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Latinx Culture, Music, and Computer Science Remix in a Summer Camp Experience: Results from a Pilot Study

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Abstract
Broadening participation of Latinx students in computer science (CS) is paramount in today's STEM educational landscape. Latinx represent the fastest growing population in the U.S. but remain under-represented in computer science. The *Remezcla* project was developed to tackle issues of broadening participation of Latinx students in CS through an informal learning program. The current paper describes the program components and provides evaluation results from the pilot summer program implementation, held virtually in Atlanta and Puerto Rico during the COVID pandemic. Preliminary evaluation results suggest these one-week summer camps were effective in impacting pre-post students' sense of belonging, self-efficacy, and intention to persist in computer science. Results reveal gender differences across several constructs with important implications for future studies.

Background and rationale

The word *"remezcla"*- the Spanish term for "remix"- encompasses the combination, manipulation and mixing of music or other cultural products in the creation of something new [1]. This idea also alludes directly to the concept of hybridization, which lies at the core of Latinidad and the essence of Latin culture, both musically [2] and culturally [3]. Remixing is considered not only a contemporary art form that cuts across multiple creative areas of the digital realm [1], but also an educational tool that provides a culturally authentic and creative form of engagement for students [4]. The benefits of remixing as an educational approach were central to the philosophy behind the creation of EarSketch, a music mixing software platform and educational curriculum [5]. EarSketch teaches students computer science coding through music remixing and has been shown in multiple studies to increase both students' computer science skills and their intention to persist in computer science [6]. However, despite EarSketch's previous successes, its benefits have been limited to English speakers, and the development of its music library has been influenced primarily by the cultural and linguistic inclinations of urban American youth.

Broadening participation of Latinx students in computer science (CS) is paramount in today's STEM educational landscape. Computer science has become a focus issue in STEM education, with scholars and national organizations emphasizing the need to encourage the development of computational thinking skills for all students in an increasingly digital and data intensive world [7]. However, these calls to action can't be successfully addressed without attending to the factors in our national educational system that contribute to the disparities in computer science participation [8]. In 2016, Latinos made up 17.8% of the U.S. population [9] but earned only 10.1% of bachelor's degrees in computer science [10]. By 2060, Latinos are expected to comprise 28.6% of the U.S. population [11]. This under-representation in computer science by the fastest growing population in the U.S. [12] is clearly a problem for our country's future workforce development and innovative diversity. Informal spaces constitute a significant area of opportunity for developing STEM interest, excitement and learning in underrepresented students, and broadening their participation and engagement in STEM. Students in the U.S. who learn science during out- of-school hours primarily do so through informal learning programs and spaces that are often designed using engagement strategies tailored to mostly white, middle-class students [13]. These informal STEM learning opportunities, including clubs, maker spaces, science festivals, TV shows and other media products, often lack practices that have been shown to be effective in engaging underrepresented ethnic, racial, and gender groups in STEM [14].

The *Remezcla* program was developed to address these issues by modifying the EarSketch platform to make it accessible and more culturally relevant to Latinx and Spanish speaking students and develop informal STEM learning programs in Atlanta and Puerto Rico designed with these students in mind. The current paper describes the program components, including the summer camp curriculum, and provides evaluation results from the pilot summer program implementation conducted during the COVID pandemic, in July of 2021.

Project Description

Reports from the National Research Council (NCR) [15] and the Center for Advancement of Informal Science Education (CAISE) [16] emphasize the need for programs that attend to the learning experiences of diverse students, by building on culturally responsive and community-focused practices. For Latinx students, educational best practices include, but are not limited to, attention to the complex issues of Latino identity, regional and cultural diversity, linguistic fluidity, the role of community and familial relationships, and the importance of considering asset-based thinking, agency and self-determination when establishing informal learning programs [17]. Curricula aimed at engaging Latinx students should be rooted in cultural connections, linguistic competence, and the validation of students' cultural funds of knowledge [18].

