Role of Assessment Conversations in a Technology-Aided Classroom with English Language Learners

An Exploratory Study

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Introduction

The number of language minority students in the United States has continued to steadily increase. The number of public school students in the United States who were English language learners (ELLs) in school year 2013-2014 stood at an estimated 4.5 million students (National Center for Education Statistics, 2016). Five of the six states with the highest percentages of ELL students in their public schools were in the West.

In the District of Columbia and six states—Alaska, California, Colorado, Nevada, New Mexico, and Texas—10% or more of public school students were ELLs, with California having the highest percentage, at 22.7%. In the 2015-2016 school year in California, there were approximately 1.374 million English learners. In California public schools, where this study was conducted, a student's primary language is identified based on a home language survey, which is completed by the parents or guardians upon registering their child for school the first time.

State and federal laws require all school districts in California to administer a state test of English proficiency, the California English Language Development Test (CELDT), to students whose primary language is not English. Depending on their performance on this annual test, students are designated as ELLs and are placed in either mainstream English classes or structured English language classes. In California ELLs speak a total of 59 different languages at home, with the vast majority of ELLs (82.7%) speaking Spanish as their primary language (California Department of Education, 2016).

This article is drawn from a study conducted to explore how assessment conversations, a type of informal formative assessment, can support science learning in a technology-aided seventh-grade classroom. The classroom setting where the study took place used interactive whiteboards in conjunction with the inquiry-based activities. But what made the learning useful were the conversations the teachers and students were all engaged in. What qualifies as effective use of technology is when the technology is well integrated with real-time, personal interactions rather than as a replacement for them.

For this study, I identified the discussions between the teacher and the ELL students in terms of assessment conversations, using the ESRU cycle (**E**licits a question; the **S**tudent responds; the teacher **R**ecognizes the student's response; the teacher **U**ses the response) (Ruiz-Primo & Furtak, 2007) and then analyzed the language used in the assessment conversations utilizing the Systemic Functional Framework (SFL) (Gibbons, 2006).

Assessment conversation—a formatted instructional dialog—embeds assessment into the activity structure of the classroom and helps teachers acquire, on an ongoing basis, information about the level of their students' understanding of the topic at hand (Duschl & Gitomer, 1997; Ruiz-Primo & Furtak, 2007). SFL views language as a social process where people use language to make meanings with each other as they carry out the activities in their social lives (Christie & Unsworth, 2000). SFL is more oriented to the description of language as a resource for meaning rather than as a system of rules, making it a powerful tool for analysis of spoken language (Halliday & Hasan, 1976; Halliday &Martin, 1993; Schleppegrell, 2004).

Background

To understand the relevance of this study, it is important to examine the background behind the challenges that ELLs face in science education in our existing K-12 school system.

ELLs in Science Education

Science instruction for most ELLs is still conducted in English; thus students must learn new academic content in a language that they are still acquiring (Warren, Balleneger, Ogonowski, Roseberry & Hudicourt-Barnes, 2001). Moreover, many schools lack the material resources and instructional supports needed to provide exemplary science instruction to all students on a regular basis (Harris, 2004).

The problem is compounded when the same schools are also more likely to have inexperienced teachers who are asked to teach science even though it is outside their field of expertise (Dorph, Goldstein, Lee, Lepori, Schneider, & Venkatesan, 2007). Since the assumption is that proficiency in English is a prerequisite for

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learning subject matter (Cummins, 1981; Stoddart, Pinal, Latzke, & Canaday, 2002), the prevalent pedagogical approach is to separate the teaching of English language from the teaching of academic content. One of the challenges teachers face is the lack of effective instructional supports in classroom settings that integrate both science content and language learning.

ELLs and Assessment

The assessment of ELLs through written or spoken language brings up questions of validity and fairness. In fact, it is difficult to create rigorous and fair assessments for linguistic minorities in the form of commercially developed standardized tests (Solano-Flores & Trumbull, 2003) or classroom assessments (Shaw, 1997; Siegel, 2007) since the assessment prompts depend on the language used to create them (Baxter, Shavelson, Goldman, & Pine, 1992). The value of alternative assessments, in the form of performance assessments, in classrooms with ELLs has also been demonstrated (Shaw, 1997; Shaw, Bunch, & Geaney, 2010).

