2020

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Original Paper

Affordances and Constraints: Pre-Service Science Educators Co-Teaching in Support of ELLs

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Abstract

Co-teaching has increasingly been utilized as an alternative model for the student teaching experience in pre-service education. Recent literature highlights potential for co-teachers to develop by engaging in cycles of inquiry in learning communities. The purpose of this study was to explore the experience of a science student teacher who engaged in cycles of inquiry around supporting English language learners (ELLs) in a co-teaching student teaching placement. This qualitative case study involved a science mentor teacher and a science student teacher engaged in a yearlong co-teaching placement. Data sources included surveys, interviews, and written and oral lesson plans and reflections. Four affordances were identified as assisting the student teacher in her efforts to support ELL students during the co-teaching experience: identification of ELL needs, purposing science labs, focusing on ELLs, and competence validation. Three constraints appeared to limit the student-teacher's ability to support ELL students during her co-teaching student-teaching experience: perceived multiple purposes for science labs, time constraints, and power dynamics in the co-teaching relationship. This study provides insights into potential benefits and challenges associated with the use of co-teaching with professional learning communities and cycles of inquiry as a model of teacher preparation.

Keywords

teacher education, teacher preparation, mentoring, science education, co-teaching, English language learners

1. Introduction

Two recent trends have emerged in the field of secondary science education in the US: the steady rise of the English Language Learner (ELL) student population and the clear need for creative ways to train teachers in the "pedagogical approaches for integrating language acquisition and science learning" (NSTA 2009). The growth in ELL student populations is a challenge for present and future science educators. Approximately 10% of K-12 public school students are categorized as ELLs (NCES 2016) and children from immigrant families in the United States comprise nearly one out of four (23 percent) of K-12 public school students (Center for Immigration Statistics, 2015).

The responsibility to educate ELLs is not the sole responsibility of English language specialists, but all TK-12 teachers (Harper & de Jong, 2009; Reeves, 2006). Yet many in-service teachers lack training in meeting the needs of ELL students (Gándara, Maxwell-Jolly, & Driscoll, 2005; Sánchez, Parker, Akbayin, & McTigue, 2010). Furthermore, in content specific contexts, a majority of teachers working with ELLs believe they are not adequately prepared to meet their needs (Janzen, 2008). Similarly, many pre-service teachers share such feelings of ill preparedness to educate ELLs (Durgunoglu & Hughes, 2010). Given that many pre-service teacher performance assessments in the U.S., such as edTPA and the Performance Assessment for California Teachers, include supporting ELLs and disciplinary academic language development as components of their assessment, insight into such preparation is paramount.

Our study offers insight from a multi-year research project exploring a co-teaching model of teacher development and mentoring, with a particular focus on how this model might be beneficial in preparing pre-service teachers to support the needs of ELLs in content-area classes. We begin with a review of co-teaching and then outline our program model, which included facilitation of co-teaching partnerships between student teachers and mentor teachers in conjunction with content specific professional learning communities (PLCs). We then present a case study of one science co-teaching partnership and discuss various affordances and constraints the student co-teacher experienced in supporting ELLs. We conclude with implications of our research for teacher education programs and suggest further areas for exploration toward developing a collaborative model of teacher preparation that optimizes learning opportunities for the mentor, preservice teacher, and k-12 students.

1.1 Co-teaching's Origins

Co-teaching began as a service delivery option whose intent was providing high quality service to students with special needs mainstreaming in general education classes (Cook & Friend, 1995, Friend & Cook, 2013). As a service option, co-teaching utilizes two or more teachers who plan, instruct, and assess students (Miller & Trump, 1973). Initially these pairings were a general education teacher and a special education teacher working to achieve "what none could have done alone" (Wenzlaff et al., 2002, p. 14). Co-teaching traditionally centered on models of co-instruction delivery developed by Cook and Friend (1995). These models include one teach one assist, station teaching, parallel teaching, alternative teaching, and team teaching. However, there is a philosophical/ideological dimension to

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co-teaching which can pose challenges in relation to the power dynamics between co-teachers surrounding questions like who the students' "real" teacher is, and where/how/when planning, instruction, and assessment take place (Murawski & Bernhardt 2015). As a result, co-teaching has experienced varying degrees of success in pairing special and general educators (Bauwens & Hourcade, 1995; Vaughn, Schumm, & Arguelles, 1997).

