Curricular innovations: Teaching a multidisciplinary module on climate-driven migration in an advanced Spanish course

Innovaciones curriculares: la enseñanza de un módulo multidisciplinario sobre migración impulsada por el clima en un curso avanzado de español

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ABSTRACT
In the past decade, both the Modern Language Association (MLA) and the American Council on the Teaching of Foreign Languages (ACTFL) called for curricular changes that better integrate languages and cultures, advocating for multidisciplinary work with the intent to broaden learners' linguistic and cultural skills as well as regional expertise. It is in this spirit, and to engage language through content, that the authors embarked on the design of a multidisciplinary teaching module in an advanced Spanish course to explore the links between climate shocks and human migration in México and Central America. At the beginning of the article, the authors discuss the theoretical and pedagogical frameworks of this curricular redesign. Afterward, a description of the curricular components is presented. Results from both quantitative and qualitative data indicate that students were able to advance content knowledge from other disciplines while developing their linguistic skills in Spanish.

Keywords: multidisciplinary approaches to teach L2, content-based instruction (CBI), climate-driven migration.

RESUMEN
En la última década, tanto la Asociación de Lenguas Modernas (MLA) como el Consejo Americano para la Enseñanza de Lenguas Extranjeras (ACTFL) impulsaron cambios curriculares para integrar mejor las lenguas y las culturas, abogando por el trabajo multidisciplinario con la intención de ampliar las habilidades lingüísticas y culturales de los estudiantes, así como el conocimiento regional. Bajo este espíritu, y para fomentar la adquisición de la lengua a través del contenido, los autores se embarcaron en el diseño de un módulo de enseñanza multidisciplinario en un curso avanzado de español para explorar los vínculos entre los choques climáticos y la migración humana en México y Centroamérica. Al principio del artículo, los autores discuten los marcos teóricos y pedagógicos de este rediseño curricular. Posteriormente, se presenta una descripción de los componentes curriculares. Los resultados de datos cuantitativos y cualitativos indican que los estudiantes fueron capaces de avanzar en el conocimiento del contenido de otras disciplinas mientras desarrollaban sus habilidades lingüísticas en español.

1. INTRODUCTION

In 2007, the U.S. Modern Language Association (MLA) Executive Council established the Ad Hoc Committee on Foreign Languages with the objective to (1) transform academic programs, and (2) make translingual and transcultural competence the center of language teaching. The MLA committee report called for a broader, more coherent curriculum in which culture, language, and literature are taught as a whole and supported by alliances with other disciplines. This proposed transformation of academic programs advocated broadening learners' linguistic and cultural skills as well as regional expertise. The World-Readiness Standards for Learning Languages (National Standards Collaborative Board, 2015) in the U. S., underscored the need for learners to understand the relationship between products, practices, and cultural perspectives. This approach to language intentionally highlights the interplay between language and culture in order to develop intercultural communicative competence. The Council of Europe (CoE) guide for educators (Council of Europe, 2018a) recognized intercultural dialogue as a basic condition for social cohesion and social justice. The MLA, CoE, and the American Council on the Teaching of Foreign Languages (ACTFL) emphasize the importance of learning a second language (L2) that is not divorced from its culture. Therefore, the L2 has both personal and professional value, as it leads to greater understanding of people with other ways of living and thinking (Wagner, Cardeti and Byram, 2019). An L2 is never learned in a vacuum, but rather in a particular context that gives meaning to that L2. With that mandate, the authors collaborated on the design of a multidisciplinary teaching module in an advanced Spanish course to explore the relationship between climate shock events, identity, and human migration from México and Central America to the United States. This transversal approach to L2 teaching is thus in line with guidelines in both the United States and the European Union.

In the context of the MLA and ACTFL revisions, foreign language educators have seen an increasing call for curricular changes in the Spanish language (Brown and Thompson, 2018). Recent studies have shown that the diverse demographics of the United States (Fry and Lopez, 2012; Roberts, 2008) and the growing presence of heritage learners of Spanish in postsecondary education necessitate a change in the curricula (Brown and Thompson, 2018; Snow, 2017). In Europe, the growing number of asylum-seekers and refugees put into question the meaning of social cohesion. In response to this situation, the Council of Europe (2018b) has created a *Reference Framework of Competences for Democratic*

Culture (RFCDC) in order to underscore the importance of intercultural communication, which is at the heart of language education. Spanish programs are feeling the tension between the traditional approaches of teaching Latin American and Spanish literature in favor of those that focus on cultural studies (Brown and Thompson, 2018). Furthermore, within the field of Second Language Acquisition (SLA), there is a need for transdisciplinary instruction that goes beyond the mere collection of discipline-specific findings and shows how content and language are related (Douglas Fir Group, 2016).

Spanish-language programs are in a unique position to introduce contemporary and relevant topics in their curricula by adopting content-based instruction (Glisan and Donato, 2012; Grabe and Stoller, 1997; Larsen-Freeman, 2018; Met, 1998; Snow, 2001; Stoller, 2002; 2006). The link between climate shocks and human migration in México and Central America is an example of a meaningful topic to explore in an L2 classroom. Incorporating this topic could improve learners' linguistic skills by engaging them in new material that develops them cognitively. They are offered the chance to use Spanish to express complex ideas and acquire new and discipline-specific vocabulary in the target language. It also provides students with a space where they can critically examine the heterogeneity of both home and target culture. This approach breaks with mono-dimensional and homogeneous presentation of cultural perspectives, practices, and products, which is what some language textbooks present, even at the university level (Canale, 2016; McConachy, 2018).