These studies highlight how ELLs face linguistic demands in performance assessments and address the validity of performance assessments as instruments for assessing science learning. What is known is that science learning for ELLs often cannot be assessed effectively by large-scale standardized tests. Hence, there is a need for a more interactive model of assessment of ELLs in science classrooms, designed to support learning through both student and teacher input (Black and Wiliam, 2003).

ELLs and Technology in Classrooms

Since the 1990s, the use of educational technology in K-12 classrooms has gained tremendous momentum across the country. In order to foster performance parity in academic achievement between ELL and regular students, researchers have examined the role of using modern technology to support ELL learning. The research includes cases of improving mathematics and reading (Lopez, 2010), language proficiency development (Green, 2013; Hur & Suh, 2012), and language and content learning (Liu, Navarrete, & Wivagg, 2014).

The common forms of modern technology often used to support ELL learning are interactive whiteboards and digital tablets in classrooms (Liu, Navarrete, & Wivagg, 2014; Lopez, 2010). An interactive whiteboard (IWB) is a touch-sensitive device that allows users to interact with digital materials (Smith, Hardman, & Higgins, 2006; Yudt & Columba, 2011). Common examples are the SMART Board and the Promethean Board.

The IWB connects a computer to a projector and shows resources from the computer on the surface of the board. The user can control the board using a pen, finger, or devices such as a mouse and keyboard and can also use it as a regular whiteboard. What is missing in existing research is evaluation of the use of technology like IWBs in classrooms to support science learning for linguistically diverse students.

What's Next for ELLs in Science?

In response to the call for reforms in assessment, the Next Generation Science Standards Diversity and Equity Group emphasizes the importance of including instructional strategies that encompass a range of techniques and approaches that build on students' interests and backgrounds so as to engage them more meaningfully and to sustain learning (NRC, 2012). There also is an emphasis on defining how students can demonstrate their competence through multiple means of expression, such as oral and visual means.

Additionally, there has been a shift in the purpose and forms of assessments from restricted forms of standardized testing, which are considered to be weakly linked to student learning, to formative assessments that can demonstrate student learning (Black & Wiliam, 1998; NRC, 2012). Given the importance and potential value of educational technology, it is crucial to understand how best to use it to support ELLs in classrooms. IWBs have been successfully used in the field of education for years, but what will be of most interest is how learning with the use of technology occurs at classroom levels and how ELLs can be assessed informally in such settings.

In the following sections, I discuss how the use of a technology applications like IWBs, coupled with integrated literacy practices during conversations, showed more promising evidence of learning. I explore how in conjunction with IWBs classroom-based assessments in the form of assessment conversations, a type of formative assessment, can support ELL student learning. I also explore the value of shifting the focus from summative assessment *of* learning to formative assessment *for* learning (Gipps & Stobart, 2008).

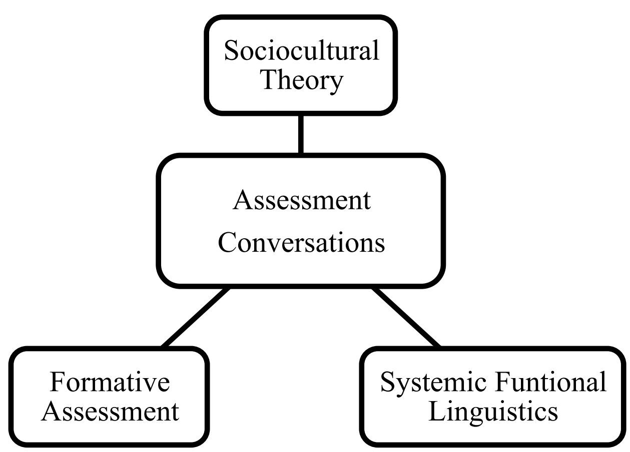
Conceptual Framework

This study is rooted in three major bodies of literature: formative assessments for learning, sociocultural theory of learning, and SFL. I will highlight the main concepts from each of these areas and discuss how each area informs my study of assessment conversations (see Fig.1).

