Journey to El Yunque: A Science Unit for Sixth Grade Spanish and a Case Study of Bilingual Student Talk

Allie Qiu, Master's Student, Learning Sciences Steven McGee, Research Associate Professor, Learning Sciences Northwestern University, School of Education and Social Policy

INTRODUCTION

PROBLEM

- Because dual language programs typically begin in kindergarten and end in elementary school, a major issue in dual language education is language attrition in middle school. Students lose their skills in the minority language when the majority language pervades students' in- and out-of-school experiences (Christian, 1996; Genessee, 2013).
- Another issue is the integration of language and content area teaching, as the dual language model emphasizes content-based instruction (CBI) (Howard, Sugarman, Christian, Lindholm-Leary, & Rogers, 2007). Language teachers are not always fully equipped to teach content in addition to language (Mercury & Ebe, 2011), and students may have difficulty transferring cognitive abilities from one language to the other (Cohen, 1998).

In addition, one of the common instructional strategies in dual language education is the heterogeneous grouping of students to encourage students to serve as linguistic resources to one another (Allison & Rehm, 2007; Christian, 2011).

I was interested in how this grouping strategy could play out in a Spanish dual language continuation class at the middle school level and in the content area of science—how students would use both Spanish and English as they worked in pairs on science activities.

OBJECTIVES

- L. To design and implement a program of study that addresses the issues of language maintenance and CBI
- 2. To test in particular the instructional strategy of pairing higher-ability Spanish students with lower-ability Spanish students as they face the challenge of studying science content in Spanish

TARGET AUDIENCE

- advanced sixth grade Spanish course intended for graduates of the district's K-5 dual language program
- 2 groups of students; 32 students total
- students are a mix of second language learners and native/heritage language learners of Spanish
 - have not yet formally studied any topics in biology at the middle school in English nor in Spanish
 - have previously studied literature and social sciences in the course
- first-year teacher is developing her own curriculum and favors inquiry- and project-based learning

PRIOR CONCEPTION INTERVIEWS

To assess students' prior knowledge of ecology and related vocabulary in Spanish, I conducted interviews with six students and arrived at the following conclusions:

Expected Challenges

Conceptual change (e.g. adaptations)

Expected Resources

- Basic conceptions of habitat, predator and prey, etc. to be expanded and refined
- Preliminary skills in reasoning about ecological data and scenarios
- Proficiency in English and Spanish and vocabulary from colloquial language that they can draw upon as they learn ecological concepts and vocabulary

BIG IDEA

Dynamic Interdependence

 aligned with the Next Generation Science Standards' Cross-Cutting Concepts of *patterns*, *cause and effect*, and stability and change

LEARNING GOALS

Student will be able to

- 1. Summarize limiting factors for the target species from texts written in Spanish.
- 2. Predict the impact of hurricanes on the target species
- using his or her summary of limiting factors as evidence. 3. Hypothesize how the limiting factors affect population
- dynamics after a hurricane.
- 4. Argue for or against an intervention for the target species after a hurricane using texts and data as evidence.

ASSESSMENTS

• Informal checks for understanding

- observing students
- asking students questions

• Worksheets

- ongoing feedback
- Performance task
 - hurricane.

The design of these assessments is based on the curricular materials of the Learning Partnership's Journey to El Yunque, which consist of interactive online modules and corresponding worksheets that take students through a case study of a rainforest ecosystem in Puerto Rico.

INSTRUCTIONAL APPROACH

- (Cummins, 2012; Mercuri & Ebe, 2011).

UNIT CALENDAR

Day	Activities & Assessments
M 12	Introduction
T 13	Vocabulary
W 14	Hurricanes
Th 15	Producers: Background
F 16	PEP ASSEMBLY (30 min. class period) Consumers: Background
M 19	FIELD TRIP: PERIOD A Consumers: Background
T 20	A.M. ASSEMBLY (30 min. class period) Guest speaker: Leida Tirado-Lee
W 21	FIELD TRIP: PERIOD B Consumers: Background
Th 22	Consumers: Prediction
F 23	INSTITUTE DAY: NO SCHOOL
M 26	MEMORIAL DAY: NO SCHOOL
T 27	Consumers: Model vs. Actual
W 28	Consumers: Discussion, recap, and sharing with the class Performance task: Introduction and outlining
Th 29	Performance task: Outlining and drafting
F 30	Performance task: Draft due by the end of the period
M 1	Performance task: Revisions
Т 2	Performance task: Final report presented and turned in

discussing feedback on worksheets

credit for completion and revision in response to feedback

• You are an ecologist doing research on a species in El Yunque! Write a report recommending whether the U.S. Forest Service should intervene to ensure the survival of your species after a

drafts and revision in response to teacher feedback

An inquiry-based intervention. By practicing inquiry, students learn about science as a discipline and have an entryway into science as a culture. This is especially important for minority students whose home cultures may involve ways of knowing that are different from those of Western science (Myer & Crawford, 2011). Such an intervention requires instructional strategies that facilitate cooperation, questioning, and student authority and that make science accessible to students.