1.2 Co-teaching and Student Teaching

More recently, co-teaching has expanded beyond the realm of special education and has increasingly become a popular alternative to the traditional model of student teaching (Bacharach, Heck, & Dahlberg, 2010; Strieker & Dooley, 2014). Critics have noted the traditional model of student teaching has not changed significantly in the past 100 years (Guyton & McIntyre, 1990). Traditional models of student teaching often include the "master" teacher leaving the classroom for long lengths of time creating a "sink or swim" experience for student teachers (Badiali & Titus, 2010, p. 75). Such models of teacher preparation typically involve the student teacher teaching for one semester, while co-teaching preparation models often extend this experience over the course of an academic year (Libler, 2010).

Co-teaching has been modified for student teaching contexts with varying degrees of success (Bacharach, Heck, & Dahlberg, 2010). Co-teaching, as an aspect of student teaching, focuses on utilizing both student teacher and mentor teachers' skill sets to help all students learn. Co-taught student teaching often relies on a modified version of the gradual release of responsibility (Pearson & Gallagher, 1983). The flexibility of the co-teaching model allows for student teachers to bring their strengths to bear on the various responsibilities required in planning, teaching, and assessing in a constructive and scaffolded way (Hedin & Condemn, 2015). Relationships with host school staff have been shown to be a key source of anxiety for pre-service teachers (Matoti & Lekhu, 2016). Yet, the emphasis on collaboration embedded in the co-teaching model has helped some student teachers think of themselves as collaborators capable of achieving more together than separate (Kassab, Tracy, & Drouin, 2016).

Asato and Swanson (2014) provide an example of how, through co-teaching, student teachers see and experience pedagogy that situates literacy development in authentic content. Additional studies have highlighted other benefits such as increased academic achievement in reading and math of students in co-taught classrooms (Bacharach, Heck, & Dahlberg, 2010). Co-teaching research further points to opportunities for professional growth and new insights into teaching for both the mentor and student teacher (Gallo-Fox & Scantlebury, 2016). Despite the many potential benefits of co-teaching, the use of this approach has had mixed results, with degrees of success influenced by factors including variance in participant buy-in and implementation, how co-teachers perceive the student teaching experience and their roles (e.g., expert vs. novice dynamics), and logistical and time constraints (Guise et al., 2017).

1.3 Trio Project Description

The Trio Project: Addressing Academic Language Development across the Teacher Continuum represents a particular vision for co-teaching in pre-service teacher preparation. A description of the Trio Project is necessary given the wide variance in how co-teaching in pre-service teacher education may manifest. The Trio Project was funded for five years by a U.S. Department of Education National Professional Development Grant. The goal of the project was to provide high quality, student-outcomes-based, professional development around disciplinary academic language development, with particular attention to addressing the needs of ELLs. More specifically, the project aimed to provide sustained, job-embedded professional development for preservice and in-service teachers by using San José State University's Yearlong Residency Program (YRP) as a context for building professional learning communities. Interested students applied to YRP and were selected through a process that included a review of their undergraduate coursework, a statement of their experience working with children, an interview with Trio staff, and an interview with potential mentor teacher/s.

In the YRP, the university's teacher education program works in collaboration with partnership schools to coordinate coursework and fieldwork, provide training for mentor teachers in instructional coaching, and sponsor professional development activities for in-service teachers, in which pre-service teachers participate and learn. At each participating school in the Trio Project, yearlong clinical residency teams, comprising one student teacher and one or two mentor teachers, collaborated on a series of activities that focused on academic language development. They co-planned and implemented curriculum, observed lessons, and mapped student progress on state content and language objectives over the course of the year. Central to the professional development was a focus on subject-specific academic language development for ELLs.

The Trio project was designed to address four professional development needs across local middle and high schools. First, the project focused on data-driven instructional decision making for ELLs. Research studies (Gandara, Maxwell-Jolly, & Driscoll, 2005) and professional standards (National Staff Development Council, 2001) underscore the importance of using formative and summative data on students to inform practice. Second, the project aimed to provide practical, standards-based, and discipline-specific professional development with a focus on academic language development for student and mentor co-teachers. Research has shown that teachers need professional development that is specifically tailored to their content area because generic strategies for ELLs do not always apply across disciplines (Ballantyne, Sanderman, & Levy, 2008). Lastly, the project hoped to improve the quality of teacher preparation, by putting field experiences at the center of learning. A growing body of research has pointed to the importance of modeling and ongoing coaching in pre-service education (Grant & Wong, 2003; National Council for Accreditation of Teacher Education, 2010). Emerging research also emphasizes the importance of focusing on student learning in achieving a powerful model of teacher development through co-teaching (Soslau et al., 2019).

