PROJECT DESCRIPTION & PROPOSAL

I would like to propose a research project in Puerto Rico focusing on the topic of STEM education: how present STEM education opportunities are, how important STEM education is (especially for women), and why STEM education in Puerto Rico is declining. This research will be conducted during January 2024. I am conducting this research because as a Mathematics major I have a high interest in STEM related fields, and as a Hispanic Studies major, I also have a high interest in marginalized and underrepresented communities (especially Spanish speaking ones).

Since 2007, the Department of Education has been shutting down public Puerto Rican schools. There had been 673 school closures as of March 2022, which totaled 44% of all public schools. Wages in Puerto Rico are far behind those of the US, with jobs that would start at $25/hr in the states earning as little as $7.25/hr in Puerto Rico. Living expenses are also incredibly high, due to the Merchant Marine Act of 1920, which makes it impossible for Puerto Rico to engage in commerce with any country besides the US. Food is imported from the US, and then marked up by margins of 15-50%. Puerto Rico pays more for utilities than US states, and new car prices start at $12,000 higher than car prices in the US. Since living expenses are so high, and working wages are so low, many teachers in the past year have gone on strike. This was largely due to the fact that they hadn't been given a raise in over 10 years.

My research objective will be to collect qualitative (and quantitative, if possible) data from STEM educators and STEM non-profit organizations in Puerto Rico, with the intention of learning more about STEM opportunities for women specifically, because they are traditionally underrepresented in STEM fields. Another objective of my research will be to discover why STEM education in Puerto Rico is diminishing, and if there are measures being taken to prevent the decline of STEM opportunities. My objectives will be obtained by interviewing current STEM educators, observing STEM classrooms (if at all possible), and visiting any STEM non-profit organizations. There is a specific NGO that I'd like to visit in San Juan, Puerto Rico called the Puerto Rico Science Technology and Research Trust, and it is run by a female director. I'd like to specifically focus on the presence of females in STEM education, both as students in public school settings and as educators or employees of the workplace.

Another topic of research that I am potentially interested in relates hurricanes in Puerto Rico to the decline of the public education system. This could be an additional area of research after collecting qualitative data from STEM related individuals. Hurricanes in Puerto Rico often cause intervention from the US, and with that intervention comes cuts to the education system. I am curious to see if there is any stark correlation between hurricanes and public school shut downs, or if that is just a common occurrence because of US intervention and lack of support. I hope to obtain some quantitative data from the Department of Education or the Office of Civil Rights on public school numbers in Puerto Rico.

In order to obtain my research objective, I will need to obtain qualitative data from STEM educators in Puerto Rico through interviews and classroom visits, along with interviews from directors or leaders of STEM non governmental/non profit organizations. I am aware that this will require asking permission of the PLU Human Participants Review Board and I will have to complete any HPRB training. I am prepared to put in the training time so as to be able to interview participants in Puerto Rico. Therefore, travel to the site is an integral part of my research because of this collection of qualitative data in the form of personal interviews. My goal is to be able to learn about how STEM educators live, and teach in the current conditions of their economy. The decline of the education system in Puerto Rico is something that needs to be told through stories and physical presence, not just through numbers. The interview process in schools will be the main focus of my research, and pictures of schools and classrooms and educators (whenever possible) will aid the visualization of my findings. Additionally, if I have extra time, seeing the physical

evidence of hurricane destruction among local public schools and non-profits will further my analysis of the decline of the Puerto Rican education system.

ACADEMIC CONTEXT OF RESEARCH PROJECT

My goal for this research project is that I will be able to connect it to my Mathematics capstone project. This could either be done through qualitative research analysis using statistics, or through mathematical modeling. This project will connect my passions of Mathematics and Hispanic Studies, since I will be able to use my language speaking skills while collecting and analyzing data. This is also a topic that I have a great interest in as the daughter of two public school bilingual teachers, and as someone who has experienced being in a STEM classroom in another country. I spent two years in middle school living in Nicaragua, where my parents volunteered as teachers and I was a student at an all Spanish-speaking school.

My background in upper division Mathematics and Statistics courses have prepared me to complete the research necessary for this project. Additionally, my Hispanic Studies courses and experience living abroad in Mexico have prepared me with the necessary language skills to be able to professionally interview Spanish speaking educators. Living abroad and traveling have prepared me to be able to complete independent research in a foreign country. After returning from Puerto Rico, I plan to analyze the qualitative research from my experience using the computer programming language R, and present my findings at my Mathematics capstone presentation. I plan to work with Ksenija Simic-Muller and/or Nicola Justice to further develop my research beyond my experience in Puerto Rico.

