Oral Academic Language by Design: Bilingual Pre-Service Teachers' Purposeful Infusion of Paired Strategies during Science Instruction

María G. Arreguín-Anderson
The University of Texas at San Antonio, United States

Iliana Alanis
The University of Texas at San Antonio, United States

Abstract

This study explores ways in which university science courses can be infused with opportunities for pre-service teachers to design student-student interactions that promote language development and content mastery. Participants included bilingual pre-service teachers enrolled in an elementary science approaches course and its school-based fieldwork component. Participant reflections reveal a positive response to integrating collaborative learning to develop scientific thinking with young bilingual learners. This research lends additional insight into the directions that teacher preparation programs must take to better serve prospective bilingual teachers and an increasingly culturally and linguistically diverse school-age population.

Keywords: culturally responsive pedagogy, science education, teacher education, linguistically accommodated instruction

Introduction

Development of oral language skills is a critical aspect of early childhood and elementary education. In today's interconnected world, skills like collaboration and communication are proposed as the basis for success in an academic context that relies less and less on rote memorization of facts and more on process oriented skills. The ability to generate and maintain successful and effective oral interactions early in the schooling experience is tied to "greater flexibility, higher reading and writing competencies, more extensive vocabularies, more complex sentences, paragraphs or both, and

more effective listening competencies" (Loban, as cited in Otto, 2014, p. 20) all of which play a key role in the development of the language of social studies, mathematics, and science. This is particularly significant for bilingual learners who often enter a schooling system that does not meet their linguistic needs (García & García, 2012).

In science education, scholars suggest that systematic integration of oral language development along with emphasis in mastery of scientific concepts and process skills determines academic success for bilingual learners (Bass, Contant, & Carin, 2009; Gomez-Zwiep, Straits, & Toops, 2015). Lee and Buxton (2013) propose that effective teachers use appropriate linguistic scaffolding to simultaneously build students' conceptual understanding and discourse skills. Appropriate scaffolding, for bilingual learners, translates into scaffolding that occurs during the "act of meaning making" (Swain, 2001, p. 45), that is, while begin involved in authentic tasks. These tasks require that students consciously engage in the process rather than the product of learning. This is important because it "pushes learners to notice gaps in their linguistic knowledge" (Mirzaei & Eslami, 2013, p. 6) while providing practice in academic language structures and vocabulary.

Although peer collaboration has been shown to enhance students' academic development, previous research reveals a tendency for preservice science teachers to use teacher centered pedagogy with limited opportunities for student engagement (Bergman & Morphew, 2014). Studies that discern the intricacies of collaborative science instruction in the context of teacher preparation however, suggest that the key is experiential learning or learning by doing (Arreguín-Anderson, 2011). Additionally, exposure to collaborative strategies that combine language and content objectives allow participants to gain insights into the complexities embedded in paired work (Arreguín-Anderson & Garza, 2014). Specifically, pre-service teachers benefit from experiences that combine direct manipulation of concepts and problem solving, all while involved in unstructured and semi-structured conversations. It is hoped that this research lends additional insight into the directions that teacher preparation programs must take to better serve prospective bilingual teachers and an increasingly culturally and linguistically diverse school-age population.

In the sections that follow, we provide a brief review of the literature on the integration of peer learning for oral language and content specific language. We focus on the need for bilingual pre-service teachers to develop scientific thinking using collaborative learning with young second language learners. Finally, we share findings and offer implications for teacher preparation programs.

Theoretical Framework

Different perspectives on peer learning have been examined in educational settings. A theoretical framework for peer learning draws heavily from two schools of thought: Lev Vygotsky and Jean Piaget. Some scholars have established direct connections between Piaget's constructivist theory and peer learning suggesting that peer interactions significantly contribute to

constant revision of one's own cognitive system, resulting in construction of new meanings (De Lisi & Goldbeck, 1999; De Lisi, 2002). Vygotsky (1986), on the other hand, stressed the role of the more competent partner in achieving cognitive development. Cognitive perspectives of peer learning intersect with humanistic and critical pedagogies that firmly oppose educational systems that situate learners as passive recipients of knowledge (Freire, 2003). In fact, critical pedagogues propose that teachers must encourage active and transformative learning through teacher-student and student-student interactions in which dialogic exchanges lead to action.