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1.4 Preparation for co-teaching and PLCs

Mentor teachers began their in-service with a day-long co-teaching professional development. Much of the framing and content on co-teaching was rooted in materials derived from the "Train the Trainers Workshop" offered by St. Cloud State University. Content around academic language was rooted in the work of Zwiers (2008) who conceptualizes academic language as the words, structures, and organizational strategies students use to express ideas, thought processes, and concepts in the classroom. Zwiers further emphasizes the importance of addressing both general and discipline-specific elements of academic language. The objectives for the in-service day included: (1) building a supportive mentoring community, (2) analyzing the elements necessary for effective collaborative teaching, (3) examining how students' language use provides them with opportunities to make meaning related to subject-matter content and develop academic language, and (4) discussing how participants can use collaborative teaching strategies to support student content language use for learning and language development.

A central focus of the professional development was devoted to unpacking and making sense of what co-teaching would look and sound like in participants' co-teaching partnership. We wanted mentor teachers to develop an understanding that co-teaching is meaningful collaboration in the planning, instruction, and assessment of students. We presented some of St. Cloud's data on the benefits and effectiveness of co-teaching and shared co-teaching models of instruction (Cook & Friend, 1995). Another major focus of this professional development day was guiding mentors to identify and analyze the ways in which students in their classes used academic language to communicate their thinking and ideas. Student teachers joined mentor teachers for day two of the professional development. We began by acquainting mentor teachers and student teachers with one another and providing a big picture of our student teaching program. Next, we had co-teaching partnerships complete several activities geared at clarifying roles and responsibilities of program participants and personnel. We also reviewed the co-teaching instructional models.

The latter half of day two of the professional development was spent in content alike groups which would become professional learning communities (PLC). In PLCs we asked participants to identify one academic language structure or skill that students will need to use to show what they know in their content area and which routine activities or structures are used to help students build mastery in this language structure or skill. We then asked pairs to brainstorm opportunities in the first week of school to collect observational data on students, including ELLs, using co-teaching strategies, such as one teach one observe, to gather baseline data on students' academic language skills. The day concluded by giving co-teaching partnerships ample time to plan the first week with an emphasis on leveraging co-teaching strategies and discussing general expectations and norms for teachers at their school site.

1.5 Yearlong Supports

As part of their credential coursework, student teachers attended a three-hour, bi-weekly student-teaching seminar led by Trio Project team members for the first semester. These sessions

worked to scaffold the student teaching experience, prime student teachers for co-teaching and academic language development strategies, and peer problem solve issues in their placement and in co-teaching.

A signature piece of our co-teaching experience was cycles of inquiry that supported ELL and other students in developing their academic language. The cycles of inquiry, which prompted preservice and mentor teachers to co-plan, co-instruct, co-asses, and co-reflect on student outcomes and next steps were designed to address a common lack of focus in co-teaching on analyzing student work in relation to learning goals and outcomes. According to researchers (Soslau et al., p. 275), "This lack of focus on pupil learning weakens the power of the [co-teaching] model, which seeks to center student learning and well-being".

Each co-teaching partnership participated in two formal cycles of inquiry throughout the yearlong experience. Cycles of inquiry began with co-teaching pairs answering a series of questions as part of a pre-planning consultation. These questions guided pairs towards identifying a focus academic language skill, assessments which utilized the skill, and strategies for supporting this skill among ELLs and other students who struggled with the skill. Content area specialists, who were members of Trio staff, used these data to gain a sense of pairs' understanding/ability to support academic language and brought suggestions to the next step of the cycle of inquiry. Next, content area specialists facilitated a co-planning conversation. Guiding questions prompted the co-teaching pair to plan a lesson addressing the academic language skill they had identified in the pre-planning phase and implementing strategies specific to helping ELL students develop this skill. The co-teaching pair then implemented the lesson and collected student work specific to the academic language focus. The cycle of inquiry concluded with the co-teaching pairs analyzing student data with attention to the effectiveness of their strategies. This debrief first occurred between the co-teaching pair and again collectively in their PLCs.

