and science education topics. This was not what we expected. The IHE facilitators had specifically asked teachers to address both science as inquiry and student accommodations in the lessons they designed. Both science and special education prompts (with some limitations as discussed in our first analysis) were included in the unit and lesson templates teachers were asked to use during their co-planning process as well.

In the 5 h of video recorded conversation among Lynn, Juan, and Manuel, for example, the topic of special education was brought up only twice. The first instance occurred during the first day of co-planning: Juan described how his students (all of whom received special education services) enjoyed a particular activity and were able to learn science content as a result. The second instance occurred at the end of the second day. In a brief exchange between Manuel and Juan, as part of a larger conversation among all three team members, the two reviewed the lesson plan they intended to present at the close of the institute. The entire exchange is presented below.

Manuel: For the special ed[ucation] kids, is this the part where you would do something different with them?

Juan: Well, I'm looking through this whole [immunology lesson]. What modalities [ways information is presented to students during lessons/activities] are we using for them?

Manuel: All three of them [modalities].

Juan: The beginning part, they are going to listen to a story. The Explore part should be tactile and visual, you know.

Manuel: Yeah, I have something [that we can use in the lesson plan].

Although the three Wellington teachers rarely broached specific topics in special education, it is important to note that they discussed at length different innovative strategies

they could use to structure, guide, and support students in learning. Strategies they identified as supporting student learning included structured notetaking, science notebooks, graphic organizers, and jigsaws. Wellington teachers, however, did not identify these strategies as specific ways to support students in their classes who received special education services.

Science topics also dominated the conversations of the Northglenn teachers, Christopher and Robert. In the 5 h of co-planning sessions recorded, Christopher and Robert broached the topic of special education only three times. Robert twice voiced concerns about activities proposed for particular lessons: He thought these activities would be "complicated" for students with disabilities and in need of facilitation by the teacher. In a third instance, Robert and Christopher discussed how Robert might implement a jigsaw activity about the periodic table and groups of elements in his classroom.

Christopher: Do you think we should have [students] jigsaw all eight groups [of elements]? Alkali metals, alkali earth metals, halogens, noble gasses.
Robert: If I was. A bigger class, yeah. If I had 32 kids, yeah, I'd do all eight [groups].
Christopher: You could just repeat [one group of elements]. Or you could just divide the class in half and have two groups [of elements to examine]. You know, do metals and nonmetals.
Robert: Yeah.

As was the case with the Wellington teachers, Robert and Christopher also discussed several different instructional strategies helpful in scaffolding student learning. Examples included the use of science notebooks and activities such as jigsaws and round robins. Again, these strategies were not specifically identified as helpful for students receiving special education services.

Further, teachers' written products reflected this disparity in time devoted to discussing science versus special education topics. Final lesson plans included much more information about science content than about strategies to support students receiving special education services. In one of their physiology/immunology unit's lesson plans, for example, Juan, Lynn, and Manuel noted that "while [the] gen[eral] ed[ucation] teacher lectures, special ed[ucation] [teacher] teaches students how to take notes and create flow charts using power notes." The lesson plan also listed several accommodations for students with disabilities—visual aids, textbooks on CD, and heterogeneous grouping of students—but did not explain under what circumstances they were to be implemented. These two references to special education were the only ones included in the lesson plan. In contrast, the teachers provided a wealth of information about science content. Teachers listed the state science content standards addressed, explained what students were to do to demonstrate proficiency for each standard listed, and described the science activities they would implement.

Teachers talked more often about teaching than learning

A second theme emerged from our examination of teachers' discourse in communities: Conversations about teachers and teaching were much more common than those about students and learning. Although each participating teacher made at least one comment regarding student learning during the co-planning process, most of their conversations focused on their own thoughts and actions. We note that the timing of the co-planning activities might have influenced this finding. Teachers worked on their lessons prior to the start of the new academic year—before

they were surrounded by and engaged with students. Had teachers co-planned lessons during the school year, discussions about students and student learning might have been more frequent.