This active view of learning coincides with science reform initiatives that suggest the development of science literacy through active pedagogical approaches (National Research Council, 2011; Quinn, Lee, & Valdés, 2012). In addition to viewing the scientific enterprise as a complex social activity, the National Research Council (2011) recognizes that "low learning expectations and biased stereotypical views about the interests or abilities of particular students or demographic groups also contribute, in both subtle and overt ways, to their curtailed educational experiences and inequitable learning supports" (p. 279). With this in mind, it is important to explore methodologies that equip pre-service and in-service teachers with strategies and techniques designed to encourage scientific thinking in collaborative settings with bilingual learners.

Paired Learning and Oral Language Development

Students who have opportunities to construct explanations in pairs have been found to successfully achieve academic goals (Saab, Joolingen, & Hout-Wolters, 2005; Veenman, Denessen, van den Akker, & van der Rijt, 2005). However, studies that focus on bilingual elementary level children's discourse skills in classroom settings are limited. Madrid, Canas, and Ortega-Medina (2007) explored ways in which 16 Spanish-English bilingual children performed on spelling assignments while working in pairs. Researchers measured performance on spelling tests under three conditions: competitive peer tutoring, cooperative peer tutoring, and teacher led instruction.

For bilingual learners, the cooperative peer structure led to a more successful experience. Additionally, in studies conducted under lab-like conditions, Rittle-Johnson, Saylor, and Swygert (2007) concluded that children as young as 4-5 years old produced a larger number of correct responses and solutions when provided with a listening partner, a finding that coincides with Fawcett and Garton's (2005) study, in which 6 and 7-year-old children were assigned to two conditions—individual work and dyadic structures or what they labeled "talk" or "no-talk" conditions. Children who worked with a partner obtained a higher number of correct responses in problem solving tasks than children who worked alone.

Given the significance of these studies for children's academic success, more research is needed that directly addresses bilingual pre-service teachers' perspectives and practices for academic oral language and peer learning, particularly in the context of science education. Part of the rationale for the use of bilingual pairs centers on the fact that discourse and systematic

interaction both play a key role in the acquisition of content. Acquisition of content occurs because dyadic or small group interactions increase the opportunities for cognitive engagement (Fawcett & Garton, 2005; Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller, 2003). In bilingual settings, Cummins (2000) suggests, students must be "stimulated to develop their capacity for democratic participation through questioning, challenging, decision making and collaborative problem-solving" (p. 262).

In agreement with previous science reform documents, the Next Generation Science Standards, define science as a "fundamentally a social enterprise" indicating that "scientific knowledge advances through collaboration and in the context of a social system with well-developed norms" (National Research Council, 2011, p. 27). Scientific knowledge and language acquisition often intersect in bilingual settings, where teachers often pair up students based on students' mastery of language and content objectives (Arreguín-Anderson, 2011; Arreguín-Anderson & Esquierdo, 2011).

Context of Study

To further explore ways in which pre-service teachers navigate the complexities embedded in field assignments that require close attention to science and language objectives, the authors of this study decided to design a study that purposefully explored verbal face to face collaboration in the context of science learning. Pre-service teachers attended a total of 15 weekly class meetings, and ten complete six-hour days of field experience. Each paired learning strategy was introduced at a weekly course meeting, modeled by the first author of this study, and then practiced at two consecutive meetings. Strategies were then reviewed throughout the semester. The class met weekly for two hours and forty-five minutes. Each meeting was designed with a predetermined semi-structured sequence that included a:

- review/introduction and discussion of a paired learning strategy (see Table 1 on the next page);
- review of language objectives addressed;
- discussion of an aspect of inquiry instruction;
- direct/hands-on experience combining a paired strategy, a language objective, and a science objective (putting it all together); and a
- post-lesson reflection.