Three other professional development days were staggered throughout the course of the year. Trio Project staff planned much of the content and activities of these days based upon feedback from the student teaching seminar, field observations, and co-planning conversations. These professional development days provided Trio Project members a unique opportunity to address the needs of all Trio participants. For example, one session included an hour-long mentor teacher only session focused on strategies for mentoring, including cognitive coaching and providing effective feedback for student teachers. Professional development days also allowed Trio staff to normalize challenges co-teaching partnerships faced and publicly acknowledge strategies and assign competence for co-teaching success witnessed in the field. These days also included time for content-specific collaboration, a form of nestled PLC. Content specific PLCs were spaces wherein pre and in-service teachers grappled with problems and shared knowledge as it related to the unique needs of their discipline in relation to ELLs. Initially, sessions focused on identifying a spectrum of how academic language manifests in co-teachers' disciplines. Later sessions focused on sharing strategies, peer problem solving, and debriefing the academic language cycles of inquiry.

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2. The Current Study/Methods

In light of more recent emphasis in the co-teaching literature on the importance of prioritizing teacher learning through collaboration and inquiry in a community of practice (Guise et al., 2017), of significant interest to us was understanding the experience of our student teachers in a co-teaching relationship focused on cycles of inquiry into supporting ELL students. The following question guided our exploration: What affordances and constraints did a student teacher in the Trio Co-Teaching Program experience in supporting ELLs through co-teaching?

Given that the nature of our question focused on sense making and understanding experience, a case study methodology was appropriate (Miles & Huberman, 1994). Case studies allow researchers to uncover both the richness and complexity emerging from data on teaching (Stake, 1995). Darke, Shanks and Broadbent (1998) posit case studies are of particular importance when context and the situational dynamics are of importance.

2.1 Participants/co-teachers

One co-teaching pair, encompassing one student teacher and one mentor teacher, was selected for the case study. This particular co-teaching pair was selected because they represented a strong co-teaching pairing. Both participants brought a wealth of discipline specific knowledge as well as experience in teaching. Both participants expressed a commitment to helping all students, ELLs in particular, to develop mastery in their content area. Also, their professional relationship was noted by Trio project personnel as a one of several "successful" relationships. Success being defined by three criteria: the partnership remained intact, the student teacher completed the program, and participants concluding the program by speaking of each other as partners, their learning from the experience, and co-teaching's benefit to their students (Kassab, Tracy, & Drouin, 2016). Having met the above criteria, this co-teaching pair was well suited for exploring and understanding the upper limits co-teaching might afford a teacher candidate in supporting ELLs.

Nancy, the student teacher, brought many strengths to her co-teaching placement. She, a recent immigrant from Brazil, brought training in both science and teaching to her co-teaching placement. Nancy had an active role in a biological research laboratory prior to coming to Trio. Additionally, she had graduated from a teacher credentialing program in Brazil and had some teaching experience.

Amy, the mentor teacher, brought depth of knowledge and skills to the pairing. Amy had participated in the Trio project for the previous 2 years. She had taught for 13 years at an urban Bay Area High School and actively participated in the regional Science Fair competition for the past 10 years. Additionally, she has taught multiple courses and ability groups, varying from ELL sheltered Biology to Advanced Placement Chemistry.

2.2 Data Sources

Data were gathered in from multiple sources. A pre-Trio Project survey and a Lesson Plan Analysis were used to collect baseline data. The survey questions focused on areas such as academic language demands of students, strategies for building ELLs academic language skills, and ELLs production of

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language to demonstrate knowledge. The Lesson Plan Analysis include a lesson designed by pre-service teachers to meet the language/literacy development needs of ELLs. Included with the lesson was a description of how the lesson was rooted in ELD standards and utilized activities, materials, and assessments which were constructed to support development of ELLs.

Both written and audio recorded data were collected from each of the two cycles of inquiry and two co-planning conversations. Each cycle of inquiry began with co-teaching pairs observing and identifying an academic language issue they wanted to address. Co-teaching pairs then co-planned, co-taught, and co-assessed a lesson. Following this co-teaching pairs reflected amongst themselves and then with their content alike PLC during professional development days. The co-planning portion of the cycle of inquiry was recorded and facilitated by the content area specialist with guiding questions.