The goals of the *Remezcla* project are to tackle issues of broadening participation of Latinx students in CS by using a multi-pronged approach. First, we aimed to modify EarSketch, a successful CS outreach platform, and adapt it into a more linguistically accessible and culturally relevant learning tool for Latinx and Spanish speaking students. We also embarked on the process of developing, implementing, and assessing an informal learning curriculum that uses community narratives, storytelling, and other culturally authentic and relevant educational practices to engage Latinx students in learning to code by mixing music.

Curriculum Overview: During the first year of the *Remezcla* project, the curriculum team developed the first iteration of the program to be implemented during the summer camp in 2021. The curriculum was developed using best practices from the Culturally Relevant Education Framework (CRE) [19] and Culturally Sustaining Pedagogy (CSP) [20]. CRE is an inclusive model that encapsulates the tenets of culturally responsive teaching [21] and culturally relevant pedagogy [22] and has demonstrated effectiveness in helping students develop academic skills and concepts through cultural connections and engagement that lead to increased cultural competency, motivation, and affective gains [23]. Best practices from CRE suggest that curriculum developers and instructors be familiar with, and knowledgeable about, students' cultures and their complexity, and that opportunities exist for the students' previous experiences and funds of knowledge [24] to be brought in and integrated into the learning experience [25]. Culturally Sustaining Pedagogy has as its explicit goal supporting multilingualism and multiculturalism for students and teachers [26] and has previously been used to understand the experience of African American, Latinx and indigenous students navigating culture, language, and music [26].

The *Remezcla* curriculum provides authentic, fluid, culturally and linguistically rich opportunities for student engagement by establishing direct and constant connections to their cultures, communities and lived experiences. Students can bring in the sounds and voices of their communities and interweave them with music to tell stories about who they are. The opportunity for recording ubiquitous sounds and music and incorporating these funds of knowledge into their computational musical creations, provides a unique vehicle for students to connect powerful cultural and musical knowledge learned in their communities, families and cultural spaces into their computer science projects. Building on community knowledge has been documented to be a powerful conduit to engage students in culturally relevant STEM learning and broaden their participation in these fields [27].

The bilingual curriculum (created in both Spanish and English) leveraged EarSketch and enabled students to increase computational thinking skills through engagement in culturally relevant sound remixing activities. The curriculum aligned CSTA standards [28], culturally sustaining and culturally relevant targets [29], with EarSketch topics such as variables and makeBeat. The summer camp curriculum comprised of four scaffolded units that use broad challenges, such as Heritage Challenge; and small tasks, such as a Favorite Place, to build students' self-efficacy (see Table 1 for a sample of a curriculum sequence). It also offers an Ecological System's Theory overarching focus that helps students frame their challenges and themes at an individual, familial, and school/summer contexts first, and later expands to broader community topics [30].

Table 1: Sample of Summer Camp Curriculum Sequence and Standards

EarSketch Topics	Computational Thinking Targets [a]	Culturally Relevant Targets [b]	Mini-Task	Unit Challenge Project
Unit 2- Family & Friends				
Exporting music, challenge share & discourse	Describe code choices & outcomes: 1-AP-15			
Variables (unplugged & plugged)	Variables: 2-AP-11			
ReadInput and print	Events: 1B-AP-10	KO3B KO4A KO2C KO2E	When I hear this, I think of home	
Challenge intro (favorite friends remix), setEffect (pitchshift effect) and setEffect envelope (i.e. fade in and out)	Remix existing programs or add advanced features: 1B-AP-12	KO4A KO2C KO2E		Friends Remix Challenge
Storytelling part 1				

[a]CT denotes computational thinking targets as established by CSTA K-12 CS standards
[b]CR denotes culturally relevant/cultural sustaining targets as proposed by Kapor Center

Summer Camp Implementation: When the 2020-2021 school year ended, most local schools in Atlanta had returned to in-person learning whereas most schools in Puerto Rico remained virtual. Mindful of rising numbers of Covid cases, and its disproportionate impact on Latinx communities, both project teams decided to conduct the summer camps virtually and rely on community and local school partners, parent, and teacher liaisons, to help with recruiting participants for camp. Four camp programs (two camps at each location) were implemented in Atlanta and Puerto Rico. The first week of the camps (July 12th- 16th) was reserved for middle school students and the second week (July 19th – 23rd) for high school students. Over the course of the two-week period, 17 students in Atlanta and 39 students in Puerto Rico participated in these camps.