Bilingual instruction. Students' learning is "maximized when they are allowed and enabled to draw from across all their existing language skills rather than being constrained" (Hornberger as cited in Creese & Blackledge, 2010). Thus, we prioritize Spanish while allowing students to use English when needed as they ask questions and work together. Spanish is the primary language of instruction; English is used for the explanation of select tasks and concepts and for translation purposes

Explicit instruction on features of the Spanish language. In order to support students' complete acquisition of the target language, explicit language instruction should be integrated with CBI (Christian, 2011). We include a short grammar lesson on the past tense to accompany the hurricane readings. Students are prompted to attend to the past tense as they read, speak, and write throughout the unit.

• **Explicit instruction in science and the language of science.** We support this second kind of language learning with the "5R Method" of vocabulary instruction (Malloy, Marshall, Silva, Smith, & Weinburgh, 2012) and the "literacy-integrated science curriculum" of *Journey to El Yunque* (Lara-Alecio, Tong, Irby, Guerrero, Huerta, & Fan, 2012, p. 991).

Group activities. Small groups are useful for cooperative learning and language acquisition, especially for students who speak a minority language (Allison & Rehm, 2007; Crandall, 2012). It is often recommended that students be grouped heterogeneously (Christian, 2011). Accordingly, we pair higher-ability students with lower-ability students.

The calendar was necessarily modified in the process of implementation, but together with the teacher, we created lesson plans for each day listed.

DESIGN-BASED RESEARCH

BACKGROUND

In the traditions of design-based research and of case studies looking at how bilingual students use their linguistic resources in the classroom (Creese & Blackledge, 2010; Stevenson, 2012), I studied students' language use during the unit by recording the conversations of two pairs of students as they read science texts, interpreted data, and made predictions and hypotheses.

The students had been paired by the teacher based on their Spanish language abilities. Higher-ability students were paired with lowerability students.

RESEARCH QUESTIONS

With what frequency and for what purposes do the students use English and Spanish respectively while working in pairs? • Do higher-ability students speak more than lower-ability speakers?

- How much talk did each student dedicate to each purpose? Were there differences between groups?

PARTICIPANTS

One pair of students, SA and SB (Group I), were native or heritage speakers of Spanish, meaning that they grew up with the language and culture of Spanish in their home communities. The second pair of students, SH and SI (Group II), were non-native speakers of Spanish and native speakers of English.

SA and SH were the higher-ability students, SB and SI the lower-ability students.

METHOD

I transcribed the conversations of the two pairs of students over two days, or 80 minutes of class time. Day 1 involved background readings and filling out a life history table for the group's species; Day 2 involved an interactive graph to predict the species' population in the months after a hurricane.

I used discourse analytical methods to identify the purposes of their language use, quantify the students' use of Spanish and English, and quantify their use of language by purpose.

I divided the students' talk into linguistic idea units and categorized each idea unit by purpose and by language. If a student used both English and Spanish within a single idea unit, I labeled it as "Mixed."

Through emergent coding, I identified seven purposes of the language used by the two pairs as they engaged in the activities. Reading directly from a text counted as "Reading." Any idea units that did not contribute to one of the seven purposes were categorized as "Other."