Participants received instruction on the 5E lesson format for science instruction from the first author of this study, who was also the instructor of record. Each participant prepared three structured 5E lesson plans and implemented two in their field-placement classroom. Participants selected at least one paired strategy to integrate into their own 5E lesson plans. Each completed a digital post-lesson reflection within 24 hours of implementing their lesson plan describing the effect of the paired strategy, their response to implementing, and students' reactions to the strategy.

Table 1
Paired Learning Strategies Introduced and Reviewed with Participants

Strategy	Description
Turn and Talk (Week 1 & 2)	This is a semi-structured strategy that allows students to process information, verbalize prior knowledge, analyze, content, etc. It can be used to explore students' background knowledge on the topic of the lesson, for example, the teacher begins with a statement such as: "Turn and talk to your partner about the four seasons, what do you know about them?" Then, the teacher randomly selects two or three pairs to share their discussion and connects to the content of the lesson. (Unstructured)
Sentence Stems in Pairs (Week 3 & 4)	An academic sentence stem is an incomplete statement that generally contains grammatical structures and vocabulary characteristic of the discourse in academic settings (Seidlitz, 2008). In a science classroom, for example, process skills such as drawing inferences, making predictions, and observing can be deliberately infused into regular classroom science activities during all phases of a lesson. (Semi-structured)
Alpha boxes in Pairs (Week 5 & 6)	An alpha box is a chart containing all the letters of the alphabet. This tool has been used to elicit background knowledge and students are generally asked to brainstorm words that they can think of in connection with a topic. Alpha boxes can also serve to summarize content discussed (Hoyt, 1998). In this case, the teacher may stop and ask students to record keywords that remind them of everything that has been discussed up to a certain point of the lesson. (Semi-structured)
Inside-Outside Circle (Week 7 & 8)	This strategy requires students to create two equal groups (Kagan, 2009). Group A will form a circle and members of group B will form an outside circle facing their partners in the inside circle. As the teacher asks a question, pairs discuss and at the conclusion of the discussion, the outside circle rotates clockwise and students face another partner. (Moderately Structured)
Think-Pair-Share (Week 9 & 10)	Structured strategies such as Think-Pair-Share are critical in holding students accountable and ensuring their participation. Initially, students independently respond to a question or problem posed. Then, they join their partner and discuss their responses (Lyman, 1981). (Moderately Structured)

Levels of Structure: 1=Unstructured (No specific steps are provided during interaction), 2=Semi-structured (One or two steps are followed by participants), 3=Moderately Structured. More than two steps are required to complete strategy.

Method

We used qualitative methods to investigate bilingual preservice teachers' use of partner based learning strategies. The questions that guided this study included:

1. What type of dyadic interactions do pre-service teachers favor as they design science instruction infused with paired learning discussions?
2. What are bilingual pre-service teachers' perceived benefits of exposing elementary students to science instruction in pairs?

Setting and Participants

This qualitative study included a purposeful sample of pre-service teachers pursuing bilingual certification for early childhood through 6th grade in a teacher preparation program at a Hispanic Serving Institution of the Southwest in a large urban city. Participants were 12 bilingual pre-service teachers enrolled in a science approaches course with a corresponding field component. Of the 12 participants, 11 were females and one male; all gave consent to participate in this study. All identified themselves as Mexican-American and exhibited different levels of English-Spanish bilingualism.

As a course requirement, participants completed field experience tasks at a local elementary school. Once a week, preservice teachers spent approximately six hours observing, implementing lessons, and shadowing a cooperating teacher. Participants were expected to engage in active usage of all language domains in English and Spanish (listening, speaking, reading, and writing) in their field placements. In all cases, students implemented their science lessons in Spanish.