Formative Assessments for Learning

Any assessment that provides evidence to modify or adapt teaching to meet the learning needs of students can be considered formative. In their seminal meta-analysis, Black and Wiliam (1998) demonstrated the inherent value of formative assessments and their role in improving student learning. Research on formative assessments in science has shown that assessments fall on a continuum that ranges from informal and unplanned, when teachable moments unexpectedly arise, to formal and planned

Figure 1
Conceptual Framework of the Study



assessments, which are used during instruction and planned or embedded in the curriculum (Popham, 2008; Shavelson, Young, & Ayala, 2008).

Informal formative assessments use everyday learning activities as opportunities to obtain evidence of students' learning in different modes, including: oral evidence, e.g., students' questions and responses, what they say in small groups, conversations with students; written evidence, e.g., notes, graphs, and drawings; and experimental evidence, e.g., data collected through students' performance assessments (Ruiz-Primo, 2011).

One such form of oral evidence is assessment conversations, which are dialogues that embed assessment into an activity already occurring in the classroom (Duschl & Gitomer, 1997). This study utilized such *assessment conversations* in the form of formatted instructional dialogs that embed assessment into the activity structure of the classroom and for which the evidence is used immediately for feedback.

Sociocultural Theory of Learning and Assessments

Through a sociocultural lens, one views knowledge as socially constructed (Vygotsky, 1978) and learning as situated (Lave & Wenger, 1991). Duff and Talmy (2011) postulate that, for ELLs, "social interaction with more proficient members of a particular community mediates the development of both communicative competence and knowledge of the values, practices, and identities of the community" (p. 98).

Thus, students' engaging in assessment conversations with teachers in science classrooms can promote the meaning-making capacity of both the English language and the language of science. Vygotsky (1978) developed the concept of the zone of proximal development (ZPD), which he described as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers" (p. 217).

In science classrooms, teachers can help students move through their ZPDs by using semiotic tools such as language. ELLs may develop a fair amount of oral fluency in English and may be considered proficient. However, in regard to the use of language in science classrooms, ELLs may still struggle. They will need additional support to engage in academic work in classrooms. Through assessment conversations, teachers can negotiate science learning through students' ZPDs.

SFL Analysis of Discourse with ELLs

Almost all teaching and learning in science classrooms takes place using the medium of language and involves some fairly complex processes and interactions, many of which depend on tacit ideas, implicit ground rules, and traditional beliefs about what is expected in science classrooms (Shanahan & Shanahan, 2008; Wellington & Osborne, 2001). SFL analysis is seen as a reliable method of discourse analysis because it is through "language that individuals enact and present themselves and their socially constructed knowledge to each other " (Olsen, 2006, p. 149).

To analyze the assessment conversations, I adopted part of the framework implemented by Gibbons (2006) in her analysis of discourse in science classrooms with ELL students in Australia. Halliday and Martin (1993) provided a framework of systemic functional grammar that characterizes the relations between a text (or discourse) and its context. Therefore, an exploration of the SFL analysis of assessment conversations will illuminate how they can support the context of ELLs' learning of science.

Sociocultural Theory of Learning and Assessments

Through a sociocultural lens, one views knowledge as socially constructed (Vygotsky, 1978) and learning as situated (Lave & Wenger, 1991). Integrating the use of science, language, and assessment for learning through a sociocultural orientation engenders participation in discourse as a primary characterization of learning and knowing (Lemke, 2001; Vygotsky, 1978), uses the support of knowledgeable others like teachers (Lave & Wenger, 1991; Vygotsky, 1978), and utilizes scaffolds that provide support and guidance to help students achieve what they cannot do alone (Wood, Bruner, & Ross, 1976).