A post-Trio Project exit interview and survey were used to understand where participants finished. Survey questions mimicked the initial survey by focusing on ELLs academic language skills, ELLs production, but added a section on perceived effectiveness of co-teaching. Exit interviews focused on the co-teaching as it related to development in curriculum, instructional pedagogy, assessment practices, and collaboration.

2.3 Data Analyses

A grounded theory approach was taken in this case study as our research question and purpose were largely exploratory. We approached the data with no predefined theory as suggested by Glaser and Strauss (1967), while recognizing that all researchers bring their own assumptions, biases, and knowledge to the research process (Dobson, 1999). With this in mind, each researcher had a background which lended itself to a different set of expertise. These areas of expertise included: academic language and English Language Learners, science content knowledge and pedagogy, and qualitative methodology. We began with a close reading of initial texts and listening to audio recordings for ideas and themes. Next, audio versions were transcribed and all the texts were re-read for emerging ideas and themes. Validity was sought through careful discussion of each of the three researchers' analysis before and after transcription. Discussions resulted in the collection of codes under the larger themes of affordances and constraints. Finally, the texts were then recoded resulting in several sub-themes.

3. Findings

3.1 Affordances

Analysis of the data resulted in three key themes surrounding how Nancy's co-teaching student teaching experience helped her support the academic language needs of her ELL students. First, Nancy was able to identify specific areas of academic language need amongst her ELL students. Next, Nancy was guided to articulate a teaching purpose in support of her ELL students. Lastly, Nancy experienced a validation of her competence as a teacher and scientist in multiple ways.

3.2 Identification of ELL Needs

The first affordance Nancy experienced was her ability to identify ELL students' areas of need concerning academic language. Nancy saw what she referred to as "CER" or claims, evidence, and explaining reasoning as closely linked with academic language. Nancy's initial conception of CER was broad and abstract. Once in her placement, Amy and Nancy utilized the co-teaching strategy of "one teach, one observe" as a first step in their initial cycle of inquiry. Through a collaborative use of "one teach, one observe" she identified explaining reasoning as the key struggle for students and later further narrowed/specified this struggle as explaining reasoning in the conclusion section of science labs.

The co-teaching strategy of "one teach, one assist" further assisted Nancy's ability to identify ELL students' academic language needs. After identifying explaining reasoning as an area of need, Amy and Nancy implemented strategies such as sentence frames, modeling, and individuated support through one teach one assist. Nancy wrote in inquiry cycle 2, "To help students engage with the supports provided I worked with students in small groups and asked questions to guide them. I focused especially on the reasoning part when helping groups, since it was the part where more students need improvement". Assisting students in this capacity enabled Nancy to increase her familiarity with the specific challenges her ELL students faced.

Also supporting Nancy's ability to identify ELL students' academic language needs was her reflective collaboration with Amy. At the end of each inquiry cycle, co-teaching pairs reflected upon the success of their inquiry cycle together and then in content alike PLCs. Such moments helped Nancy to calibrate her understanding of the needs of her ELL students. So, while typical issues like assignment completion and motivation arose, specific academic language issues such as explaining reasoning received intense scrutiny. For example, as part of the end of the first cycle of inquiry, Nancy and Amy reflected that guiding questions needed to become key routines to help support their students' academic language development. Nancy wrote she needs to remember to use guiding questions to force students to "explain their thinking process in the best of their ability, the more they train explaining their thinking process, the better they will get into 'translating' their thoughts into reasonable and intelligible explanations". Such collaborative reflections reinforced explaining reasoning as a legitimate need of her ELL students.

3.3 Purposing of Science Labs

A second key affordance of the co-teaching student teaching experience was encouraging Nancy to be purposeful in her teaching. By this, we mean the co-teaching pair came to purpose science labs in a very interesting way. Science Fair is a regional competition that Amy had participated in and many of the students in her class were excited about. Preparing for Science Fair included developing academic language around science. Specifically, the focus on CER in conclusion statements was noted as a needed area of development as students prepare for science fair. As such, Amy explained science labs are "like, the scaffold. Because we are trying to introduce all the terms with like error analysis, graphing, you know, how to write a conclusion paragraph, how to write written observations,

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procedures, materials, all those things". This realization that the co-teaching pair could feed multiple birds with one hand helped the co-teaching pair to be, at times, purposeful in their co-planning and co-instruction or science labs.