Data Collection

Data collection included participants' 5E lesson plans, digital reflections, in-class discussions and researcher field notes. 5E Lesson plan design was chosen because the instructional format is based on a constructivist approach to learning that allows children to make discoveries and process new skills. The 5 E's are: Engage, Explore, Explain, Elaborate and Evaluate. The role of the teacher is to extend children's prior knowledge to build new understandings.

Participants documented their experiences through weekly digital reflections. Through this activity, they were asked to become observers of their students' learning and their experiences as novice teachers. Their detailed accounts revealed pre-service teachers' perceptions related to the overall implementation of their lesson, impact of partner based learning on students' linguistic and academic progress, and their own reactions to implementing collaborative 5E lessons.

Additionally, participants engaged in weekly in-class discussions. These discussions; led by the course instructor focused on bilingual pre-service teachers' experiences, struggles, and lessons learned. There was also much discussion regarding the children's response to partner based learning. They had an average duration of thirty to forty-five minutes and were audio recorded in order to document participants' perceptions and development with collaborative structures. The recordings were then transcribed for data analysis.

Data Analysis

All of the data, including the 5E lesson plans, digital reflections, field notes, and in-class discussion transcriptions, were coded and analyzed to identify salient themes, patterns, and relationships (Miles, Huberman, & Saldaña, 2014). Initial, data analysis began with coding based on pre-established categories including the type of structure used such as turn and talk strategy, or inside circle-outside circle.

Pre-established codes were also used to identify the use of students' academic language, and self-efficacy. Later, the authors established internal validity through triangulation, or the use of multiple data sources (Creswell, 2003). Specifically, the authors use the constant comparative method to "compare one segment of data with another" to identify valid emerging themes (Merriam, 2009). This process yielded categories including language domains, oral language, written language, reading, listening, structured interactions, and semi-structured interactions. For example, we noticed that some pre-service teachers used the Turn and Talk strategy and let the students guide the direction of the conversation. Other prospective teachers combined the Turn and Talk strategy with the use of specific sentence stems. We coded the former as a semi-structured interaction and the Turn and Talk/ Sentence Stem combination as a structured interaction.

Results

Gaining Confidence: From Unstructured to Semi-Structured Strategies

Results indicate participants predominantly chose (n=11) to combine the use of unstructured and semi-structured strategies including Turn and Talk and Sentence Stems in pairs as they designed their 5E science lessons. Congruent with previous studies highlighting pre-service teachers' preference for simple, semi-structured collaborative interactions (Arreguín-Anderson, 2011) prospective teachers in this science approaches course infused their lesson plans with simple, yet strategic opportunities for students to interact as indicated by Laura:

> I utilized the turn and talk strategy along with sentence stem strategy. When I used this strategy I felt comfortable because students were familiar with it and it seemed easier to implement. This strategy does not consume too much time and is easy to follow. [Yo utilicé más la estrategia de voltea y habla junto con la estrategia de inicio de oraciones. Cuando utilicé esta estrategia me sentí muy cómoda ya que los estudiantes estaban familiarizados con ésta y se me hacía fácil de implementar. Esta estrategia no utiliza mucho tiempo y es sencilla de seguir].

This level of comfort eased bilingual pre-service teachers' anxiety as they implemented complete lessons for the first time in their academic experience.

It also revealed the simplicity of the strategies to advance children's academic knowledge within a safe space for second language learners. Participants also noticed that careful planning resulted in consistent student engagement as indicated by Grace:

> "Mis puntos fuertes en las lecciones que implementé fue que tuve mayor control. Me sentí más segura y confiada de lo que estaba haciendo" [My strengths in the lesson I implemented were the control I had of the class. I felt confident of what I was doing].

Participants did not choose paraphrasing pairs, alpha boxes in pairs, inside-outside circle, and think-pair-share as often. Overall, only four pre-service teachers chose to use them during the Explain phase of the inquiry cycle when they introduced the concept and the vocabulary. Summarization pairs were not mentioned in pre-service teachers' lesson plans or digital reflections.