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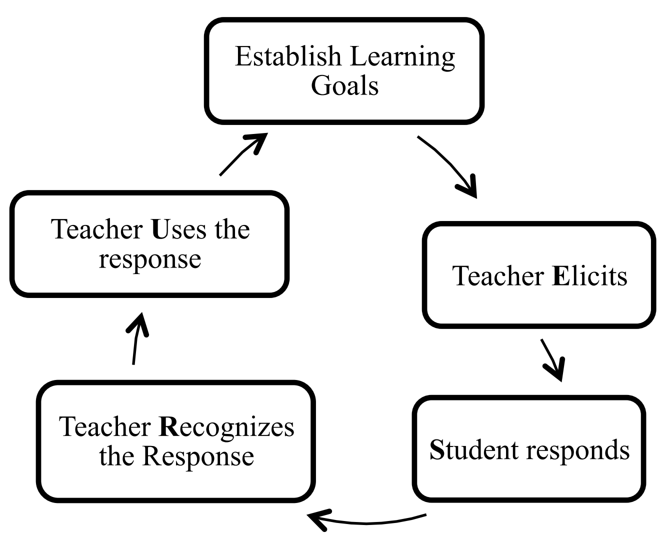
Assessment Conversations

Ruiz-Primo and Furtak (2007) described assessment conversations as ESRU cycles: the teacher **E**licits a question; the **S**tudent responds; the teacher **R**ecognizes the student's response; the

Figure 2
ESRU Cycle of Assessment Conversations
E- elicits, S-student responds, R-recognizes, U–uses the response

From Ruiz-Primo, M. A., & Furtak, E. M. (2007). Exploring teachers' informal formative assessment practices and students' understanding in the context of scientific inquiry. *Journal of Research in Science Teaching, 44*(1), 57-84.



teacher **U**ses the response (see Figure 2). The ESRU cycle (Ruiz-Primo & Furtak, 2007; Ruiz-Primo, 2011) begins with the teacher's explaining the learning goals at the beginning of the lesson or unit and then (a) Eliciting information, which could be in the form of prompts or questions, which entails making the students' understanding explicit or visible (E); (b) Students' responding, whereby students share their thinking with the teacher and class (S); (c) Recognizing students' responses, whereby the teacher uses students' responses and makes the relevant ones explicit (R); and (d) Using the students' responses to help the students move toward the learning goals (U).

It is important to note that assessment conversation is not an avenue for providing correct answers or evaluating other answers. In her analysis of the value of assessment conversations as formative assessments, Ruiz-Primo (2011) *highlighted the importance of not just identifying the ESRU cycles* in classroom conversations but also *analyzing the type of discourse* that occurs within these conversations.

Hence, for this study, I focused on analyzing the discourse within the conversations, using SFL to understand the extent with which the teachers and students used conversations to facilitate science learning in a linguistically diverse classroom.

Methodology

Research Questions

This section presents my research questions, how I collected the data for the assessment conversations in a middle school science classroom, and how I analyzed the data as assessment conversations to inform how they supported the science learning of ELLs. As noted earlier, the purpose of this study is to explore the assessment conversations implemented in a 7th grade science classroom with ELL students where the teacher used interactive white boards to implement the science lesson.

The research questions guiding my study include:

1. How do the teacher and students use language in the assessment conversations to describe the science content using the SFL framework?

2. How is the language used in the assessment conversations to establish the role and relationship between the participants using the SFL framework?

3. How is the language used in the assessment conversations to organize text for meaning making using the SFL framework?

Setting and Participants

The setting of the study is a seventh-grade classroom in a middle school, Willow Brook Elementary School (a Pseudonym), in Northern California. This is an urban school in which about 50% of the population are ELLs, 60% are Latinos and over 30% are Asians. There are 30 students in this classroom, of whom six were designated as ELLs based on their performance on the CELDT.

The teacher of this classroom, Mrs. A, has taught for over 15 years and has considerable experience teaching ELLs. She has also taught pre-service teachers at a local university about such practices in their methods course. The teacher employs curriculum materials through the use of the interactive whiteboard (IWB) focused on language art practices. She also embeds activities such as instructional conversations in her classrooms as a means to engage students in meaning making while using the IWB (Black, Harrison, Lee, Marshall, & Wiliam, 2003).

The class that I observed included all of the ELLs, since the teacher had divided the class into two groups on that day. The group I observed had 15 students, of whom six were ELLs, five were at CELDT level 4, and one was at CELDT level 3. The other group attended a history workshop, while this group studied science that day.