When outlining her previous year's biology curriculum for Juan and Manuel, for example, Lynn highlighted what activities she implemented, what projects she assigned, and how she herself felt about her lessons' success. She mentioned students ("kids") only at the end of her description.

> Yeah, so that's what I did [last year for the cell biology unit]. That's where I did a mini-bacteria project and then I started the cell city project there too. But we don't have to [include them both here].
> //
> [Next year], I'm either going to keep the cell city [culminating project] but I wanted to try something new which I've seen done before. It's a book, a little book about DNA. I told my AP [Advanced Placement Biology] kids this time around and they did it and it was really good. So I can change [the assignment] for the Bio[logy] kids.

Of the three Wellington teachers, as suggested in our findings under small group interactions, Juan focused most heavily on students and their learning. In addition to frequently suggesting lessons be connected to students' daily lives, Juan made it clear to Lynn and Manuel that he thought it important for students to have repeated opportunities to share their ideas and questions during a lesson. Juan, for example, suggested his team include as an assessment a game he regularly played with his students. The point of the game was for students to create questions about the topic under study that other students in their class would be unable to answer correctly. Students then quizzed each other for prizes. Juan thought this game successful in engaging his students and encouraging them to interact with the material.

> I did it [the game] with kids reading at a much lower level. You could see some of the stuff [the questions] that they came up with was good. The great part of it [was] that when you [walked] around the room, you [heard] these guys [students] trying to get [to stump] somebody else [with their question].

Both Lynn and Manuel agreed the game should be incorporated into their team's unit plan.

The Northglenn teachers, Robert and Christopher, discussed students and student learning more often than the Wellington team. Both Christopher and Robert noted whether or not their students had "liked" certain activities when sharing them with each other. They also considered students' potential for success or failure when making decisions about which activities to include in their lesson plans. For example, when Robert and Christopher debated two similar introductory inquiry activities—the black box activity and the marbles activity—Robert argued for the black box activity because he thought it more appropriate for his students with disabilities.

Christopher:	Black box [activity] or marbles [activity]?
Robert:	I don't know. I've heard of the black box activity. Seemed interesting to me. I didn't do it, but I'll probably teach it. I haven't done the marbles thing. The marbles seems.
Christopher:	Black box is seeing or visualizing the invisible.
Robert:	Yeah. The marbles thing is interesting to me [too]. I see that as being difficult for some students.
Christopher:	Yeah.
Robert:	Especially for students who can't–who don't have good.
Christopher:	Chemistry.

Robert: Spatial orientation. That could be.
Christopher: Okay so that's.
Robert: That could be difficult.

Further, in our examination of written lessons, we found teachers placed little emphasis on students' prior conceptions. As part of the model of inquiry instruction presented during the institute, the IHE facilitators had encouraged teachers to identify possible student misconceptions and to explain how these prior conceptions would be raised and addressed during the lessons' activities. Both the Northglenn and Wellington teachers did list several potential misconceptions as part of their plans, but did not explain how they would work to raise and address them.

Discussion

Our decision to use three conceptual lenses and to conduct three sets of analyses allowed us to examine multiple, sometimes overlapping, and sometimes disparate dimensions of teachers' co-planning process. Indeed, we view the contribution of this study to be twofold: (1) to provide insights into the strengths and limitations of science and special educator teachers' co-planning process; and (2) to make visible the strengths and limitations of different qualitative approaches to analyzing co-planning. Below, we weigh the benefits of employing multiple conceptual lenses versus a single one to investigate co-planning. We also discuss limitations of our co-planning investigation and provide suggestions for future research.

Affordances of using multiple conceptual lenses

This study serves as a reminder that a particular conceptual lens provides insights into certain aspects of a complex process and ignores others. Each lens shaped our choices regarding types of data to use, kinds of analyses to perform (see again Table 1), and salient claims to make. Each set of analyses yielded both unique and common findings. As should be expected, it was in reading across all three sets of findings that the most complete and balanced description of science and special education teachers' views and interactions during co-planning could be found.