A Winning Combination: Developing Oral Language Through Turn and Talk and Sentence Stems in Pairs

Based on analysis of the 5E lessons plans, pre-service bilingual teachers favored the use of Turn and Talk in combination with the Sentence Stems in Pairs strategy to promote verbalization of student thinking at different points of their inquiry-based science lessons. These interactive structures were generally infused during the beginning of the Engaging part of the inquiry lesson and during the Explain phase or direct teach segment of the lesson.

Participant reflections revealed the integration of the Partner A and Partner B strategy, a practice modeled during course meetings to facilitate turn-taking, ensure balanced participation, and identify who would initiate the conversation. Amy, for example, narrated how she started her lessons with an unstructured question and then transitioned to a more structured collaborative design with the following instructions:

> I started the lesson by saying [empecé la lección diciendo]:
>
> Turn to your partner and ask: What do you know about eagles? [Voltea y pregunta a tu compañero: ¿Qué sabes acerca de las águilas?]
>
> Make sure you are next to your partner [Asegúrense de estar a un lado de su compañero].
>
> Next, partner A will ask the question: What detailed observations did you make after watching the eagles video? [Luego, el compañero A preguntará: ¿Qué observaciones detalladas hiciste después de ver los videos?

> Partner B will respond using the following sentence stem: "I observed _____" [Yo observé que _____ y _____].

The use of sentence stems to consciously use academic language while engaging in context embedded and cognitively demanding authentic activities (Cummins, 2000) as in Amy's experience, allowed her students to engage both in the process of symbol formation and conceptual understanding (Otto, 2014). Gradually, as students achieve ownership of the language and concept, they "are able to make independent use of what is originally co-constructed language knowledge" (Fernández Dobao, 2012, p. 230) as reflected in Amy's reflections about her students' oral participation through the use of paired strategies that combined Turn and Talk with Sentence Stems:

> I gradually noticed that children, without being told, would respond in complete sentences (My partner observed _____...I predict that_____). They feel encouraged and are happy to work with a partner. When I ask somebody to share what was discussed, they are not embarrassed anymore and know what they want to say. [Pude notar que los niños, sin antes yo decirles ya contestaban en oraciones completas incluyendo (Mi compañero observo_____... Yo predigo_____). Se sienten animados y felices de trabajar con un amiguito. Cuando le pido a alguien que comparta lo que discutieron ya no sienten pena de hablar y saben lo que quieren decir].

Examples of open-ended stems and questions bilingual pre-service teachers used for oral discussions during their lessons included:

- We believe this happened because _____. [Creemos que esto pasó ya que_____].
- An item that we selected was____. We infer that the items are made out of ____. One way to preserve it is _____. [Un artículo que escogimos fue _____ e inferimos que el artículo está hecho de_____ y una manera de conservarlo es _____].
- We discovered that animals need _____ to survive. These elements are important because _____. [Descubrí que los animales necesitan _____ para sobrevivir. Estos elementos son importantes ya que _____].
- The teacher explained that _____. She also explained that_____. [La maestra explicó que _____. También explicó que _____].
- I infer that a food chain breaks when _____. [Yo infiero que una cadena alimenticia se rompe cuando_____].

Bilingual pre-service teachers also reported that students intermittently assumed the role of the "more knowledgeable others" when engaging with their partners (Vygotsky, 1986). That is, they complemented each other in knowledge and skills. What one student did not understand the lesson, his/her partner was able to explain and vice-versa. This was possible, because in "learner-learner" interactions "no two learners have the same weaknesses and strengths" (Fernández Dobao, 2012, p. 232). In her reflections, Dora, indicated:

> "I noticed that in pairs, students have deeper discussions about the concept adding their own perspective and by discussing with their partner they have a better idea because they continuously clarify and help each other". [Noté que en parejas los alumnos discuten más sobre el tema proponiendo su propia perspectiva y hablando con su pareja. Y así los alumnos tienen una idea más clara porque uno le ayuda al otro].