RESULTS

Table A: Distribution of Language Use Across Idea Units

		English	Mixed	Spanish	Total
Group I	SA	62%	8%	30%	195
Group i	SB	80%	6%	14%	111
Group II	SH	30%	4%	66%	290
Group II	SI	42%	1%	57%	213

Table B: Distribution of Purposes Across Idea Units

	Gro	
	SA	
Directing the activity	13%	
Discussing the definition of a word or a translation	11%	
Discussing content	16%	
Discussing the graph and/or how to draw one	5%	
Discussing what to write down	18%	
Discussing where to find and/or place information	1%	
Other	28%	
Reading	7%	
Total	195	

рΙ	Group II			
SB	SH	SI		
15%	24%	17%		
12%	6%	5%		
14%	7%	8%		
14%	21%	17%		
16%	21%	22%		
5%	7%	2%		
23%	15%	22%		
0%	2%	8%		
111	290	213		

RESULTS (CONTINUED)

Table C: Distribution of Language Use by Purpose **Across Idea Units**

	Gro	up I	Gro	Group II	
	SA	SB	SH	SI	
Directing the activity					
English	9%	13%	6%	6%	
Mixed	2%	1%	1%	0%	
Spanish	3%	2%	17%	11%	
Discussing the definition					
of a word or a translation	n				
English	11%	14%	1%	6%	
Mixed	0%	0%	2%	0%	
Spanish	6%	0%	3%	1%	
Discussing content					
English	7%	11%	4%	1%	
Mixed	3%	0%	0%	0%	
Spanish	2%	1%	1%	3%	
Discussing the granh					
and/or how to draw one					
English	4%	14%	2%	4%	
Mixed	1%	0%	0%	0%	
Spanish	0%	0%	18%	13%	
Discussing what to write down					
English	6%	3%	2%	2%	
Mixed	2%	5%	0%	0%	
Spanish	11%	9%	19%	20%	
Discussing where to find and/or place information	1				
English	1%	4%	3%	2%	
Mixed	1%	1%	0%	0%	
Spanish	0%	1%	4%	0%	
Other					
English	25%	23%	12%	21%	
Mixed	1%	0%	0%	0%	
Spanish	2%	1%	2%	0%	
Reading					
English	0%	0%	0%	0%	
Mixed	0%	0%	0%	0%	
Spanish	7%	0%	2%	8%	
•					
Total	195	111	290	213	

FINDINGS

- Overall, the higher-ability students spoke more than the lowerability students.
- There appears to be no difference between the higher-ability students' and lower-ability students' language preference. However, there is a clear difference between Group I and Group Il's language preferences: Group I used more English, while Group II used more Spanish. It is possible that the non-native Spanish speakers of Group II made a special effort to use Spanish, while the members of Group I preferred English as they felt more comfortable speaking English. The phenomenon of students, especially minority students, preferring to speak the majority language after achieving conversational fluency in the majority language is not uncommon (Christian, 2011) and may have occurred here.
- Overall, there appear to be no differences between the amount of talk dedicated to each purpose by higher-ability students vs. lower-ability students. Instead, this seems to depend on each group's decisions and dynamic. For example, though the higherability student in Group II directed their activity more than the lower-ability student, the students in Group I shared more equally the direction of activity.
- Group I preferred to direct their activity in English, while Group II preferred to direct in Spanish.
- Group I's content discussion ([reading] content and graph) occurred primarily in English, while Group II's occurred primarily in Spanish
- Both groups dedicated a large amount of talk to discussing what to write down on the worksheet. Both groups also used Spanish for most of their discussion of what to write down.

IMPLICATIONS

Given that this is a case study, it is uncertain whether the results can be generalized unless a larger study is conducted. However, implications for language education can still be drawn from the study:

- Language maintenance for the native/heritage speaker of the target language in a dual language continuation program may require additional attention and support. Alongside the classroom policy of speaking the minority language as much as possible, there appears to be a need for the development of instructional strategies that encourage native/heritage speakers of the target language as they speak the target language in class.
- Allowing the use of the majority language when discussing the meanings of words and translating between languages can be useful not only to students whose native language is the majority language but also to students who are native/heritage speakers of the target language, as suggested by Cummins (2012) and Mercuri & Ebe (2011). This may be especially useful when the content area is one that involves academic and content-specific language that is different from the everyday spoken language of home communities.

FUTURE ITERATIONS

Based on the case study and my observations during implementation, I propose some potential features of future iterations of the unit:

- support for native/heritage learners of Spanish in speaking • modeling or other types of scaffolding for students as they form
- predictions and hypotheses
- instruction in reading strategies for the background readings task The teacher proposes
- scientist journals with reflections, concept maps, drawings, and worksheet content, regularly turned in for teacher checks and feedback
- structured communication among the teams of researchers and sharing with the whole class
- a culture unit on Puerto Rico to precede the science unit



ACKNOWLEDGEMENTS

Ms. Rebecca Shearer, Spanish Teacher Mr. Doug Shearer, Science Teacher Hawthorn Middle School North The Learning Partnership

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