Content-based instruction can be attained through the careful implementation of Project-based learning (PBL) (Barrett and Woods, 2012; Blumenfeld et. al., 1991; Kahl, 2008; Krajcik and Blumenfeld, 2006; Lathrop and Ebbett, 2006; Stoller, 2002; 2006; Stoller and Myers, 2020). More than simply integrating projects into the classroom, PBL instruction maximizes opportunities for students to make meaningful connections to the second language, while increasing content knowledge through authentic experiences. PBL instructors achieve greater success when they take time to identify an appropriate project theme and scaffold activities to complete the final product. PBL tends to work well with themes that are relevant to the students or the greater community. The themes must have sources, whether print or digital, readily accessible to the students. Then, PBL instructors must allow students time to gather and examine newfound material before displaying the final project. Finally, PBL instruction is most successful when both the instructor and student reflect on the learning and project. More than simply integrating projects into the classroom, PBL instruction maximizes opportunities for students to make meaningful connections to the second language, while increasing content knowledge through authentic experiences. PBL instructors achieve greater success when they follow a five-step framework (Stoller and Myers, 2020).

This article describes and evaluates a curriculum redesign module that teaches language through the lens of a multidisciplinary topic: climate-induced migration. The authors begin by discussing the theoretical and pedagogical frameworks of the curricular redesign and how it facilitates the development of intercultural competence. Afterward, a detailed description of the curricular components is presented, with a focus on both the learning objectives for those components and the methodology for delivering content in the L2 language. The authors present quantitative, empirical results from an assessment survey instrument given to students both before and after the delivery of the curricular content. The empirical results are complemented with qualitative data from a reflection piece in which students provided open-ended thoughts on what they learned. Results from both quantitative and qualitative assessment data indicate that students were able to advance content knowledge from other disciplines while, at the same time, developing their

linguistic skills in the target language. The authors conclude the article with an evaluation of this curricular redesign and offer pedagogical recommendations for future multidisciplinary work between language professionals and subject matter experts in the L2 classroom.

2. THEORETICAL AND PEDAGOGICAL FRAMEWORKS OF THE CURRICULAR REDESIGN

The theoretical and pedagogical frameworks of this curricular redesign come from Content Based Instruction (CBI) (Met, 1998), also called Content-and-Language Integrated Learning (CLIL) (Coyle, 2007). Major support for CBI comes from second language acquisition (SLA), in particular, from three scholars: Krashen, Swain, and Cummins. Krashen's comprehensible input hypothesis (1982, 1985) provided an early rationale for the development of CBI in second language contexts. CBI was originally associated with immersion programs developed in Canada during the 1960s. The University of Ottawa offered programs for second and foreign language learners, emphasizing the importance of comprehensible input for L2 development and L2 content learning (Snow, 1993; Wesche, 1993). Swain formulated the output hypothesis (1985, 1988; Swain and Lapkin, 1995), which states that learning takes place when learners encounter a gap in their linguistic knowledge, notice it, modify their production, and respond to feedback. She strongly argued that in order to develop L2 proficiency in writing and speaking, it is important to explicitly focus on productive language skills. Her research had great impact on the Canadian immersion programs and beyond. Furthermore, the relationship and integration of form and content in L2 teaching has been the focus of many discussions (Garrett, 1991; Lightbown and Spada, 1994; Swain, 1995; Tarone and Swain, 1995). The main argument raised in these studies is that both form and meaning (content) are important and not readily separable in language learning. Moreover, all meaningful language communication combines formal accuracy and relevant content.

Finally, theoretical support from second language learning for CBI comes from Cummins' (1984, 1989) notion of Cognitive Academic Language Proficiency (CALP). He argues that many students learn basic interpersonal communication skills fairly quickly. These skills alone, however, are not sufficient for students to succeed in academic learning contexts. This is where CBI can make a difference, and is the most effective way in developing CALP skills because this framework delivers more complex and authentic content.

Researchers are generally in agreement about the effectiveness of CBI. Particularly, Grabe and Stoller (1997) have posited four research-based findings that support the use of CBI for language educators: (1) learners are immersed in the target language and acquire it while they engage in meaningful interactions; (2) learners have the opportunity to receive comprehensible input and negotiate meaning while interacting with their peers and the instructor; (3) learners are challenged cognitively to express complex ideas and to complete authentic tasks; and (4) learners make meaningful connections to related information by working through a coherent content. All of these serve to foster a better learning process. ACTFL has endorsed CBI as a research priority (Glisan and Donato, 2012), and recent work by Larsen-Freemann (2018) identified CBI as "an obvious growth area" for the next few years. However, CBI and CLIL have not always been associated with language education. Traditionally, the discipline specialist teaches content, for example, science in

the target language. The discipline specialist has enough proficiency to deliver the content and ensure that learners acquire the necessary knowledge and skills. In the case presented here, it is the language professor who is team-teaching content drawn from other content areas, cooperating in a multidisciplinary setting with colleagues from history and climate science. The chosen content (climate-driven migration) is challenging, relevant to the students' lives, and sometimes difficult and sensitive to discuss. Working with this complex and multidimensional content is critical for the language classroom because students learn to explain their own thinking in the target language, learn appropriate ways to share their new acquired knowledge with others, and discuss among their peers making comparisons and interpretations so they can learn from each other. These kinds of classroom projects have proven to be an effective way to approach such learning goals.