Vygotsky's work reveals the nature of peer mediation and the power of learning from each other. Dora's reflection illuminates the opportunities for her students to address scientific misinterpretations within the dyad structure.

Discussion

This study was designed to answer two questions:

1. What type of dyadic interactions do pre-service teachers favor as they design science instruction infused with paired learning discussions?
2. What are bilingual pre-service teachers' perceived benefits of exposing elementary students to science instruction in pairs?

In this study, the authors chose to implement interactive strategies that ranged from unstructured to moderately structured keeping in mind ease of preparation. Interestingly, none of the moderately structured strategies including Alpha boxes, Inside-Outside Circle, Think-Pair-Share, and Summarizing Pairs were favored by a significant number of participants. This finding coincides with previous research indicating that pre-service teachers benefit from exposure to simple strategies that allow them to take small steps, gain confidence, and successfully implement lessons during field experience (Arreguín-Anderson, 2011; Woolfolk Hoy & Tschannen-Moran, 1999).

Bilingual pre-service teachers strategically implemented simple interaction strategies, showing an inclination for unstructured and semi-structured to augment children's academic knowledge with a preference for the turn and talk strategy and the use of open-ended sentence stems. Participants expressed the ease of implementation; noteworthy given their preservice teacher status. This was noticeable not only in terms of their

ability to cover prescribed science objectives, but as they released control and opened critical spaces for students' voices. Ultimately giving them "hands-on practice" as to what they can do someday in their own classroom, making it more likely that they will actually repeat it.

Conscious of the need to scaffold academic discourse, bilingual pre-service teachers recognized that science and all subject areas require the use of specific language to efficiently demonstrate content knowledge (Seidlitz, 2008). Sentence stems or frames, can target complex academic/grammatical structures that bilingual students may not have mastered yet. In science for example, cause and effect relationships can be expressed using sentence stems such as: _____ is one cause of _____, or _____ contributed to _____ due to _____. After integrating the turn and talk strategy with sentence stems, participants realized the value of these sentence stems as a means to integrate science content and complex linguistic structures for young bilingual learners.

Often, bilingual learners "confront the demands of academic learning through a yet unmastered language without the instructional support they need" (Lee & Buxton, 2013, pp. 37-38). The use of key sentence and question stems to facilitate inquiry in the context of hands-on activities is important, not only because the use of such language becomes meaningful, but also because the academic demands can be addressed and discussed with a peer before students face the challenge individually.

By promoting the use of more complex language, participants also designed questions and stems that were open-ended to enhance young children's scientific thinking. This is significant because historically, bilingual teachers have been inclined to ask low level questions (Diaz, Whitacre, Esquierdo, & Ruiz-Escalante, 2013; Ramirez, Pasta, Yuen, Ramey, & Billings, 1991) and are often unaware of this practice.

By raising the cognitive demand of students' oral language production, bilingual pre-service teachers designed instruction that engaged students "with language at a conscious level" (Mirzaei & Eslami, 2013) all while making predictions, drawing inferences, and providing a rational for their scientific thinking, which not only pushed students to "notice gaps in their linguistic knowledge" but then placed them in a position to notice academic vocabulary they knew with academic vocabulary they didn't know. This is especially valuable for bilingual learners whose "home experience may not include the language of school" (Echevarria & Graves, 2011, p. 159).

Participants also realized that careful planning resulted in consistent student engagement. For example, prior to implementing any strategy, pre-service teachers formed pairing arrangements based on their observations of students' strengths and the possibilities for language enrichment within their Zone of Proximal Development (Vygotsky, 1986). They avoided pairing a student who had advanced language proficiency and/or advanced content knowledge with a student whose language proficiency and content knowledge was limited. Participants were careful to avoid a wide gap between the knowledge and competencies of both students, thus generating frustration

for one or both of the students. Instead, the dyad structure allowed children a safe space where they could try out new ideas, challenge each other's thinking, or analyze their own conclusions. Thus preparing participants for the complexities embedded in partner work.