An example of this purposing of science labs developed after a lab on skin. As part of the lab, students needed to take pictures of their skin and label them as evidence to support their claims. However, Amy and Nancy quickly realized during the lab, students were spending a disproportionate amount of time on retaking, formatting, and labeling their pictures. Amy explained, "it's not like it's not valuable, but then it's like, yeah, it's not academic, as academic as writing a conclusion paragraph, but the kids wanted to spend time on that because it's their picture, you know". Their initial response was to both circulate the room together refocusing students. Nancy explained to students "you're probably not thinking [reasoning] is important because it is a small box", in the rubric for the lab. Later, Amy and Nancy discussed how to make future science labs focused on academic language development by revising and reorganizing rubrics to emphasize explaining reasoning in conclusions. In the co-planning conversation, Amy rationalized this change by saying:

> Like, we can change the rubric for next time, you know? But that's what we're focusing on for this one, like are they able to do, just like, this is our first conclusion paragraph that's included in the lab report, so just kind of focusing on that. But so, like if the rubric changes, tailored to each lab, then maybe we can just change it for the next time to specifically include the terms claim, evidence, and reasoning.

Such rubric modifications would seem to help focus both students and the teachers on a specific academic language skill in each lab.

3.4 Focus on English Language Learners

Another affordance of Nancy's co-teaching student teaching experience was the systematic focus on ELLs. Both Nancy and Amy had expressed a commitment to instructing diverse groups of students with a particular emphasis on ELLs. However, teachers' beliefs and actions in the classroom do not always align (Bingimlas & Hanrahan, 2010; Drouin, 2013). Yet, co-teaching created spaces for teachers to not only identify academic language challenges, but then to brainstorm and implement targeted interventions. One reflective question from the inquiry cycles asked the co-teachers to explain what this academic language struggle looked and/or sounded like. Nancy wrote the following example of what a student who struggled in explaining reasoning sounded like during a symmetry lab:

> Me: "So, what kind of symmetry do you think this animal is?"
>
> Student: "Bilateral?"
>
> Me: "Can you explain why?" "How can you divide the organism in equal parts?"
>
> Student: "With a line through the middle?"

Nancy is sharing that the student is able to identify the correct concept, but whose explanation of reasoning is severely limited. As part of the cycle of inquiry reflection, the co-teachers brainstormed targeted interventions for future implementation. Nancy wrote they planned on "addressing students

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struggle with CER by giving students class and homework activities in which they have to elaborate an explanation with evidence and reasoning". Such instances highlight the potential for targeting and addressing the individualized needs of ELL students.

3.5 Competence Validation

A final affordance Nancy experienced in supporting the academic language needs of ELL students was a validation of her competence. Status in co-teaching partnerships has a long documented history of struggle (Sacks, 2014; Gallo-Fox & Scantlebury, 2015). Status is negotiated between stakeholders in a student teaching setting. Cohen and Logan (2014) outlined the importance of assigning competence as a means of treating status in public ways.

Students assigned competence to Nancy by validating her competence as a teacher. Under the co-teaching model, students seeking assistance who found Amy busy were grateful to have Nancy as an alternative. More specifically, Amy reminded Nancy of a time "when she taught the lesson and then the kids have questions and then come around and helping them, I think it works out really well". Such comments reinforce the notion that Nancy is a teacher and contributing figure of authority in the classroom community.

Amy also assigned competence to Nancy through her use of "we" language and willingness to integrate input. Co-planning conversations gave us a glimpse of how the co-teaching pair co-planned. Granted, the co-planning conversations occurred in a relatively non-naturalistic setting given that a content-area specialists facilitated and recorded the collaboration. However, Amy and Nancy's conversations lasted over 30 minutes, and were largely between the two of them with some assistance from the content area specialist. Throughout these conversations, Amy consistently referred to the co-teaching partnership in terms of "we". One example of this language occurred when Amy stated, "Yeah, and we can for our next one, alter it so it's more specific to claims, evidence, and reasoning in the conclusion paragraph. Like, we can change the rubric for next time, you know?" Such language is reinforced as a best practice in collaborative efforts such as collaborative coaching (Elish-Piper & L'Allier, 2014).