2.1 Project-based learning in the L2 classroom

Language practitioners who use CBI usually struggle to balance content-specific delivery and focus on the target language. As discussed in section 1, language educators have looked at project-based learning (PBL) in order to alleviate some of those concerns and to integrate discipline specific content and L2 learning. Stoller (2002, 2006) and Stoller and Myers (2020) worked in the integration of content and L2 learning, and as a result of her research in this area, she offers three additional benefits of using PBL in the context of L2 learning: (1) PBL fosters L2 learning by engaging learners in projects that require them to use their L1 and L2 in meaningful ways, including using both to complete a number of complex tasks; (2) learners are pushed to use all four skills (listening, reading, speaking, writing) in their L2 at different levels of complexity inside and outside of the classroom; and (3) learners work collaboratively and construct knowledge through exploration and interaction with their peers. This promotes autonomy, interaction with others who may hold different points of view, as well as development of cognitive skills. There is also a significant body of scholarship in the sciences that highlights the value of PBL. Blumenfeld et al. (1991) conclude that PBL is a comprehensive tool for classroom teaching and learning that engages students in investigation of authentic problems, thereby sustaining both their motivation and their critical thinking. Lathrop and Ebbett (2006) note it is important to use PBL to engage students in critical thinking activities. They argue such activities help students retain information they learn in the classroom. Kahl (2008) argue that "application learning" should be one of the standards for student engagement, and Krajick and Bluemfeld (2006) report that the cognitive structure of deep, conceptual understanding can come from engagement in PBL, allowing students to "learn by doing." Barrett and Woods (2012) show that teaching strategies that incorporate PBL, and particularly PBL activities that are multidisciplinary (Barrett, Moran and Woods, 2014), have a significant impact on learning for both secondary and post-secondary students. This model applies in the L2 classroom as well: students learn language via PBL as they apply their cognitive skills and engage both their L1 and L2 in new and meaningful ways to complete complex tasks.

The authors of this current study designed a multidisciplinary module using a PBL approach. PBL has proven to promote cross-disciplinary collaboration that benefits students and promotes learner autonomy (Tatzl et al., 2012). Additionally, PBL is a comprehensive, enriching pedagogical approach that can better engage and empower students by developing academic skills such as planning, researching, analyzing, synthesizing, producing, and reflecting, all while developing language and content knowledge. Research

on PBL suggests that participating in projects can build decision-making skills and foster independence while enhancing cooperative work skills, challenge students' creativity, and improve problem-solving skills (Beckett and Slater, 2018). Additionally, PBL is a student-centered approach that offers students opportunities to learn and produce language creatively and work collaboratively. Learners focus on what they are interested in (Alan and Stoller, 2005; Habók and Nagy, 2016), and apply the target language -in this case Spanish- in a professional context.

The authors used what Wiggins and McTighe (2005) call "backward design", that is, they discussed and agreed upon the goals and objectives of the unit before they started working on the overall design. The main focus of this multidisciplinary module was to teach Spanish through the lens of a multidisciplinary topic: climate-induced migration. A team of three Naval Academy professors redesigned the seminar "Latinos in the U.S." to include this multidisciplinary module, taught in Spanish, that addresses issues of migration and climatic shock events. Furthermore, the module was enriched by themes from data science (with financial support from the Office of Naval Research; ONR), which students learn and use in other courses at their institution. By linking migration with climate and data science, the module thus aligned well with the institution's mission to graduate cross-culturally adaptable naval officers. Moreover, the institution is presently embarking on an ambitious goal to develop data science skills at various points in the four-year curriculum. By connecting L2 language students to this data science movement through the lens of Spanish instruction, the authors' module aligns well with the specific language-learning goals of the seminar course, the MLA, and ACTFL, and the broader learning goals of the institution.

The main objective behind incorporating this module in the Spanish-language classroom was to improve learners' linguistic skills by engaging them in new and relevant content, cultural perspectives, practices and products (McConachy, 2018). In this manner, students were offered the chance to use Spanish to express complex ideas and acquire new and discipline-specific vocabulary in the target language.

2.2 Curricular components for the multidisciplinary module

Since winter 2016-2017, U. S. Naval Academy (USNA) professors from different disciplines (applied linguistics, climate science, and history) have been working to explore the links between, and consequences of, climate shocks and human migration. This multidisciplinary project emerged from their shared interests to understand the many dimensions of the complex climate-migration question, and to fill an existing gap in both scholarship and pedagogy on migration. Indeed, the existing academic literature on migration draws largely from the social sciences (Durand, Massey and Pren, 2016; Rumbaut and Portes, 2001; Young, 2015). However, there is now literature emerging that suggests a link between migration and climate shock events (Feng and Oppenheimer, 2010; Nawrotzki and DeWaard, 2016). Moreover, the decision to migrate usually takes place at the household level, which contributes to substantial variation across regions and populations (Suárez-Orozco, 2019). Migration is thus a multicausal phenomenon, benefitting from an integrated methodological approach using both quantitative and qualitative methods. This project has created new opportunities to conduct joint research with undergraduate STEM students (Peart, Crawford and Barrett, 2019), who currently rarely come to understand the deep connections between the humanities, social sciences, and their own field of inquiry (Wagner, Cardetti and Byram, 2019). This gap is what motivated the creation of this module, in the hope that students will develop boundary-crossing skills that enable them

to integrate knowledge of several disciplines to achieve cognitive understandings in their L2 that go beyond single disciplines.

In order to determine how to design the multidisciplinary module, the authors considered several questions. Answering them guided the authors' work and helped them determine the topics to include, the strategies to use in delivering the content, and how to engage students in complex discussion using exclusively Spanish:

1. What type of tasks do we want students to perform?
2. What type of texts do we want them to interact with in this module?
3. What is the students' current ability to perform discipline-specific tasks and comprehend and/or deliver discipline specific products?
4. What type of linguistic support might students need in order to work with discipline-specific content?
5. How will we three specialists collaborate?
6. What type of tasks will serve as building blocks of this multidisciplinary unit?