Implications

Our research highlights the need to provide bilingual pre-service teachers with specific collaborative structures within their teacher preparation program. If we are to prepare prospective bilingual teachers to address issues of equity and diversity in science, and to meet the demands of a globalized world, higher education faculty must infuse science approaches courses with opportunities to design instruction that promotes verbalization and interaction while engaging young learners in the mastery of science content and skills. This has the potential to revert the science educational achievement gaps that affect linguistic and cultural minority learners.

Opportunities for students to speak are important and bilingual pre-service teachers must allow young learners to express their thinking, process information, problem-solve, and paraphrase, not only because in doing so they acquire language naturally, but because "speaking is the agent in the production of meaning" (Smagorinsky, 2001, p. 240). Scientific "sense making and language use" are at the core of current initiatives that promote scientific literacy (Quinn, Lee, & Valdés, 2012, p. 2). The systematic use of paired learning strategies, the freedom to select those that best fit the science and language objectives of their planned lessons, and the opportunities to reflect, allowed these bilingual pre-service teachers to discern the significance of these strategies for young bilingual learners.

Although our participants were pre-service bilingual teachers, the findings of this study have direct implications for all teacher preparation programs. Students' language needs must be addressed regardless of subject area or specialization of prospective teachers. Pre-service teachers must know how to implement paired learning as a pedagogical tool if they are to create meaningful activities that lead to academic learning. Learning by doing, is key in prospective teachers' decision to incorporate a linguistically sensitive methodology in their future teaching (Arreguín-Anderson, 2011). Pre-service teachers need multiple opportunities to use appropriate linguistic scaffolding to simultaneously build students' conceptual understanding and discourse skills. Current demographic trends justify approaches that materialize intersections of strategies that emphasize language acquisition, content mastery, and socialization. ■

References

Arreguín-Anderson, M. G. (2011). Using dyad learning as process in a science methods course with preservice elementary teachers. *Curriculum and Teaching Dialogue, 13*(1-2), 19-33.

Arreguín-Anderson, M. G., & Esquierdo, J. J. (2011). Overcoming Difficulties: Bilingual second-grade students do scientific inquiry in pairs during a lesson on leaves. *Science and Children, 48*(7), 68-71.

Arreguín-Anderson, M. G., & Garza, E. V. (2014). Bilingual pairs in teacher education: Exploring WILD strategies in an environmental education workshop. *Action in Teacher Education.*

Bass, J. E., Contant, T. L., & Carin, A. A. (2009). *Methods for teaching science as inquiry.* Boston, MA: Allyn & Bacon.

Bergman, D. & Morphew, J. (2014). Comparing classroom interactive behaviors of science and nonscience preservice teachers. *Journal of Classroom Interaction 49*(2), 4-10.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches.* Thousand Oaks, CA: Sage.

Cummins, J. (2000). L*anguage, power and pedagogy: Bilingual children in the crossfire.* Clevedon: Multilingual Matters.

De Lisi, R. (2002). From marbles to instant messenger: Implications of Piaget's ideas about peer learning. *Theory into Practice, 41*(1), 5-38.

De Lisi, R., & Golbeck, S. L. (1999). Implications of Piagetian theory for peer learning. In A. M. O'Donnell & A. King (Eds.), *Cognitive perspectives on peer learning* (pp. 3-37). Mahwah, NJ: Lawrence Erlbaum.

Diaz, Z., Whitacre, M., Esquierdo, J. J., & Ruiz-Escalante, J. A. (2013). Why did I ask that question? Bilingual/ESL preservice teachers' insights. *International Journal of Instruction, 6*(2), 163-176.

Echevarria, J., & Graves, A. (2011). *Sheltered content instruction: Teaching English-language learners with diverse abilities.* Boston, MA: Pearson.

Fawcett, L. M., & Garton, A. F. (2005). The effect of peer collaboration on children's problem-solving ability. *The British Journal of Educational Psychology, 75*, 157-179.