Amy also speaks about planning, instruction, and assessment in terms that are inclusive of Nancy as a meaningful contributor. In one interaction, we hear Nancy' suggestion enthusiastically supported by Amy:

> NANCY: So maybe one of the labs we could do like, instead of just writing the conclusion paragraph, presenting to the class, the results.
>
> AMY: I love that, yeah. I mean, we'll still make them write it because, to help them focus their thoughts, I think, because then they'll get instant feedback. I'm going to write that down too. Because that's what they're going to have to do for science fair…

Examples such as this highlight some of the ways in which Nancy's contribution to the classroom are being honored by Amy.

Nancy's prior experience as a scientist and teacher were also validated through her co-teaching experience. Amy and Nancy drew upon their experiences in teaching and science to plan, instruct and

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assess their ELL students. In this example, Nancy shares with the Content Area Specialist how her and Amy decided to draw upon Nancy's experience to help students see the structure of writing the conclusion of a science lab. Nancy said:

> I am talking about the research I did in Brazil and so I'm going to use that just for them to understand the reasoning… we are using my results and then my conclusion and so they are able to see how it will have to reflect upon your data and to discuss it at the end…

Such instances allowed Nancy to actively draw from her past experiences as a fully credential teacher in Brazil as well as an accomplished scientist. Drawing from her research in Brazil as a scaffold for academic language instruction validates her identity as a scientist. Furthermore, instances such as this allowed Nancy, the teacher, to speak from a position of authority about the science she did and model her thinking in powerful ways for her students' betterment.

3.6 Constraints

Nancy's experience also highlighted three ways in which her ability to effectively support ELL students was limited by her co-teaching student teacher experience. These limitations included perceived multiple purposes for science labs, time constraints, and power dynamics. We recognize the needs of ELLs are diverse and that co-teaching cannot in and of itself address all challenges facing such students. Furthermore, the purpose of case studies are to understand the particulars of the participants, rooted in their contexts. Our purpose is not to generalize or make statements of causation. Rather, our purpose is to provide a window into successes and challenges experienced by our participants, and consider potential implications of these experiences in similar contexts.

3.7 Perceived Multiple Purposes for Labs

One interesting finding of the study concerned the perceptions of multiple purposes for science labs held by Amy and Nancy. We found that the co-teaching pair often conceptualized purposes for science labs unrelated to explicitly developing academic language. These alternate purposes—institutional goals, technology literacy, and inquiry, complicated the co-teaching pair's ability to focus on academic language development.

One such complicating purpose was alternate institutional goals. Amy explained, "O High also has their own cycle of inquiry we're supposed to be doing with our department and also separately with our professional learning community, so there's like, three cycles of inquiry we're all doing". Amy perceived professional development foci in the high school and the science department as competing with the academic language focused cycles of inquiry that was a key focus of the Trio Project. With finite labs, time, and focus, Nancy and Amy felt pulled to address multiple purposes for science labs which were not necessarily focused on academic language development.

Within individual labs, seemingly competing purposes for labs also limited focus on academic language development. Amy viewed labs as serving multiple purposes. One such purpose was developing technological literacy. Amy noted the students:

…did not know how to graph using Plotly and they also don't, not all of them read the instructions…So we spent a lot of time talking about that, but, you know, because we spent so much time doing that, we didn't really get to talk about how do we write that in our conclusion paragraph, how do you work that in?

Here we see Amy exhibiting tension between wanting to expose students to technology, but such emphasis extended time in science labs and shifted the focus away from academic language.

A final alternative purpose for science labs was to make the labs inquiry based. Making science labs more inquiry based has become a rising trend in the student centered science classroom (Peffer et al., 2015). However, such moves may come at a cost. Here Nancy describes collaborating to redesign a bone lab with Amy. She wrote:

Ann actually had a previous lab where she just had all the types of bones sorted for students and they had just to write the description, so I said, "Why don't you do it more inquiry?" And she likes inquiry, so she said, "Oh, that's great".

In this section we see that Nancy was confronted with negotiating with Amy to define the purpose of science labs. However, the two were able to come to a singular definition of the purpose for science labs. As a result, science labs became a mixture of what was being taught, how it was being taught, and for whom the lab was designed. The result appears to be labs that have multiple purposes, for multiple institutions, with limited time.