During the pedagogical development, the professors used what in language education are called "essential questions" (McTighe and Wiggins, 2013), which are: (1) open-ended; (2) thought provoking and intellectually engaging because they spark discussion, questions that call for (3) higher order thinking, favoring analysis, inference, evaluation and prediction; (4) questions that point to cross-disciplinary or transferable ideas; and (5) questions that spark further inquiry. Essential questions are useful tools that help students to connect each perspective with the bigger picture that the module was trying to present. Additionally, these types of questions foster critical thinking, and the inclusion of knowledge from different disciplines.

The main goals of each of the tasks designed by the professors was to support students' linguistic development, while at the same time offer them the opportunity to (1) delve into questions about climate driven migration that focus on increasingly complex and nuanced aspects of this phenomena as module develops (2) evolve their understanding with small group and whole class discussions, and (3) show their understanding through different products such as written reflections, research projects, and oral presentations.

Once the main topic was discussed and the authors agreed on the general objectives for this multidisciplinary module, the instructor of the course identified the best place to incorporate this module within the existing schedule of the course. It was decided that the authors would teach four classes (an introduction to the module plus three additional class periods). Finally, the module would end with the presentation of students' research on a particular topic of their choosing from a list of four given by the team of professors:

1. Migration and the Dry Corridor
2. Migration and water scarcity
3. Migration and water abundance
4. Migration and hurricanes

The multidisciplinary module was taught completely in Spanish for a total of six days spanning two calendar weeks. The seminar was taught on Mondays, Wednesdays, and Fridays for 50 minutes, and all classes were designed by the authors. All three authors were present at all times and actively participated in each class. In the first class period, the authors introduced the module and presented the main tasks and objectives to the students. Then, for the next three class periods, each author led a content presentation and class discussions, thereby bringing their own disciplinary perspective to the class to look at migration from a particular lens. In the final two class periods of the module, the students delivered an oral presentation about their research. The main objective of these

presentations was for students to integrate relevant content on migration, history, climate and identity. A number of sources were provided by the authors for each topic, and students were instructed to expand upon the initial number of sources given to the students. In the last portion of their presentations, students were asked to propose a research project and describe (1) what type of research they would conduct; (2) what type of data they would use and how they would analyze it; and (3) what challenges they might encounter in this proposed project. Students were assessed with a rubric designed by the professors that was introduced to the students the first day of class. A total of four student teams delivered oral presentations (three teams of three students each, and one team of two students) on the four topics listed above. Students presented their findings for approximately 15-20 minutes using PowerPoint, and all presentations were given in Spanish.

3. METHODOLOGY

3.1 Context

Students at the U.S. Naval Academy are accepted for admission after undergoing a rigorous application and nomination process; during their second year, they commit to serving a minimum of five years as military officers in exchange for their education. The student body is approximately 60 percent non-Hispanic white and more than 70 percent men (U. S. Naval Academy, 2019). Spanish is not offered as a major subject, but is offered as a minor.

This multidisciplinary module offers advanced Spanish learners the opportunity to collaborate and think creatively about a pressing problem of our time, helping students who will be future officers in the U.S. Navy and Marine Corps gain greater regional expertise. Moreover, due to the heavy emphasis on science and engineering at the institution (e.g., all students, regardless of major, must complete two courses in chemistry, three in calculus, two in physics, and three in engineering), a multidisciplinary module of this nature can help them see the content with a new perspective that integrates humanistic concerns about migration and scientific, data-driven analysis of climatic shock events.

3.2 Participants and course

Table 1 summarizes the characteristics of student participants in the study. A total of 11 advanced learners of Spanish (3 males and 8 females) participated in the study. None of the participants was more than 25 years old. A total of five students were STEM majors (mathematics, quantitative economics, computer science, physics, and mechanical engineering), five were humanities majors (two in Arabic, one in English, and two in political science), and one was undeclared (an exchange student from another institution). A total of four students were heritage language learners (HLL), and seven were second language learners (SLL). All of the students were enrolled in a 400-level (the most rigorous of course levels numbered from 100 to 400) seminar entitled "Latinos/as in the United States." Students were placed at this level through a combination of a placement test and successful completion of prerequisite course work.

Number of students	Eleven: 8 females and 3 males.
Student age	None more than 25 years old.
Student majors	Five in STEM fields (mathematics, quantitative economics, computer science, physics, and mechanical engineering). Five in humanities (two in Arabic, one in English, and two in political science). One undeclared.
Heritage language status	Four heritage language learners (HLL). Seven second language learners (SLL).

Table 1. Characteristics of student participants in the study.

The course focused on the historical forces pushing and pulling people from Latin America to the United States. Furthermore, it also examines how "Spanish," "Latinxs," "Hispanics," "Latinos/as" adjust, integrate, assimilate, resist, and adapt to the many forces that affect their lives in the U.S. over the last century and a half, creating new ethnic, racial, and local identities in the process. Throughout the semester, students were exposed to the experience of Latinos/as and Latin American immigrants, with an eye toward patterns of second-class citizenship, identity formation, ethnic culture, community maturation, labor struggles, and social mobility. Through the problematization of migration, this course explores how issues of mobility had and still have an impact on both the Spanish and English languages. The course addresses many of these issues through a variety of texts, films, current events, and guest speakers. Students took this course for primarily two reasons: pursuit of a Spanish minor and continued mastery of the Spanish language.