More specifically, from our third analysis using community discourse as a conceptual lens, we found that teachers talked more often about science education topics than those related to special education. Our examination of the curricular materials teacher teams produced also yielded more attention paid to teaching science as inquiry than to teaching students with disabilities. On the surface, these findings resonate with previous studies of co-teaching between general and special education teachers: Harriet Bessette (2008) found that general education teachers tended to take the lead when co-teaching with special education colleagues. However, the layering of additional findings provided by our other two analyses allowed a more nuanced understanding of science and special education teachers' contributions to the co-planning process to emerge. In other words, our study adds to the existing literature on imbalances between general and special education teachers while co-teaching by providing two possible reasons such imbalances exist.

From our first analysis on co-planning as collaboration, we found that science and special education teachers agreed both on the tasks at hand and on the key constructs (more often related to science education than to special education) to include in their co-planning efforts. All teachers also took ownership over the final products that they presented to their fellow

participants and noted that they valued co-planning with teacher colleagues. However, two of the three science teachers, Lynn and Christopher, shared more of their curricular resources with their respective teams than did their special education colleagues. Further, both special education teacher participants included seeking disciplinary information and instructional suggestions from content teachers in describing their experiences with collaboration during their individual interviews. The disparity between time spent on science education versus special education topics might be due, in part, to the differential sharing of resources and the different views of why and with whom to collaborate.

Further, from our second analysis of co-planning as groupwork, we found that although Lynn and Christopher shared more curricular resources, they did not dominate their teams' conversations with respect to the number of turns of speech they took; special education teachers talked almost as much. Viewing co-planning as groupwork allowed us to differentiate between how often a participant elected to speak to his or her team members and the role(s) he or she adopted when doing so (see again Richmond and Striley 1996 for their examination of group roles). Not only did each teacher participant share at least one resource as found in our first analysis, each adopted the group role of co-creator an almost equal number of times. However, in each team, one science teacher did tend to enact the roles of taskmaster and source more often than her or his special education colleague. As such, we argue that the disparity between attention paid to science education versus special education topics might be explained, in part, by the differential enactment of these two group roles. We discuss other possible reasons for the privileging of science topics in teachers' co-planning talk and products below.

When multiple analyses are not feasible

The use of multiple lenses and sets of analyses is rarely feasible, however. First, the size and scope of this research project (i.e., the number of participants and the length of the summer institute) allowed us to analyze the same data in multiple ways. Conducting multiple analyses of a much larger data set would require time and resources available to few researchers. Second, identifying multiple lenses for use in analysis can easily lead researchers outside their own areas of expertise. Even with our prior experiences using two of our three conceptual lenses, by including the unfamiliar construct of collaboration, the writing of this manuscript took multiple iterations.

Still, this study gives us hope that at least some key findings—although certainly not all—can emerge despite the conceptual frame selected. Stated plainly, our study also contributes to the existing literature by demonstrating that different conceptual frameworks can yield similar qualitative results. Indeed, identifying common findings across lenses would have been more prevalent had we not made several strategic decisions about where to place certain claims; we were concerned about the length of the paper and the patience of readers. For example, each set of findings suggested that all teachers—irrespective of discipline—productively participated in the co-planning process. Using our first lens of co-planning as collaboration, at least to some extent, we presented evidence for each of five characteristics of successful collaborations. In viewing co-planning as groupwork, we found that teachers talked and adopted the role of co-creator approximately the same number of times. Our analysis of data through the lens of community discourse suggested all teachers engaged in conversations about science education topics more often than special education ones, and teachers and teaching more often than students and learning.

Although multiple conceptual lenses, data sources, and analyses were used, our study is not without limitations. We discuss two here. One, because the institute we investigated occurred in the summer, teacher participants did not yet have access to their class rosters for the upcoming

school year. They knew neither the student composition of the classes they would teach nor the specific needs of individual students with disabilities in those classes. Perhaps if our study of the co-planning of lessons had continued into the academic year, participating teachers might have moved to address topics in special education more often. The two teams of teachers we studied might also have shifted the focus of their conversations from teachers and teaching to students and learning. Further, the kinds of group roles special education versus science teachers adopted might have changed. We acknowledge that the design of our study precluded us from speaking to these aspects.