Data Sources and Collection

The data sources included field notes written during the observation and a 45-minute audio recording of the teacher and the students during the class discussions. The audio recording was of discussions between the teacher and students during the teaching of a unit on the scientific method focused on science processes and experimentation. The audio recording was transcribed verbatim and then analyzed in detail using the SFL framework.

The teacher used the interactive whiteboard to introduce concepts and terms and display the students' ideas. The teacher also used the IWB to a lesser extent, mainly due to limited expertise and non-reliable internet connection. Thus the students did not interact with the IWB and instead watched as the teacher used it to display and discuss the content needed for the class. Nevertheless, it was notable to see how she used it seamlessly to support student conversations in the classroom.

Data Analysis

The sources for my data analysis are (a) the science lesson, which I audio-taped, and (b) the field notes of the science lesson. I transcribed the audio recording and coded the transcripts as follows: (a) introduction of concepts and terms, e.g., hypothesis, variables (independent, dependent, and control), and discussion of the scientific method (or process; the teacher used the two words synonymously) which were displayed on the interactive white board; (b) application of the concepts to the students' science fair project ideas; and (c) application of concepts in a short inquiry lab, where the students had to examine how to dissolve M&M chocolates in different types of liquids, like water, juices, etc.

The goal was to identify the ESRU cycles and then use the SFL method to analyze the data. Establishing the learning goals was considered as the first step, hence the data were coded according to what the teacher had established as learning goals of the science lesson. The teacher had identified three purposes in the science lesson being taught, namely to understand the concepts and terms in the scientific method/processes, how to apply them in the students' own science project, and finally the application of these concepts in the small inquiry lab designed by the teacher.

The data were coded under these three categories using the thematic method (Gibbs, 2007). Thematic coding is a form of qualitative analysis which involves recording or identifying passages of text or images that are linked by a common theme or idea allowing one to index the text into categories and therefore establish a "framework of thematic ideas" (Gibbs 2007).

I used two main approaches to analyze the data. First, I used the ESRU framework as a means to identify *the complete and incomplete ESRU cycles* within each topic identified by the teacher. Second, I used *SFL*, adopting both Halliday and Martin's (1993) and Gibbons' (2006) frameworks, to analyze the nature of conversations within each aspect of the ESRU cycle.

Halliday and Martin (1993) provided a framework that deals with the relations between form and meaning of language. A text relates to its context through *field*, the subject matter of the text or the socially recognized activity that is taking place at the time; through *tenor*, the social relationships that occur among the various participants in the interaction; and through *mode*, the role language plays in the interaction.

Table 1. presents the relationship between field, mode, and tenor and the research questions. By analyzing the field, mode, and tenor of the text, one can link function and meaning of text. The grammatical features of text can account for the linguistic features of text. The interplay between the field, mode and tenor contributes towards the construal of meaning of the text. Wells (1999) stated that teachers make linguistic choices, which have meaning making potential, that significantly change the register and genre of the subject taught and, thereby, present different learning opportunities for their students.

Findings

I started the analysis by identifying the number of ESRU cycles. A total of 18 cycles of assessment conversations were identified in the transcribed conversations. ESRU cycles were complete when they contained assessment conversations in which the teacher connects the student's response to the learning goals. ESRU cycles were incomplete when they contained assessment conversations in which the teacher did not connect the student response to the learning goal.

Of the 18, 10 were complete and eight incomplete cycles. I observed that there were more instances of complete cycles when the teacher applied the concepts to the students' science fair projects or the lab activity, and incomplete cycles when she taught the concept of variables.

In Table 2 I show the '*what and how*' of the SFL analysis of assessment conversations. The three register variable—field, tenor, and mode (what)—allow for understanding different kinds of meaning making based on the lexico-grammatical choices of language (how).

In the first phase, I analyzed the field of discourse (Halliday & Martin, 1976), where I examined how the teacher elicited student learning during assessment conversations.

The teacher usually elicited the assessment conversation or ESRU cycle with questions that were generally open-ended or pseudo-open-ended (Cazden, 2001; Wellington & Osborne, 2001). In complete cycles, open-ended questions took the form of "How do you know that?" or "What else can you change?" which led to multiple iterations and connections to learning goals (See Appendix A).