The multidisciplinary learning module focused on immigration and built on prior topics covered in the course: the Spanish spoken in the U.S., its historical presence, relevance, current impact and the relationship between this linguistic variety and the linguistic variations spoken in Latin America. HLL students were able to explore their family history, and better understand their own bilingualism. Both SLL learners and HLLs bring to the course a variety of skills that complement each other. This diverse classroom offers the opportunity to collaborate, where students can integrate their own family history and connect it with the content in a meaningful way. Moreover, it can also bring empathy to SLL learners about the cultural diversity and contributions of Spanish-speaking migrant communities in the United States. Finally, it gives students the opportunity to establish new connections between their major, the language they are learning, and Latin America. Additionally, with a wide range of majors in this class, students had the opportunity to collaborate and understand their peers' different perspectives.

3.3 Assessment instruments

Two formal instruments were used to assess student learning as a result of participating in the module. In the first, quantitative instrument, the authors asked students to respond twice to a Likert survey instrument: once before the start of the learning module, and once at the end of the module. The instrument contained 13 statements (Table 2), and students were asked to read and respond to each of the statements (by circling a number) according to the following scale: 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, and 5 = strongly disagree. The questions in the instrument were designed to assess their understanding of key elements that were covered during the learning module: migration, climate, history, Latin America, and data science. This assessment was delivered in English,

which is the language of instruction of all courses at the institution, with the exception of foreign language courses.

Differences between student responses to the survey instrument before and after the module quantified their learning as a result of participating in the module. The authors used two methods to report the quantitative assessment results: the first method was to calculate, for each student and each question, the difference between the post score and the pre score (here, the difference was calculated as "post minus pre"), and report the average of those differences for each of the 13 questions. This calculation is referred to hereafter as "average change." The second method was to calculate the "normalized gain," c (Figure 1), following the method of Marx and Cummings (2007) adapted for a Likert scale from 1 to 5 with 1 being "high" and 5 "low," for each student and each question: where "post" and "pre" are the paired Likert responses in the post-module and pre-module survey for each student. In the calculation, when scores were already at the upper or lower limit and did not change between surveys (i.e., a student indicated "strongly agree" for a question in both the pre- and post-module survey), those scores were dropped from the calculation. Normalized gains c for each student were then averaged for each question, with the results interpreted as small ($c < 0.3$), medium ($0.3 < c < 0.6$), and large ($c > 0.7$), following Hake (1998).

1. I have learned about climatic shock events in the past.
2. I have learned about climatic shock events and their effects in Latin America.
3. I know the difference between climatic shock events and climate variation.
4. I have studied the links between migration and climatic shock events in the past.
5. I have learned about the patterns of migration from Mexico to the U. S.
6. I understand the patterns of migration from Mexico to the U. S.
7. I understand how migration patterns from Mexico to the U. S. have changed over time.
8. I understand how weather/climate has affected México.
9. I understand how weather/climate can potentially affect other areas in Latin America.
10. I have studied how language is related to identity.
11. I understand how language is related to "place" and "identity."
12. I have used data and data science to help me understand migration.
13. I understand how data and data science are connected to migration.

Table 2. Quantitative assessment instrument.

$$c = \begin{cases} \dfrac{post - pre}{1 - pre} & post < pre \\[2ex] drop & post = pre = 1 \text{ or } 5 \\[2ex] 0 & post = pre \text{ (and not 1 or 5)} \\[2ex] -\dfrac{post - pre}{pre} & post > pre \end{cases}$$

Figure 1. Procedure to calculate normalized gain, c.

In the second, qualitative instrument, students were asked to respond freely to the following prompt: "¿Qué has aprendido en este módulo?". This assessment prompt was given in Spanish. Ten of the 11 students in the course answered the question (one student was absent on the day of the assessment), and all ten of the students who responded to the assessment did so in Spanish, thereby providing data on both content and lingusitic skills on how to articulate the new content in the target language.

Finally, following Nekrasova-Beker and Becker (2017), the authors used formative and summative assessments to evaluate this learning module. Formative assessments are used to collect information about the learning process, in this case the Likert-scale assessment and the free response assessment. Summative assessments are used to determine achievement at the end of instruction, in this case a final oral presentation. Additionally, PBL can be assessed directly, that is measuring, and observing students' knowledge. In this learning module, the final oral presentation is an example of direct assessment. The final oral presentation was assessed using a scoring rubric (see Appendix I), and all presentations were assessed by all three professors. On the other hand, the Likert-scale assessment and the free response assessment are examples of indirect assessment, where students' attitudes and reflections about their own learning experience were obtained via free response.

3.4 Procedures

Students were asked to complete a formal consent form acknowledging that they agreed to voluntarily participate in this study and that neither their participation nor their results would affect their semester grade. All the students agreed to participate and completed all the activities, which were part of the course. Afterwards, students were asked to read and respond to each of the 13 questions in the quantitative Likert survey instrument. They were told that their participation in the survey was optional. They indicated their level of agreement with each statement by circling their response. Student responses before and after the module were then matched, and all students (n = 11) participated in both portions of the quantitative assessment. Students took approximately 10 minutes to complete each survey. For the qualitative assessment, students were asked to respond freely to describe what they learned. As with the quantitative assessment, students were told that their participation in the qualitative instrument was optional. Students took approximately 15 minutes to complete the qualitative instrument, and ten students participated in it.

4. RESULTS

In this section, the authors present the results of the two assessment instruments: a quantitative Likert-scale assessment answered by students before and after the learning module and a qualitative free-response assessment answered by students at the conclusion of the learning module.