Two, had we employed member checking with all five of our teacher participants, we might have more thoroughly probed why science education topics and issues of teachers and teaching were discussed more frequently and in more detail. We remind readers that we shared preliminary findings with and solicited feedback from only one teacher participant from our investigation. Because this individual had since become a facilitator working with the IHE to plan the upcoming iteration of the professional development program, his feedback may have represented a unique perspective on the summer institute.

Insights for future research on co-planning

Our study's findings suggest three areas for future research. One aspect of co-planning in need of additional research is the examination of teachers' collective work over time. Similar to research that points to the unequal sharing of instructional responsibilities when general and special education teachers co-teach lessons (Bessette 2008), our findings indicate differences in reasons for and contributions to the co-planning process. Yet, the participating teachers in our study never discussed with each other or with their professional development facilitators why science teachers would share more instructional resources, who should take the lead in organizing their teams' tasks, and/or if it made sense to take more time to examine science content than special education issues. As we mentioned earlier, one potential reason for these disparities was the timing of the institute. Therefore, future studies on co-planning should include longitudinal data collection to identify the ways in which teachers' talk and actions change over time, particularly during the school year as they gain insight into the specific needs of their students. Future studies might also incorporate use of cogenerative dialogues (Tobin et al. 2001) among teachers before and during, rather than simply after, the co-planning process to better understand reasons for decisions, talk and actions, and resulting products.

Another area for future research is examining how the number and variety of teachers' experiences in preservice education and/or school-based and district-based professional development shape their co-planning process. Specifically, researchers should identify the experiences teachers had learning how to adapt their curricular lessons to meet the specific needs of students with disabilities across their preservice teacher education program, induction program, and/or schools and districts. Researchers should also explore the opportunities and/or guidance afforded teachers in relation to forming interdepartmental collaborations at their schools. Information along both of these dimensions would provide further insight into how and why teachers interact with colleagues during the co-planning process.

A final area for future study pertains to how facilitators can best assist teachers in co-planning. The professional development project studied here, it is important to note, held an explicit view of collaboration and spent time explaining its definition to participating teachers. IHE facilitators asked teachers to use this definition in a Norms-of-Collaboration Inventory to assess their work with colleagues back at their school sites. Further, co-planning and co-teaching were explicit and central elements of the IHE's definition of collaboration. As stated previously, to facilitate collaboration among co-teachers, professional development on co-planning has

been recommended (Keefe and Moore 2004). Our study highlights the need for professional developers to think and act deliberately about how to best guide teachers when collaborating in teams. For example, our study found that teachers shared common goals for their co-planning sessions, and that this might have been due, in part, to the highly structured unit and lesson templates they were provided. While sharing common goals is a characteristic of successful collaborations, additional research on how the use of such templates benefits and/or constrains teachers' co-planning process, and thus, shapes their collaborative efforts is needed.

Additionally, our study's finding regarding the privileging of science education topics in both the teachers' talk and their curricular materials indicate that the IHE and its facilitators might have paid closer attention to issues of parity between science and special education teachers when designing and carrying out the summer institute. Specifically, three of the four facilitators selected by the IHE were science teachers. Science topics were highlighted more than special education ones during the first 2 days of the institute. The positioning of science education prompts before those of special education and the framing of inclusion as the use of accommodations when co-teaching in the unit and lesson templates might have encouraged teacher participants to pay less attention to special education topics when creating their plans. Further, facilitators might have better tracked how and what each team member was contributing to the development of co-planned lessons. Thus, future studies that focus on how the (intentional or unintentional) framing of a professional development opportunity shapes participants' interactions, including their co-planning efforts, are warranted. Additional research into facilitators' own views of collaboration and co-planning, how those views influence their work with teachers, and what strategies they implement to balance attention to subject matter and special education during the co-planning process is needed as well.

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