Integrating flexible language support within online science learning environments

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CHAPTER 4

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ABSTRACT

Students learn best when instruction builds upon the resources and knowledge that they bring to the classroom. We have developed multilingual scaffolding for English language learners within an online science project. The scaffolding allows students to freely switch the “paragraph” and “support” languages in terms of both written and spoken text. Students can therefore harness their proficiencies with written and spoken English and Spanish as they switch back and forth to make sense of the science concepts and the critical academic English. This chapter presents preliminary analysis of student usage of these supports.
INTRODUCTION

While some English language learners (ELLs) have had extensive schooling in their native tongue prior to arriving in the United States, others may have had minimal formal instruction. Despite this fact, it has been argued that all students bring valuable linguistic, social, and scientific resources from their home experiences and cultures to the classroom (Fradd & Lee, 1999; Lee & Fradd, 1998, 2001). Our research group, Technology Opening Diverse Opportunities for Science (TODOS), has worked to develop and test language supports in online learning environments that draw upon these resources to help students learn science while simultaneously building academic English language proficiency. Considerable research suggests that cutting off students entirely from their primary language in the classroom may have negative effects on academic achievement and a variety of affective measures (August & Hakuta, 1997; Ovando, Collier, & Combs, 2003; Valdes, 2001). Instead, research demonstrates the efficacy of allowing students to use their primary languages to support their progress in gaining mastery of their second language as well as critical subject matter competence (Echevarria, Vogt, & Short, 2000; Rosebery, Warren, & Conant, 1992; Rosebery, Warren, Conant, & Hudicourt-Barnes, 1992; Snow, Met, & Genesee, 1989; Warren & Rosebery, 1995). We are therefore working to develop language supports that harness students’ meta-linguistic knowledge as the students switch between Spanish and English to support scientific conceptual development and academic language proficiency. Online learning environments provide a promising medium for these supports in terms of potential versatility and wide dissemination of benefits. Our initial work focuses on Spanish-speaking students in Arizona, but our eventual goal focuses on implementing these supports to serve multiple groups of students simultaneously in the highly diverse classrooms across the country and around the world.

BACKGROUND

The United States continues to diversify ethnically and racially. This diversification is especially pronounced among school-age children (Garcia, 2001a). With this growing diversity, promoting educational equity in our classrooms has become a critical challenge and goal for teachers, administrators, and policymakers, as demonstrated in multiple reports by the National Research Council (e.g., Smelser, Wilson, & Mitchell, 2001; Tienda & Mitchell, 2006; Welch-Ross, 2012). Many linguistically diverse students have unsuccessful schooling experiences in which their strengths and needs are not adequately addressed (Garcia, 2001b). Science classes, which are traditionally considered “culture-free,” actually often foster inhospitable and intractable environments for diverse learners (Banks, 1993; Lee & Fradd, 1998; Peterson & Barnes, 1996; Warren, Ballenger, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001).
Language learners cannot afford to postpone learning science and other subject areas while they learn English. Not only must students pursue appropriate grade-level science inquiry for its own sake, but supporting language learning through content, such as science, has also been shown to be the most effective means of building academic language proficiency (Chamot & O’Malley, 1994; Mohan, 1979; Short, 1999). With its multiple opportunities for hands-on and visual interaction with academic concepts, science provides rich contexts to support academic language development (Chamot & O’Malley, 1986, 1994; De Avila & Duncan, 1984). Although it requires substantial time and support to develop (Collier, 1987, 1989; Hakuta, Butler & Witt, 2000), academic language proficiency is critical to students’ future success in science and throughout school.

Our goal is to explore the integration of students’ home language into an online science learning environment to support the students’ understanding of science and the surrounding academic English discourse. Our language-support development efforts are grounded in research on: (a) language as a resource in learning and teaching in the content areas, (b) native language (Spanish in the current study) as a resource in learning a second language (English in the current study), (c) scaffolding for reading in a second language, and (d) computer-supported collaborative science learning environments.

Language as a Resource in Learning and Teaching in the Content Areas

Peal and Lambert (1962) suggest that the intellectual experience of acquiring two languages contributes to advantageous mental flexibility, superior concept formation, and a generally diversified set of mental abilities. U.S.-related research with Chicano bilingual children reported by Kessler and Quinn (1985, 1987) supplies empirical support for the emerging understanding that, all things being equal, bilingual children outperform monolingual children on specific measures of cognitive and meta-linguistic awareness. Kessler and Quinn (1987) engaged bilingual and monolingual children in a variety of symbolic categorization tasks that required their attention to abstract, verbal features of concrete objects. Spanish/English, Chicano bilingual children from low socioeconomic status (SES) backgrounds outperformed both low and high SES English monolingual children on these tasks. Such findings are particularly significant given the criticism by MacNab (1979) that many bilingual “cognitive advantage” studies have used only high SES subjects of non-U.S. minority backgrounds. Meta-linguistic advantages have also been reported for low SES Puerto Rican students (Galanbos & Hakuta, 1988). Goncz and Kodzepelvic (1991) and Swain and Lapkin (1991) provide overviews of international work in this area. A common finding of these “cognitive flexibility” studies is that bilingual children have mastered the ability to strategically use their understandings of multiple languages to acquire new academic material (García, 2001a). This metalinguistic ability could prove highly advanta-
geons in a technology-driven learning environment that facilitates the access to both languages during the teaching event.