4.1 Likert assessment results

Scores on the Likert survey instrument (Table 1) tended to decrease in the post-assessment compared to the pre-assessment (Figure 2). This indicates that students agreed more with the statements after participating in the module than they did before participating in it. The

average change across all 13 questions was -0.77. Because the statements reflect knowledge about different subjects, a decrease in scores on the post-assessment compared to the pre-assessment indicates greater knowledge about the subjects. The average normalized gain (c) across all questions was 0.38 (Figure 3), which can be interpreted as a medium gain in knowledge as a result of participating in the module.
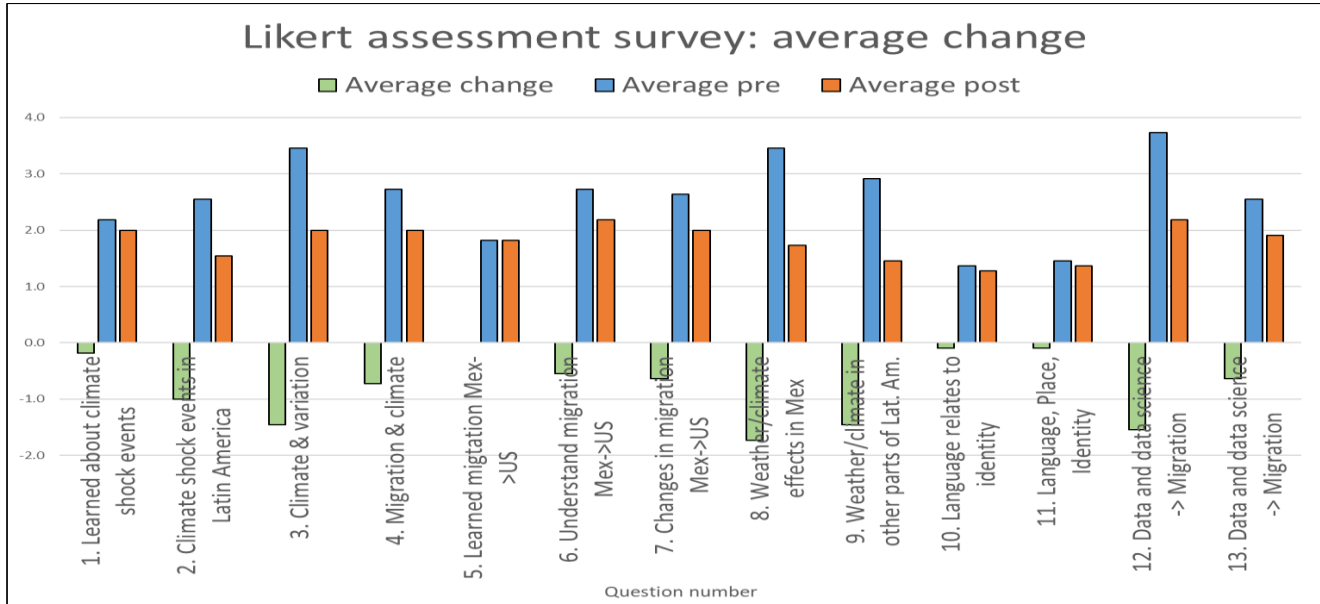

Figure 2. Results from the Likert assessment survey for each of the 13 questions administered before ("pre") and after ("post") the learning module (student population n = 11). A negative average change (post minus pre) indicates an increase in agreement with the statement after the module compared with before the module. Negative average change can be interpreted as showing student learning, with more negative average changes showing greater learning.
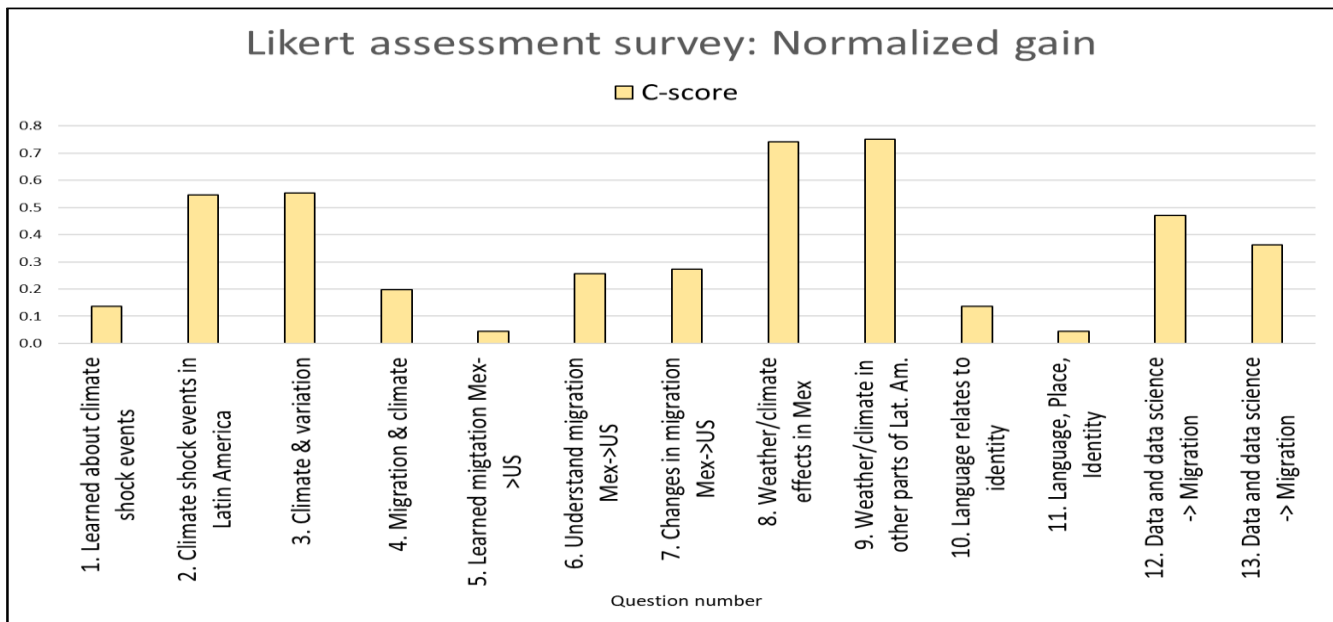

Figure 3. As in Figure 2, but for Normalized gain c for the post survey compared to the pre survey (see section 3.1.3 for details on how to calculate c).