3.8 Time Constraints

Time constraints challenged Nancy's ability to support her ELL students in two ways. Academic language support and development takes time and the length of the inquiry cycles were insufficient. As Nancy noted, "we didn't have enough time to, I mean, two months is not enough for them to really develop the skills". Here she is recognizing that purposefully planning, teaching, and reflecting on academic language development with her mentor co-teacher is a time consuming endeavor.

Amy's perception of time also hindered the two's ability to support ELL students. Amy was of two minds concerning time and science labs. In one respect, she actively collaborated with Nancy to stretch and refine labs to meet the needs of their ELL students. An example of this thinking occurred when Amy said, "maybe if I stretched it out, in our planner we can stretch it out maybe and help them in class". She is talking about modifying a science lab by extending the number of days. However, Amy also made statements such as, "this lab took five of our curriculum days, you know, so it should have taken three at the most". In statements such as these, we see Amy actively comparing their progress this year with the speed and scheduling of previous years. In this way, time influenced when and how some forms of academic language development manifested in the classroom.

In addition to these internally constructed time constraints, external factors, namely the co-teachers' high school, manipulated contact time as well. Amy noted, "We used to meet with them five days a week last year… this year, we meet them four days a week". The high school switched to a modified block scheduling at the start of the school year. As a result, Amy and Nancy were hyper aware of

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contact time with students and constantly trying to view this year's labs through the lens of previous years, while increasing the emphasis on academic language development.

3.9 Imbalance of Power/Power Dynamics

A final way Nancy's ability to support the academic language needs of her ELL students arose as a result of an imbalance of power in the co-teaching relationship. In both planning and instruction, Amy had the final say over what, how, and for whom teaching would occur. In one planning conversation Amy noted, "Like, I want them to do this lab and this lab and this lab, you know, I want them to do all these labs". What is interesting in this moment is a digression from the "we" language discussed previously. Amy moved away from what the co-teaching pair wanted to do and asserted explicitly what she, the figure of authority over both Nancy and the students wanted. This authoritative speaking for the pair emerged concerning instruction as well. Amy stated, "The co-teaching when it's two of us teaching at the same time, gets really confusing for the students". Such messages seem to have communicated to Nancy these topics were not up for discussion. It should be noted the reason this pair was chosen was because of both of their willingness to collaborate and treat each other equally. However, even strong co-teaching pairs appear to fall prey to issues of status and power in certain contexts over certain issues.

4. Conclusions and Implications

Our inquiry into the experiences of two co-teachers in our Trio program provided important insights into different affordances and constraints the student co-teacher experienced in supporting ELLs. Affordances experienced by the student teacher included identifying specific areas of academic language needs among ELL students, being prompted to articulate a teaching purpose in support of ELL students, and undergoing a validation of her competence as a teacher and scientist in multiple ways. However, various "constraints" in supporting the needs of ELL students also came to light through our inquiry. These limitations included perceived multiple purposes for science labs, time constraints, and power dynamics.

These findings have important implications for further research and practice. First, because this was a case study, we, of course, cannot generalize the findings to all student teachers who experience similar co-teaching models of teacher preparation. However, our findings do shed light on important questions to explore further. For instance, might student teachers in a co-teaching model in a similar context experience the same types of affordances and constraints? To what extent did the content and structure of the co-teaching professional PLCs provided by the university influence the affordances and constraints experienced by the co-teachers? A particularly noteworthy insight from our case study is the potential importance of addressing the imbalance of power inherent in co-teaching relationships. Our work shows that even strong co-teaching relationships are challenged by issues of status and power and we have begun to explore ways to address this issue in our PLC activities. This is certainly an area that warrants further research.

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We are bolstered by the affordances experienced by the student-teacher, despite the imbalances of power that sometimes emerged in the co-teaching relationship. We are also encouraged by anecdotal findings of researchers at St. Cloud University who have shown higher rates of return amongst co-teaching mentors as opposed to traditional mentors (T. Heck and N. Bacharach, personal communication, May 19, 2015). Such findings lead us to recommend investing further development in a collaborative teaching model of teacher preparation that focuses on the co-teaching relationship and its benefits. In the last few years of Trio we invested in expanding and focusing our efforts on developing our co-teaching model. We have seen promising preliminary results in cases like that of Amy and Nancy, where the student teacher experiences competence validation and co-teachers are able to delve deep into how to address needs of their diverse students, including the academic language development of their ELLs.

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