Fernández Dobao, A. (2012). Collaborative dialogue in learner-learner and learner-native speaker interaction. *Applied Linguistics, 33*(3), 229-256.

Freire, P. (2003). *Pedagogy of the oppressed.* New York: Continuum.

García E. E. & García E. H. (2012). *Understanding the language development and early education of Hispanic children.* New York, NY: Teacher's College Press.

Gomez-Zwiep, Z., Straits, W., & Topps, J. (2015). 5E for ELLs. *Science and Children, 53*(2), 80-86.

Hoyt, L. (1998). *Revisit, reflect, retell: Strategies for improving reading comprehension.* New Hampshire: Heinemann.

Johnson, D. W., Johnson, R. T., & Smith, K. A. (2006). *Active learning: Cooperation in the college classroom*. Edna, MN: Interaction Book Company.

Kagan, S. (2009). *Cooperative learning.* San Clemente, CA: Kagan Publishing.

Lee, O., & Buxton, C., A.,. (2013). Integrating science and English proficiency for English language learners. *Theory into Practice, 51*(1), 36-42.

Lyman, F. T. (1981). The responsive classroom discussion: The inclusion of all students. In A. Anderson (Ed.), *Mainstreaming Digest* (pp. 109-113). College Park, MD: University of Maryland Press.

Madrid, L. D., Canas, M., & Ortega-Medina, M. (2007). Effects of team competition versus team cooperation in classwide peer tutoring. *Journal of Educational Research, 100*(3), 155-160.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation*. San Francisco, CA: Jossey-Bass.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: An expanded sourcebook.* Thousand Oaks, CA: Sage

Mirzaei, A., & Eslami, Z. (2015). ZPD-activated languaging and collaborative L2 writing. *Educational Psychology: An International Journal of Experimental Educational Psychology, 35*(1), 5-25.

National Research Council. (2011). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas.* Retrieved from Washington, DC:

Otto, B. (2014). *Language development in early childhood.* Upper Saddle River, NJ: Pearson.

Quinn, H., Lee, O., & Valdés, G. (2012). *Language demands and opportunities in relation to Next Generation Science Standards: What teachers need to know.* Stanford, CA.

Ramirez, J., Pasta, D., Yuen, S., Ramey, D., & Billings, D. (1991). *Final report: Longitudinal study of English immersion strategy, early-exit, and late-exit bilingual education programs for minority children.* (No. 300-87-0156). San Mateo, CA: Aguirre International.

Rittle-Johnson, B., Saylor, M., & Swygert, K. E. (2008). Learning from explaining: Does it matter if mom is listening? *Journal of Experimental Child Psychology, 100*(3), 215-224.

Rohrbeck, C. A., Ginsburg-Block, M. D., Fantuzzo, J. W., & Miller, T. R. (2003). Peer-assisted learning interventions with elementary school students: A meta-analytic review. *Journal of Educational Psychology, 95*(2), 240-257.

Saab, N., Joolingen, W. R. v., & Hout-Wolters, H. A. M. v. (2005). Communicating in collaborative discovery learning. *British Journal of Educational Psychology, 75*, 603-621.

Seidlitz, J. (2008). *Navigating the ELPS: Using the new standards to improve instruction for English Learners.* San Antonio, TX: Canter Press.

Smagorinsky, P. (2001). Rethinking protocol analysis from a cultural perspective. *Annual Review of Applied Linguistics, 21,* 233-245.

Swain, M. (2001). Integrating language and content: Teaching through collaborative tasks. *Canadian Modern Language Review, 58*(1), 44-63.

Veenman, S., Denessen, E., van den Akker, A., & van der Rijt, J. (2005). Effects of a cooperative learning program on the elaborations of students during help seeking and help giving. *American Educational Research Journal, 42*(1), 115-151.

Correspondence regarding this article should be directed to María G. Arreguín-Anderson from the University of Texas at San Antonio. Email may be sent to Maria.ArreguinAnderson@utsa.edu.