The knowledge gains were not distributed evenly across questions. This indicates that students learned more in some content areas than others. For example, average change was most negative for questions 3, 8, 9, and 12 (-1.5, -1.7, -1.5, and -1.5, respectively), indicating that students learned the most about the differences between climate shocks and climate variation (question 3), the weather and climate impacts on Mexico (question 8) and other areas of Latin America (question 9), and the use of data science to understand migration (question 12). The average normalized gains indicate that students learned the most about how climate and weather affect Mexico (0.74) and Latin America (0.75); those scores convey large student knowledge gains in those content areas. Medium student knowledge gains were found for climate shock events in Latin America (question 2; $c = 0.54$), the difference between climate shock events and climate variability (question 3; $c = 0.55$), the use of data and data science to help understand migration (question 12; $c = 0.47$), how language is related to identity (question 10; $c = 0.38$), and understanding how data and data science connect to migration (question 13; $c = 0.36$).

Student knowledge gains were least pronounced for questions 1, 5, and 11, indicating that students learned the least about climate shock events (question 1), patterns of migration from Mexico to the U.S. (question 5), and how language is related to place (question 11). Average normalized gains for each of those questions were generally small ($c < 0.3$). The questions that showed the most learning (3, 8, 9, and 12) also had the highest Likert scores in the pre-module assessment, indicating that students may have entered the module with the least amount of knowledge on those topics. The questions that showed the least learning (1, 5, and 11) had the lowest Likert scores in the pre-module assessment, indicating that students may have entered the module with the most amount of knowledge on those topics.

Finally, it is worth noting that each student showed negative average change in Likert scores from before and after the module. That result indicates that each student individually showed knowledge gains as a result of participating in the module. Three of the 11 students showed gains more than -1.0, or a whole Likert category.

4.2 Free response assessment results

In addition to the quantitative assessment, student learning in this module was assessed qualitatively via a free response at the end of the module. Student answers to the prompt (summarized in Table 3) indicated that they learned about many topics ranging from climate, migration, identity, and research. Those topics were emphasized by the three authors during the module. Several themes seen in the qualitative assessment include: (1) a deeper understanding of the links between climate and migration, including an understanding that climate and climate shock events can be catalysts for the decision to migrate; (2) a deeper understanding of the connections between history, identity, and migration; (3) an understanding of the relationships between economics and impacts from climate shocks; and (4) new knowledge of the Dry Corridor of Central America. The learning module focused exclusively on the Americas, with examples from Mexico, Brazil, Argentina, Puerto Rico, Guatemala, Honduras, Nicaragua, Colombia and the U.S., and the qualitative assessment reflects student learning in those regions. Finally, one student mentioned that some concepts in the student's major discipline (oceanography) were reinforced in the multidisciplinary module (hurricanes and the El Niño phenomenon).

Student	Comments
1	Aprendí sobre la conexión entre el clima y la migración; sobre las dificultades de una región que experiencia un evento climático terrible; y como el clima afecta a la agricultura y la migración y las personas y su identidad.
2	Aprendí que es un "climatic shock event"; La conexión fuerte entre lugar e identidad; y el corredor seco.
3	Aprendí la conexión entre la ciencia y la migración; Ejemplos más concretos de migración (tipos diferentes de eventos naturales y su impacto); y cuáles son los países más afectados en Latinoamérica.
4	Yo no sabía del corredor seco y de los efectos del clima a la pobreza; aprendí como el clima afecta a la identidad; y estoy en una clase de oceanografía y en ese módulo aprendí cómo se relacionan los temas de migración y huracanes y el niño
5	Lo que yo encontré muy interesante fue el corredor seco; los países afectados son Honduras, Guatemala y El Salvador; nunca supe del TPS de Honduras y Nicaragua.
6	Aprendí cómo proponer una investigación de desastres y migración; los efectos del clima a la migración.
7	Aprendí de la investigación la intersección de la socioeconomía y la ciencia del clima.
8	Aprendí la gran conexión entre la migración y la lengua, y cómo los eventos del clima pueden totalmente cambiar la vida de una persona; los patrones de la migración y las sequías, especialmente en México.
9	Aprendí que los eventos climáticas son una de las razones más comunes para migrar; los eventos de "shock" afecta a la población indígena y de la clase baja de una manera desproporcionada; eventos como las sequías afectan más de un área; Hay un patrón de migración de áreas rurales a las ciudades.
10	Aprendí que las inundaciones son muy peligrosas y pueden desplazar a la gente; huracanes son peligrosos; el corredor seco está en Centroamérica.

Table 3. Qualitative assessment: student free-response answers to the prompt "¿Qué has aprendido en este módulo?" Ten of the 11 students in the module answered the prompt.