Learning, from a constructivist perspective, involves students building upon and reorganizing prior knowledge in interaction with new ideas and experiences. A student's first language represents a critical component of the student's prior understanding (Cole & Cole, 2001; García, 2001a, 2002; Tharp & Gallimore, 1988). Traditional academic culture in U.S. schools, however, tends to: (a) exclude systematically the histories, languages, and experiences of diverse students from the curriculum, (b) impose a "tracking system" that restricts access to higher-order curricula, and (c) limit access to developmentally appropriate learning configurations (García, 2001b; García & Lee, 2008). While traditional curricular configurations tend to ignore the linguistic resources of diverse students, studies indicate that there are important advantages associated with using students' home language in the curriculum. Curricula incorporating students' home language provide important cognitive and social foundations for students' success in the second language (García, Bravo, Dickey, Chnn, & Sun-Inminger, 2002), have a positive effect on measures of academic achievement in school (August & Hakuta, 1997), and promote participation and positive relationships in the classroom (Au & Kawakami, 1994; Trueba & Wright, 1992).

The National Research Council (August & Hakuta, 1997) reviewed optimal learning conditions for linguistically diverse students and made several recommendations relevant to the design of the learning environment, including: (a) provision of a customized learning environment, (b) use of native language in instruction, (c) a balanced curriculum focusing on both higher order and basic skills, (d) opportunities for practice, (e) systematic student assessment, and (f) staff and parent involvement. Other studies support these findings regarding the importance of incorporating students' linguistic resources into the curriculum (Berman, 1992) and of the use of inquiry and cognitively complex learning (Thomas & Collier, 1995). Rosebery, Warren, and Conant (1992) also support these conclusions and place strong emphasis on the importance of authentic activities to induct students into the discourse of science. García and Lee (2008) similarly suggest focusing on: (a) bilingual/bicultural skills and awareness, (b) high expectations for diverse students, (c) treatment of diversity as an asset, (d) attention to and integration of home cultures/practices, (e) maximizing student interactions across categories of English proficiency, (f) student and teacher input in lesson planning and design, (g) a thematic approach to learning activities with the integration of various skills, and (h) language development though meaningful interactions and communications.

Native Language as a Resource in Learning a Second Language

A number of studies have found that instructional time spent in a student's native language is positively related to academic achievement measures in their adopted second language. For example, using a large national sample, Ramirez,
Pasta, Yuen, Billings, and Ramey (1991) studied children in English-only, late exit, and early exit bilingual programs and found that children could receive substantial amounts of primary language instruction without diminishing their acquisition of English language and reading skills and that doing so allowed them to catch up to their English-speaking peers in English language arts, reading, and math. Meta-analyses (Greene, 1998; Willig, 1985) and two research reviews conducted by the National Research Council (August & Hakuta, 1998; Meyer & Fienberg, 1992) reach similar conclusions.

A limitation of using academic achievement measures to evaluate programs for ELLs, as is commonly done in the program comparison literature, is that such measures are generally not constructed in relation to a theory of language ability (Thompson, DiCerbo, Mahoney, & MacSwan, 2002), leaving us with limited understanding of the independent impact of bilingual instructional programs on the separate constructs of academic achievement and English language development. For instance, learners’ test scores may increase due to improved language ability but reflect little actual growth in the academic content areas. Conversely, increases in test scores may reflect greater mastery of content but only minimal second language proficiency, sufficient enough to improve comprehension of test items but not reflective of substantive gains in English language proficiency. Furthermore, while program evaluation research is helpful in setting initial hypotheses, it does not in itself help us understand the specific mechanisms responsible for the observed outcomes. For that, a specific learning theory must be constructed and evaluated.

A well-known, though somewhat controversial, hypothesis that predicts gains in second language ability for children in native language instructional environments is known as the comprehensible input hypothesis (Krashen, 1985, 1996). The central component of a theory of second language learning, the comprehensible input hypothesis proposes that second language learners acquire a new language by understanding messages. Hence, Krashen’s model proposes that native language instruction provides a conceptual framework for ELLs, which in turn gives them a conceptual and analytical framework to make English-medium messages comprehensible. Creating second language messages that are comprehensible to learners, in turn, results in acquisition of both vocabulary and grammatical structure because learners’ knowledge of the underlying semantic message permits them to analyze the grammatical structure at a subconscious level. Although this suggestion has not previously been tested empirically, theoretical work in first language acquisition, similarly aimed at explaining gaps between language input and learner output, has also proposed that children use “semantic bootstrapping” to decode messages and make complex inferences about underlying linguistic structure. For instance, Grimshaw (1981) and Pinker (1984) provide evidence suggesting that children use their knowledge of word meaning to infer syntactic properties of lexical items.