The summer camps in both locations implemented the same curriculum but structured the programming with some differences. For example, the camp times in Puerto Rico were roughly from 9-3pm, with an hour break for lunch. In Atlanta, camp were held from 9-12pm with drop-in office hours with the instructors from 1-3 pm. Due to students' language preferences, instruction in Atlanta was primarily in English and utilized the English version of the EarSketch platform, although one student used the Spanish version. In Puerto Rico, instruction was in Spanish and utilized the newly developed Spanish version of the EarSketch platform. One student, however, was more comfortable with English and an instructor provided English one-on-one support in a virtual breakout room.

The decision to virtually conduct the summer camps created technology challenges in both sites. In Puerto Rico, frequent power outages and lack of access to hotspots sometimes prevented students from engaging in sessions. Project team members made home visits to bring equipment as they were able. In Atlanta, students who did not have laptops at home attempted to participate in camp via a cellphone or tablet. Because EarSketch was not designed for mobile devices or tablets, these caused accessibility challenges, and these students withdrew from camp. The virtual nature of camp also enabled students to turn their videos off. This was more prevalent in Atlanta, making it challenging for instructors to determine the level of student engagement.

The first three units of the curriculum were implemented during the camp week and students worked on six EarSketch script activities. As added motivation, the camp ended with a virtual activity, the Remix Code and Music Jam, combining participants from Puerto Rico and Atlanta. Students' families and friends were invited to join camp participants and program staff, in a celebration where students shared some their musical creations, selected specifically for the event. The following section describes our evaluation methods and shares preliminary findings of this informal STEM learning pilot.

Methods

Participants and Procedures: Students who assented and whose parents also consented to participating in the research study were invited to complete three survey instruments. The three surveys (intake, pre- and post-) were administered during the summer camp during the first day (intake and pre), and last day (post). All surveys were administered online via Qualtrics, and students were given the choice to complete them in either Spanish or English. Table 2 shows the demographics of students participating in the summer camp pilot evaluation study.

Table 2: Demographics of Student Participants, Summer Camp 2021

Demographics		**Atlanta**	**Puerto Rico**	**Total**
Gender	Girl	8	16	24
	Boy	9	22	31
	Prefer not to say	0	1	1
Ethnicity	Puerto Rican/ Boricua	0	38	38
	Latin/ Hispanic	8	1	9
	Mexican/Mexican- American/Chicano	9	0	9
Grade	6	1	0	1
	7	6	6	12
	8	2	8	10
	9	2	6	8
	10	4	3	7
	11	2	13	15
	12	0	3	3

Instruments: Prior to implementation, a multidisciplinary team of bilingual researchers from Atlanta and Puerto Rico engaged in an exhaustive review of the existing literature and validated instruments that measured the constructs targeted by the research study. The instrument development and validation process was informed by best practices in translation, adaptation of cross-cultural instruments, and cultural equivalency [31] [32] [33]. See the Appendix, for a sample of survey items included in the instruments.

The intake survey consisted of 31 items, and included general demographic information questions, as well as questions about students' prior experiences with computing and music technology, music use and listening preferences. Pre and post surveys contained questions that explored students' perceptions with regards to various attitudinal, socio-cognitive, and motivational constructs. These constructs of interest, scales used, and sample items are as follow:

Perceived Threat/Cultural Congruity: Items were modified from the Perceived Threat Scale [34] to assess student's perceived threat associated to their identity and lack of cultural congruity. The scale was modified so that students selected from "Strongly disagree/agree" instead of "Not at all" to "A great deal." Students were asked to what extent they experienced feelings such as, "*I feel that I have to change myself to fit in at school*" and "*I often feel like a chameleon, having to change my colors depending on the culture of the person I am with*."