In the incomplete cycles, the questions were usually pseudo open-ended, which meant that they appeared open in form but were closed in function, with the teacher's typically asking the students to play a "what's-in-my-head" game (Cazden, 2001). This was seen when the students were planning a short inquiry lab to determine the different rates at which the colors of M&M chocolates dissolve. The teacher asked, "What else could we change?" In this instance, the teacher expected the students to give the names of different liquids, even though the students could suggest other ways of dissolving them.

In complete cycles, in addition to open-ended questions, the teacher also elicited assessment conversations by asking transfer questions (Wolf, 1987). These are questions that" provoke a kind of breadth of thinking" by asking students to take their knowledge to new situations. The teacher recalled a section from the science text. "Do you remember in the text book when they talked about the crickets chirping? If, so how would you write that [hypothesis]?" The students later engaged in formulating a hypothesis.

In the second phase, I analyzed the mode of discourse when the teacher recognized and used the student response to connect to the learning goal. Under the mode of discourse, the organization of the text of the assessment conversations, was analyzed (See Appendices C and D). Lemke (1989) explained that students develop understandings of science content through dialogue or discourse, when teachers and students use language to make sense of one another and of science texts. The approach that he described helped the students to paraphrase science text in their own words. In this study, this was accomplished by a discourse strategy called revoices.

In revoices, the student's contribution is rebroadcasted back to the group, often giving it a "bigger voice" (Cazden, 2001). In this study, the students often stated the hypothesis of their science fair experiments in their own words, which the teacher 'revoiced'. Below is an example of how the teacher acknowledges the student response and accepts the student's idea of using another term to describe the independent variable.

> Student: I remember you told me that the dependent variable depends on the independent variable or something like that.
>
> Teacher: Yes that is why it is dependent.

Table 1
Phases of Data Analysis, Focus of Research Question with Parts of ESRU Cycle Analyzed

Phase of Analysis of Assessment Conversations	*Research Question*	*Type of Analysis*	*Part of ESRU Cycle*
First	How does the teacher and student use language to describe the science content?	Field	Teacher Elicits, Students respond (ES)
Second	How is the oral language used to organize text for meaning making?	Mode	Teacher Recognizes student's response and Uses student response (RU)
Third	How is the language used in establishing the role and relationship between the participants?	Tenor	Teacher Elicits, Students respond (ES) Teacher Recognizes and Uses response (RU)

Table 2
What and How of the SFL Analysis of the Assessment Conversations

What of SFL analysis (Register)	*How of the SFL Analysis (Language Used)*
Field of Discourse	Language used to describe content knowledge in science
Mode of Discourse	Language showing the organization of text to support science learning
Tenor of Discourse	Language describing interaction between the participants

You are absolutely right, Cari.

S: And it changes the dependent variable, and that means it manipulates it!

T: Right! Change or do, and we can put that in manipulate.

In the third phase, I analyzed the tenor in each part of the ESRU cycles.

The main theme that emerged from these analyses was how the teacher positioned the science content with the students (See Appendices A, B, C and D). Within the general theme of tenor, the teacher not only explicated the importance of knowing the science content and using the scientific terms correctly but also positioned the students as middle school students and, thus, expected a high level of performance from them in the science fair. The tenor remained the same throughout the assessment conversations, regardless of whether they were complete or not.

In the following excerpt, she presents the importance of not only knowing the term hypothesis but also of explaining the hypothesis in a specific manner.

T: When we wrote the hypothesis, and that is your prediction, and we wrote it a very special way. How do we write it?

S: A statement!

T : Yes but how . . . ?

S: In a question.

T: No it's not a question. There were two words.

S: Conclusion . . . Then.

T: Yes, that was one of them and what comes before then?

S: If.

T: Correct. So I am going to write it as, "If we do something," and I am also going to put up here "change," so if we change or do something, then . . . ?

In another excerpt which follows, it can be seen how the teacher bridges the student's everyday use of words and academic language and does it in non-evaluative or judgmental manner. This is seen during the end of the lesson with the M&M chocolates in the inquiry lab.

