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Latino(a) and Burmese elementary school students reading scientific informational texts: The interrelationship of the language of the texts, students' talk, and conceptual change theory

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ABSTRACT

This article is the result of an investigation examining 17 multilingual students transacting with scientific informational texts during miscue analysis. Students' retellings scores were generally found to be low despite high semantic acceptability during read alouds. Further investigation involving the use of social semiotics and discourse analysis revealed that the language patterns found in the scientific texts had similar social purposes to the language patterns in many students' retellings. Conceptual change theory was also applied to examine segments of students' retellings that differed from the retelling rubrics. As a result multilingual Latino(a) and Burmese students in this study were found to possess resources as readers during the assessment process that were not initially measured through retelling scores.

Introduction

The discourses of science texts represent unique ways of thinking and learning (Halliday & Martin, 1993; Lemke, 1990). Previous research has explored how monolingual students develop as scientists (Pintrich, Marx, & Boyle, 1993; Posner, Strike, Hewson, & Gertzog, 1982; Treagust & Duit, 2008) and as readers of science texts (Halliday & Hasan, 1985; Lemke, 1990; Martins, 2002; Mayer, 2002). More research is needed which investigates how language and the practices of communities influence how students talk about scientific informational texts (Sinatra, Broughton, Diakido, Kendeou, & den Broek, 2011). Martin (2013) suggests that research must now focus on the renovation of pedagogy in order to recognize the interrelationship of culture and genre. In an effort to address this call for research the following article investigates how multilingual elementary school students understood scientific informational texts in Arizona and Maryland.

One way to examine how multilingual students are navigating the discourses of scientific informational texts is to examine students' retellings. In contrast to multiple-choice tests, retellings provide the opportunity to ask the open-ended question, "What was that about?" (Goodman, Watson, & Burke, 2005). Since retellings occur within specific social settings (Golden & Pappas, 1990), the presence of a teacher or assessor during a retelling may influence the event. In addition, retellings rely on multilingual students' abilities to verbally express their ideas. What students do express during their retellings can be viewed as discourses used by students to position themselves in the world (Gee, 2005). By analyzing students' retellings we

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can learn more about how students engage with the language patterns of the texts and how a student is developing in his or her understandings of scientific concepts.

The following article is the result of a five-year investigation studying the ways in which 17 multilingual students understood scientific informational texts during retellings that occurred during miscue analysis. The study focuses on participants separated by geography, language, and time. Fourth and fifth grade Latino(a) students living in Arizona with at least one Spanish-speaking parent were studied reading scientific informational texts over one year. Three years later Burmese refugee fourth and fifth grade students living in Maryland with at least one Burmese-speaking parent were also studied reading scientific informational texts over one year. In order to investigate the ways in which students understood the scientific informational texts the data was analyzed in two ways. First, the language patterns of both the texts and the students were analyzed using social semiotics and discourse analysis. Second, elements that appeared in students' retellings of a text but not in the retelling rubrics designed by the researcher were coded as 'unexpected' and analyzed using the framework of conceptual change theory. This article begins by discussing where this study is positioned among what is already known about how multilingual students develop in science classrooms. This is followed by a review of literature that focuses on multilingual students as readers of scientific informational texts.

Research investigating multilingual students in science classrooms

It has been strongly argued that social interactions inform how students develop as scientists (Piaget, 1929; Vygotsky, 1986). Members of a culture construct their shared understandings through language (Halliday, 1999). Accordingly, in order to support these social exchanges during science most research has concentrated on the language of instruction. For example, studies have found it beneficial to provide science content in the United States in both a students' native language and English (Clark, Touchman, Martinez-Garza, Ramirez-Martin, & Drews, 2011; Goldberg, Enyedy, Welsh, & Galiani, 2009). This led a few researchers to investigate the discourses of classroom exchanges.

Systemic functional linguistics (SFL) has been used to examine language and science in classrooms with multilingual learners by focusing on classroom discourses (Mohan, 2001; Mohan & Slater, 2005; Slater & Mohan, 2010). SFL has focused on genre and register (Halliday, 1999). Genre is the result of language that commonly occurs during specific social interactions. Register indicates meaning potential. It has been suggested that teachers use SFL in schools to assess whether multilingual students have developed meaning potential and can apply it to relevant situations (Huang & Mohan, 2009; Mohan & Slater, 2005). Slater and Mohan (2010) further suggest that collaboration between ESL teachers and content area teachers should focus on the development of register. They recommend that assessment regarding science content should be meaning based and the product of social discourse.

While discourse has been studied in the classrooms of multilingual learners, Gee (2001) has been instrumental in asserting that linguistically diverse students must also be able to engage within the many social discourses within a science text. To support this assertion he states, "This style of language also incorporates a great many distinctive discourse markers, that is, linguistic features that characterize larger stretches of text and give them unity and coherence as a certain type of text or genre." (p. 718) He further maintains that many multilingual students fail to be successful in school-based environments because they fail to master these discourses.

Research investigating multilingual children's understandings of scientific informational texts

The majority of research which centers on multilingual students' understandings of scientific informational texts focuses on texts that are read aloud to students (Pappas, Varelas, Patton, Ye, & Ortiz, 2012; Varelas, Pappas, & Rife, 2005, 2006), as opposed to texts that are read by students independently (Garcia, 1991). Within this research on read alouds deficit theories for children in urban classrooms have been discredited by demonstrating that students' funds of knowledge inform responses and connections to texts (Pappas et al., 2012; Varelas & Pappas, 2006). Much is still unknown about multilingual students' comprehension as they read scientific informational texts independently.

In general, research concerning assessment of students learning English as an additional language is not substantial (Gunderson, Odo, & D'silva, 2011). Research has investigated the processes multilingual students employ as they read aloud texts. Miscue analysis studies have demonstrated that students use cueing systems as they read that are universal across languages (Freeman, 2001; Mott, 1980); yet, these studies do not investigate the role of genre in influencing the multilingual learner. What has been determined is that the scores that bilingual Spanish/English student received for reading comprehension of expository texts might not accurately reflect their reading comprehension (Garcia, 1991). In addition, when kindergarten through third grade Burmese refugee students were studied as they read English scientific informational texts it was determined that the sociopolitical contexts of the students' lives informed their understandings of the texts (Croce, 2014). In light of these findings one element of the study discussed in this article attempts to add to what is known about how multilingual learners engage with the languages of scientific informational texts. A second aspect of this study considers how reading assessments may ask students to change their minds about scientific concepts. The following section discusses what has previously been proposed regarding how or if students change their minds about scientific concepts. This is called conceptual change theory.