Identity Identification: This construct focused on students' perceptions of their collective identity, specifically those aspects of their self-concept that might relate to race, ethnic background, and feelings of belonging in one's community. These items were adapted from the Collective Self-Esteem Scale [35] and included three of the original MIBI-T seven subscales (centrality, private regard, and public regard). We used this scale with the purpose of exploring students' ethnic identity identification [36]. Because Latinx ethnic identity can be complex and varied, we developed an initial question to allow the students to self-identify ethnically (Latin/Hispanic, Puerto Rican/Boricua, etc.), they then answered follow-up questions related to that identity such as "*I have a strong sense of belonging to other _____ people*," and "*Most people think that ______(s) are as smart as people of other groups*."

Sense of Belongingness in Computer Science: Items were selected from the Sense of Social and Academic Fit (in STEM) instrument [37] and measured to what extent students felt included, valued and respected. We used this scale with the purpose of exploring students' sense of belongingness, specifically in CS, and modified the items to include "in computing." A definition of computing was also included, "*Computing is defined as doing things like making an app, coding, fixing a computer or mobile device, creating games, making digital music, etc.*" Sample questions then asked students to indicate the extent to which they agreed with statements such as, "*I feel comfortable in computing*" and "*Compared with most other students at my school, I know how to do well in computing*."

Self-Efficacy: Self-efficacy captures students' beliefs that they can accomplish designated tasks [38] related to computing and included sample questions such as asking to what extent students agree that "*I'm certain I can understand the ideas taught in computing courses.*" These items were modified from the Motivated Strategies for Learning Questionnaire [39]. We adapted the items to specifically ask students about their beliefs related to computing and used the same 5-point Likert scale (strongly disagree to strongly agree) as Matthews [40].

Intent to Persist: Items for this construct measured students' intent to persist, interest in computer science careers, and perceived relevance of computer science to future/future time and content. These items asked students to what extent they were interested in taking more computer science classes, interested in computer science careers *("I think I would enjoy a career in computer science")*, and the perceived relevance of computer science to their future or future time perspective ("*What I learn in computer science will benefit my future*"). The response scale for these items was modified as a 5-point Likert scale (strongly disagree to strongly agree). These items were selected from the BASICS Study Student Questionnaire Measures [41] and were used in prior EarSketch research.

Results

Students' Identity Identification and Perceived Identity Threat: Results related to students' identity identification revealed that students' scores on public regard (how they think others perceive people from their group) were lower than those for private regard and centrality (see Table 3). These results indicate that students may believe that the public sees their ethnicity as less intelligent and valuable than they do themselves.

Table 3: Pre-Survey Results for Students Identity Constructs

Construct	**Scale items (#)**	***n***	***M***	**Cronbach's alpha**
1. Identity Identification: Centrality	2	56	4.28	0.776
2. Identity Identification: Private Regard	3	55 to 56	4.62	0.812
3. Identity Identification: Public Regard	3	56	3.79	0.741
4. Perceived Threat	6	55 to 56	1.78	0.802

T-test comparisons between groups showed that students from Atlanta, girls, and those who identify as Mexican/Mexican- American/Chicano tended to have significantly lower scores on public regard, especially on the item *People from other groups think that ____ s have made important contributions.* That is, they have markedly lower levels of agreement with the perception that people from other groups valued their group's contribution to society, compared to students from Puerto Rico, boys, and those who identified as Puerto Rican/Boricua (See Table 4).

Table 4: Pre-Survey Results of Public Regard Scale by Location, Gender, and Ethnicity

Group		***n***	***M***	***p***	***d***
Location	Atlanta	17	3.53	0.049	0.607
	Puerto Rico	39	3.74		
Gender	Girl	24	3.58	0.019	0.666
	Boy	31	4.26		
Ethnicity	Mexican/ Mexican-American/ Chicano	9	3.11	0.014	1.138
	Puerto Rican/ Boricua	37	4.14		

Results from the perceived threat scale for all students were relatively low (see Table 3, $M =$ 1.78), indicating that overall, students seem to experience cultural congruity or feel their ethnicity is not incompatible with the larger social context they participate in. However, as in the case of identity identification, results indicate there are differences in students with regards to location, gender, and ethnicity. That is, compared to students from Puerto Rico, Atlanta participants report higher levels of perceived threat for all items, although not significantly so; and boys experience significantly greater threat as a result of their ethnicity as measured by the item *I try not to show the parts of me that have to do with my culture* (*M* boys = 2.27; *M* girls = 1.33; $p = .015$, $d_s = .67$). This suggests that boys can be at a higher risk of being under ethnicity-related perceived threat, which may manifest itself in learning settings in unique ways.