T: What are you doing to the temperature?
S: Rising it.

T: Rising is a word, but what is the other word?

S: Increasing!

T: Good. We want to say that we are increasing the temperature.

At the beginning of the lesson, the teacher explains the importance of students' starting their science project with a research question and prediction and that she expects a certain level of performance because they are in middle school. She states,

If we change or introduce something to something, then we predict. Ready? We predict that this will happen. Okay, got it? Okay, you are not in fourth grade anymore. It's time to raise this up.

Summary of Findings

The identification of the ESRU cycles helped in determining which parts of the conversations would be useful for the SFL analysis. Determining the number of complete or incomplete cycles in each part of the lesson did not provide any significant result to make a reasonable conclusion. The SFL lens provided an insight on how to analyze the teacher and student usage of language to elicit the assessment conversations and how the students responded.

The analysis of the *field of discourse* illuminated how the participants of the assessment conversation, namely the teacher and students, appropriated language to describe and understand science content. The analysis of the *mode of discourse* explicated the aspects of the language used by the teacher to recognize the student response and how she used it to connect to the learning goals in the form of recasts. The analysis of the *tenor of discourse* highlighted how the teacher appropriated language, which helped in balancing the academic nature of the lesson an maintaining a supportive environment. Table 3 provides a brief summary of the findings aligned to each research question.

Conclusions and Implications

In this study, the teacher used the IWB to display content, which proved to be a conduit to support conversations in the classroom. Through the assessment conversations, the teacher was able to recognize how students constructed knowledge of the scientific process through both ESR and ESRU cycle of the assessment conversations. The teacher also examined and supported the students' understanding of science concepts and processes in an encouraging and non-evaluative manner.

As all the ELLs were in the classroom that was observed, including the students

Table 3
Summary of findings in Each Research Question

Field of Discourse	*Mode of Discourse*	*Tenor of Discourse*
How does the teacher use language in the assessment conversations to describe the science content and process?	How is the oral language used in the assessment conversations to organize text for meaning making?	How is the language used in the assessment conversations in establishing the role and relationship between the participants?
• Bridging of everyday words and academic vocabulary in discussions.	• Use of students' words and ideas by teacher	• High expectations of the students
• Open ended Discussions (including student initiated) focused on applying the scientific method.	• Revoicing by teacher	• Close-ended discussions focused on understanding of ideas.
		• Active participants in the conversation.
		• Use of academic language of science in the class
		• Supportive environment
		• No negative evaluation of the students' responses.

who had lower proficiency in language arts, the linguistic background of the students may have played a role in shaping the teacher-student interactions. Schleppegrell (2004) contends that raising both teacher's and student's awareness of linguistic choices will enable them to better participate in the contexts of learning. When the teacher shared with students the multiple ways that they presented their ideas, she not only provided a voice for her students but she also used as it as an avenue to provide feedback on the quality of evidence and ideas put forth by the students and

Despite the students having lower English language proficiency, the teacher maintained an academically rigorous environment, which was demonstrated in the way she emphasized a clear standard for the science fair project and the use of academic language in expressing their ideas. Having a high level of proficiency in English is not required to engage in academic discourse in science. What is essential is giving value to the student's ideas and connecting it to the academic language of science.

The SFL lens—the lexical and grammatical choices—provides an insight as to how the teacher connects the students' ideas to the learning goals. Within the complete ESRU cycles of the assessment conversations, the teacher guides the students through their zone of proximal development by providing scaffolds in the form of revoices, open-ended and transfer questions. The teacher, thus, was able to acquire, on an ongoing basis, information about the level of their students' understanding of the topic at hand and connect their ideas to the learning goals.

By engaging in assessment conversations, the teachers and students have the potential to develop the classroom as a potential sites of "progressive discourse"—where the student's ideas are accepted (Bereiter, 1994). Once teachers are aware of the value of informal formative assessments for ELLs, they too can contribute to the development and implementation of equitable classroom-based assessments that better serve all students.