5. DISCUSSION

The results showed student learning in all of the content areas. Moreover, the results show that the learning occurred more in some areas than others. Largest gains occurred in topics related to differences between climate shock events and climate variation and weather and climate impacts in México and other areas in Latin America. Smallest gains occurred in topics about climate shock events, patterns of migration from México to the U.S., and how language is related to place and place attachment (Higgins, 2017). Students gained a deeper understanding about the relationship between climate and migration, and how climatic shock events can be an added factor that may have an impact on people's decision to migrate. Several students mentioned the dry corridor, the links between climatic shock events, migration, and Temporary Protected Status (TPS), and how mobility has a strong

impact on language and identity. It is important to note that all of these gains occurred in the Spanish language and reflect new vocabulary and context, alongside new content. Students also gained an understanding of the use and application of data science to migration, a skill that is relevant for not only both STEM and humanities majors but also for their profession as military officers. This new knowledge will help students communicate with others who may think differently, those who speak Spanish in Latin America, and become mediators for people that may not otherwise be able to communicate with each other (Wagner, Cardetti and Byram, 2019). Additionally, students were able to further develop academic skills that are highly transferable, such as planning and collaborating with a team and researching authentic and contemporary problems (Stoller, 2002, 2006). Furthermore, they were able to analyze, synthesize, and produce new content knowledge while developing their L2 (Tatzl et al., 2012)

Students at this institution receive information briefings about the "northern triangle" (Council on Foreign Relations, 2019) that emphasize poverty, drug and human trafficking. This module presented a more nuanced and complex perspective on this topic. The fact that the module was taught in Spanish provides students with the opportunity to decentering, leading to comparing the new knowledge acquired with other views on the same topic, questioning old paradigms. By seeing these topics through the lens of a different language and culture, students are able to re-think their own personal values and beliefs.

Quantitative and qualitative results show that students valued the inclusion of this learning module into the course as a means of developing their understanding of the connections between climate and mobility in Latin America. For questions with the least amount of learning, it is possible that students entered the module with prior knowledge about those topics. That possibility is supported by the "pre" survey data (Figure 2), in which student answers on questions about those topics indicated greater agreement (and thereby familiarity) than in other topic areas. In fact, patterns of migration from México to the U. S., and the relationship between language and place (language loss as a consequence of migration, for example), were topics explored before this module was introduced to the class. However, it is also possible that those topics were not taught as well, or emphasized as much, by the authors. Nevertheless, student scores on the "post" survey indicated that students left the module with knowledge about those topics.

6. CONCLUSIONS AND FINAL REMARKS

As a result of this module, the authors have reached the following conclusions. These conclusions can also be considered as suggestions for others interested in pursuing similar learning modules in the Spanish classroom.
1. Multidisciplinary collaborative teaching is worth pursuing. In this case, students in an upper-division Spanish elective course were exposed to new vocabulary and content in essentially four disciplines (applied linguistics, climate science, history, and data science) in a way that a single instructor skilled in only one of those disciplines would not likely be able to accomplish. Learners showed gains in all of those disciplines, and they gained a new perspective on the links between migration and climate shock events in Latin America. Moreover, via the free response instrument and oral presentations, students demonstrated a new understanding of the technical terminology in Spanish.

2. This multi-week learning module can fit in the general curriculum of many programs of study. Here, it is situated in an upper-level elective course in Spanish taken by students typically near the end of their undergraduate studies. The course is viewed by students as a fundamental part of the minor curriculum in Spanish and thus utilizes linguistic skills from earlier foundation courses as well as literary and cultural content from peer courses. The course is typically offered once a year and has an enrollment of between 10 and 20 students. Depending how the module is situated, the authors suggest it can fit into any upper-level Spanish course.

3. Even though it is worth pursuing, multidisciplinary collaborative teaching is challenging. The authors were fortunate to have partial funding from ONR to support their pedagogical developments, which they worked on during the summer months. Additionally, the authors had the support of their direct supervisors to try this new pedagogical redesign. Nevertheless, the structure of the institution resulted in only one of the three authors getting "credit" for the pedagogical innovation, meaning the other two authors worked to deliver the content in a manner above-and-beyond their other duties. Institutional support is thus crucial to foster cross-disciplinary collaborative, faculty development opportunities that advance their knowledge and lead to innovate, rich experiences for students and colleagues.

4. The traditional view of teaching each discipline (language learning, climate science, and history) in isolation is pervasive in academia, and hard to change. One of the secondary goals of the authors in pursuing this multidisciplinary collaboration was to demonstrate to our students that such work is possible, and thereby begin to change the institutional culture at the "grass roots" level.

5. Although PBL and CBI are critical for student learning, multidisciplinary PBL and CBI are less developed in Spanish classroom contexts. We believe this curricular innovation is an excellent example, supported by quantitative and qualitative assessments, to show the value of multidisciplinary PBL and CBI in the Spanish classroom. By being multidisciplinary, the module allowed students to communicate collaboratively with both a diverse set of instructors and a diverse set of peers. They were able to thus understand a complex problem (in this case, the links between climate and migration) and do so in the target language. Students worked collaboratively in teams and applied problem solving and decision-making skills to prepare for each task inside and outside of class. In an oral presentation, students developed their L2 skills by presenting new information and a novel research project to an audience delving into two of the most pressing problems of our times: migration and climate.

In this article, the authors have related a theoretical and practical curricular development in the Spanish language with other disciplines. Such a module represents a multidisciplinary paradigm that is gradually moving toward the development of an interdisciplinary and collaborative pedagogical approach to study a second language. In today's world, educators need to teach students how to collaborate to solve real problems. This module presents a model on how this objective can be accomplished in the L2 classroom by engaging and fostering communication with those who speak a different language, hold a different opinion or come from a different background.

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