The remaining three constructs explored (Sense of Belonging, Self-Efficacy, and Intention to Persist) were measured at both pre and post. We conducted both paired and independent significance tests which showed significant pre to post changes on all constructs with one exception. The independent pre-post T-test for Intention to Persist was not significant; however, the paired T-test showed a pre-post increase in Intention to Persist ($M_1 = 3.62$, $M_2 = 3.74$; $p = .05$*, $d_s = .13$). Our findings suggest that overall, students had greater Sense of Belonging in computing ($M_1 = 3.18$, $M_2 = 3.40$; $p = .00$*, $d_s = .20$) and Self Efficacy in computing ($M_1 = 3.62$, $M_2 = 3.87$; $p = .00$*, $d_s = .28$) at the end of the camp, than at the beginning.

A closer analysis of the pre/post responses to Sense of Belonging shows that Atlanta students showed no significant gains on individual items, whereas Puerto Rico students did have significant gains on items such as *I belong in computing* ($M_1 = 2.76$, $M_2 = 3.54$; $p = .00$*, $d_s = .63$) and *Compared with most other students, I get along well with people in computing* ($M_1 = 2.97$, $M_2 = 3.76$; $p = .0$*, $d_s = .83$). Girls showed significant gains on items such as *I feel comfortable in computing* ($M_1 = 3.60$, $M_2 = 4.25$; $p = .00$*, $d_s = .87$) and *I think in the same way as do people who do well in computing* ($M_1 = 2.85$, $M_2 = 3.50$; $p = .00$*, $d_s = .74$) compared to boys. On the other hand, boys showed significant gains on *Compared with most other students at my school, I am similar to the kind of people who succeed in computing* ($M_1 = 3.04$, $M_2 = 3.42$; $p = .02$*, $d_s = .48$) and *Compared with most other students, I get along well with people in computing* ($M_1 = 3.35$, $M_2 = 3.81$; $p = .0$*, $d_s = .47$) while girls did not. For girls, feeling comfortable and confident in their thinking seem to be important sources of belonging, while for boys these lie on their identity and perception that they are similar and have positive interactions with others in computing. When we consider the gender numerical composition of the CS field in both the educational pipeline and the computer science industry, these findings could suggest that boys and girls might rely on different strategies for engaging in CS and negotiate their identities within the field.

With regards to Self-Efficacy, overall construct significance was driven by three items: *Compared to other computing students, I think I'm a good student*; *My study skills in computing are excellent compared with others*; and *Compared with other students, I think I know a great deal about computing*. A closer analysis shows that girls and boys scored significantly higher on the pre-post item: *My study skills in computing are excellent compared with others.* However, only boys reported significant gains from pre-to-post on *Compared with other computing students, I think I'm a good student* ($M_1 = 3.31$, $M_2 = 3.77$; $p = .01$*, $d_s = .54$) and *Compared with other students, I think I know a great deal about computing* ($M_1 = 2.58$, $M_2 = 3.12$; $p = .03$*, $d_s =$

.45). These findings suggest that while both genders are confident in their computing studying skills, this confidence does not translate into other broader beliefs for girls. Therefore, gender differences in perceptions of competency should be explored more in depth, so we can properly support girls as CS students. Lastly, analysis of the Intention to Persist scale shows overall pre-to-post increases. Specifically, we see significant pre-to-post increases on the item *I think I would enjoy a career in computer science* ($M_1 = 3.40$, $M_2 = 3.74$; $p = .01$*, $d_s = .39$) for all students. However, a close analysis suggests that these gains are largely driven by girl student responses ($M_1 = 3.25$, $M_2 = 3.75$; $p = .01$*, $d_s = .66$).