There were limitations to this study which include: (a) the ESRU analyses of the assessment conversations was done by a single researcher leading to limited reliability, (b) the lack of triangulation of the data with other forms of data such as how the teacher used the IWB, teacher or student interviews, and (c) the lack of analysis of assessment conversations in other science classrooms that contain ELLs. Hur and Suh (2012) have found that for IWBs to be effective in classrooms, students need to have more control in using interactive white boards. In this study, the teacher had control of the IWB and used it as a milieu to generate conversations.

By analyzing instances of ESRU cycles and examining the language used by the teacher and students in the ESRU cycle, it has been demonstrated that assessment conversations—a form of informal formative assessments—can be operationalized for ELLs in a middle school science classroom using interactive whiteboards.

Assessment conversations can serve as entry points into scientific discourse for students from diverse communities, including students from a variety of social and linguistic traditions, who are often identified as ELLs. It is through conversations around student work between students and teachers, as well as through information about how students are reasoning, using evidence, and constructing explanations, that science learning becomes visible and tangible.

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Appendix A

Teacher Eliciting	*Declarative*	*Imperative*	*Interrogative*
Understanding the concept of variable – Student Initiated.	So the number is what we changed.	Really, that is all you can think of is salt water.	So what are you measuring? What are you measuring?"
Understanding the concepts in the scientific process through their experimen.t		We can change the number, right, exactly! That is the independent.	Ok, so scientific process. What do you have to start with?
Understanding the concept of hypothesis.	Well, your question and your purpose are the same thing: you are asking the question because you want to find out the answer to that question, right.		… then you are creating something that can be tested and that is perfect. Once you have that question, you have to come up with what?
Using the academic language of science.	Right! That whole-rising was close but it is called raising. You were all close. So we are going to say increasing, That is why you say "if-changes." If savanna has a headache, I predict that there will be tension, and my hypothesis was correct.	Ok, You are not in fourth grade anymore, its time to raise this up. Good, we want to ….say that we are increasing the temperature.	We wrote it a very special way and does anyone remember what our special way was? How do we write it?

Appendix B

Student Response	*Clauses*	*Questions*	*Nouns/Adjective*	*Processes (Material or Relational)*
Understanding the concept of variable.		"Wait but what is the dependant variable and what is the independent variable?"	Manipulator.	
Understanding the concept of hypothesis.			A hypothesis. A statement.	A scientific guess that you think is going to happen.
Understanding the concepts in the scientific process through their experiment.	How fast!	Wait but what is the dependant variable and what is the independent variable in my experiment?"		
Using the academic language of science.	The scientific way huh?			And it changes the dependant variable and that means it manipulates it!

Appendix C

Recognizing Student Response	*Repeating the Statements*	*Recast (In relation to grammar)*	*Recast (In relation to subject matter content)*
Understanding the concept of hypothesis.			
Understanding the concept of variable.	Ok, so your prediction is that if we raise the temperature in the box of crickets, then we predict that the chirping will decrease.	Instead of saying "go down" you want to use "decrease" ok?	
Understanding the concepts in the scientific process through their experiment.	You are measuring how fast it goes.	So you measure how far or how fast?	
Using the academic language of science.		If, so how would you write that? If you change the temperature in the box of the crickets, then we predict that …	

Appendix D

Using Student Response	*Repeated the Statements*	*Interrogative Statements*	*Imperative Statements*
Understanding the concept of hypothesis.	Thesis is an idea," or "It could be both."	Once you have that question, you have to come up with what?"	"That is a little weird. Now, you are to make your hypotheses, lets do the temperature."
Understanding the concept of variable.		"It all depends on what you do." "So what do you want to change?"	"Really that is all you can think of is salt water?"
Understanding the concepts in the scientific process through their experiment.	"Good, we want to say that we are increasing the temperature."	"If it comes up, we have to… Do you understand the question has to be tested?	There you go, that is your results. You got it? So you got your dependant, you are changing the temperature and you are measuring how fast it goes so you are seeing if you change the temperature will affect the speed."
Using the academic language of science.	"First of all, we are not just going to say " I think this will happen" you have to say, "if we change something" or "if we do something then this other thing will happen.		"Ok, You are not in fourth grade anymore, its time to raise this up. No more volcanoes."