Discussion and conclusions:
Preliminary evaluation results from our study suggest that the *Remezcla* one week summer camp was effective in impacting students' sense of belonging, self-efficacy, and intention to persist in CS. Results also show the presence of some interesting gender differences with regards to the source of sense of belonging and self-efficacy. Girls demonstrate higher levels of intention to persist at the end of the program compared to boys. However, boys seem to be at a higher risk for ethnicity-related perceived threat.

This study, while it constitutes a pilot program evaluation is still limited in some important ways. The overall sample size is small (especially for the Atlanta cohort) and there are differences in sizes at each location that can impact our inferences. For example, results showed that significance for sense of belonging and self-efficacy was driven by Puerto Rico students, but sample issues make us unable to determine if this is due to statistical power issues, or differences in the effectiveness of the program implementation between sites. Considering the preliminary nature of our results and these limitations, we should interpret the results with caution.

Despite these limitations, we would like to offer the following important practical considerations. Future studies of this program should explore more in depth the nature of gender differences in this CS context. Results from this pilot study are encouraging for girls, especially considering the traditional challenges documented in computing contexts. However, they also suggest the presence of gender and ethnic intersectional phenomena which may manifest itself in special ways within this program, since both EarSketch and the *Remezcla* curriculum requires students to be artistically expressive and creative, in addition to using computational thinking skills.

In terms of practical implications, while we had the advantage of being able to run our program during the COVID pandemic, since EarSketch constitutes a free online platform; we still faced many challenges related to the use of technology, the impact of virtual learning fatigue, and our ability to conduct observations of students' engagement. Further studies should explore this impact and compare different delivery methods, as well as differences in the curriculum implementation. This examination can be particularly valuable to potential practitioners interested in engaging students virtually, or across multiple locations.

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Appendix

Sample Survey Questions

English Items	*Spanish Items*
Identity Identification*	
I have a strong sense of belonging to other [selected race/ethnicity] people	Mi sentido de pertenencia con otros { }s es muy fuerte
I am proud to be [ ].	Estoy orgulloso(a) de ser {. }.
Perceived Threat**	
I feel that my culture is incompatible with the new people I am meeting and the new things I am learning	Siento que mi cultura es incompatible con las personas nuevas que estoy conociendo y las cosas nuevas que estoy aprendiendo
I often feel like a chameleon, having to change my colors depending on the culture of the person I am with	Me siento muchas veces como un camaleón. Tengo que cambiar mis colores dependiendo de la cultura de la persona con quien esté
I feel that I have to change myself to fit in at school	Siento que tengo que cambiar quién soy para encajar (fit in) en la escuela
Sense of Belongingness in Computer Science*	
Compared with most other students, I know how to do well in computing	En comparación con la mayoría de los otros estudiantes, sé cómo salir bien en computación[#]
Compared with most other students at my school, I am similar to the kind of people who succeed in computing	En comparación con la mayoría de los otros estudiantes de mi escuela, me parezco al tipo de persona que es exitosa en computación[#]
I belong in computing	Siento que pertenezco al mundo de la computación[#]
Self-Efficacy*	
I am certain I can understand the ideas taught in computing classes	Estoy seguro(a) de que puedo entender las ideas enseñadas en las clases o actividades de computación[#]
I am sure I can do an excellent job on the problems and tasks assigned in computing classes	Estoy seguro(a) de que puedo hacer un trabajo excelente en los problemas y tareas asignados en las clases o actividades de computación#
I expect to do very well in computing classes or activities	Mi expectativa es salir muy bien en clases o actividades de computación#
Intent to Persist*	
I am interested in pursuing a career in computer science	Estoy interesado(a) en hacer una carrera en computación[#]
Computer science will help me reach my goals for college/ career	La computación[#] me ayudará a alcanzar mis metas universitarias/profesionales.
What I learn about in computing will benefit my future	Las cosas que aprenda en computación[#] beneficiarán mi futuro

*5-point Likert scale items ('Strongly disagree' to 'Strongly agree')
** 7-point Likert scale items ('Not at all' to 'A great deal')
***5-point Likert scale items ('Never' to 'Always')
[#] original survey used "informática." It was replaced by "computación" following cognitive interviews with students in Puerto Rico