The PLU mission statement states that we seek to educate students for lives of thoughtful inquiry, service, leadership, and care—for other people, for their communities, and for the earth. My research about STEM education in Puerto Rico directly ties in to PLU's global education vision of educating for a more just world. The inequities in living conditions between the US and Puerto Rico (even though it is a US territory) are stagnant, especially when it comes to education, which I hope to show through my qualitative research.

PLANNING & PREPARATION

To complete my proposed research project I will need to be able to communicate in both social and professional settings in Spanish. Due to my studies as a Hispanic Studies major and my past experiences living abroad in both Nicaragua and Mexico, I am fluent in Spanish. My language ability is at a professional level, where I will be able to effectively communicate the questions pertaining to my research topic. I plan to record interviews (whenever possible and with permission), so that I am able to listen back and effectively translate anything that I might have missed during the interview. My experiences living abroad will be relevant to my independent travel and research, as I will be able to apply my past travel experiences to living in Puerto Rico.

My past experiences abroad include time living in Matagalpa, Nicaragua and Oaxaca, Mexico. I was able to experience the private school system in Nicaragua as a student at a start-up Christian academy. Living in a third world country gave me a perspective on life that I will hold on to forever, and I always keep that perspective in mind when traveling to new places. Studying abroad in Mexico last Spring provided me with more independent opportunities to explore a new country, and in doing so I became more comfortable with my language skills and social skills in general. I also had the opportunity to participate in an internship with a micro loan organization called SEFIA, where I was able to go out into the fields and interact with indigenous communities who were benefiting from their partnership with SEFIA.

As a Mathematics major and Statistics minor, my problem solving and analysis skills make me a good candidate for this applied research. The two Statistics courses that I will have taken prior to my research project (STAT 242 and STAT 348) will have given me enough skills to be able to complete an individual project based on qualitative data. Additionally, I hope to have completed an internship related to Statistics and/or research collection/data analysis before January 2024. I will also be in contact with Ksenija Simic-Muller and Nicola Justice before, during, and after my time in Puerto Rico. I hope to have established a clear hypothesis for my research project by December 2023, through consultations with Dr. Justice and Dr. Simic-Muller.

My time frame of travel will be one month: January 2024. During those 4 weeks I plan to visit public schools, universities, and STEM organizations. My first week will be spent reaching out to public schools and organizations to set up interview times and classroom visits. The next two weeks I will make visits and travel when necessary to meet with Puerto Rican STEM educators and non profit organizations. During my last week I will begin the process of organizing my qualitative data by listening to recorded interview sessions, going through classroom photos, and choosing a presentation method for how to show my findings. My budget proposal attached includes an estimation of round-trip plane ticket prices to Puerto Rico, housing accommodations, travel using local transportation within Puerto Rico, and food costs. Currently my budget is a very rough estimate, and will be finalized around September/October 2023.

FACULTY SUPPORT

Ksenija Simic-Muller is my faculty mentor for this project. Before my project, she plans to help me find relevant readings on the education system in Puerto Rico, STEM organizations, and/or hurricane destruction within San Juan. Together we will locate and reach out to potential contacts for interviews, including but not limited to STEM educators, STEM students, and STEM non-profit organizations. She will help me to prepare interview questions, and will also walk me through the process of HPRB training. During my time in Puerto Rico, I plan to communicate with Ksenija regularly and update her on how my interviews are going. After returning from Puerto Rico, she will help me analyze my data and prepare a report on my findings. We will then find a venue(s) where I can present the findings of my research. She will also help me with connecting my research findings to my Mathematics capstone project.

RECRUITMENT EMAIL FOR PARTICIPANTS (ENGLISH & SPANISH)

Dear (insert organization/name/school),

My name is Mackenzie. I am a 4th year undergraduate student from Pacific Lutheran University in Tacoma, Washington studying Mathematics and Hispanic Studies. Throughout my studies, I have developed a strong interest in working to better mathematical opportunities for historically underrepresented groups in the STEM field, such as women and/or Latino populations.
I have a received a research grant from my university to explore the topic of the change in the STEM education system in Puerto Rico, and its effects on female identifying students. This grant provides me with funding to travel to San Juan, Puerto Rico in January 2024 to research this topic in person. The purpose of this study is to get a better understanding of the education system in Puerto Rico and how it is

changing, and whether or nor this has affected female students in STEM. I'd like to be able to share these results with others at PLU and beyond. As a woman in STEM myself, this topic holds great importance to me.
(FOR A SCHOOL) Since my research directly deals with the education system, I was hoping to be able to hear from educators first hand and learn about their opinions/experiences with this topic. If you have any STEM (or STEM adjacent) educators who would be willing to meet in person with me for a ~30 minute interview in January 2024, I'd request that you send me their contact information so we can set up a date and time. I believe this is the most valuable type of research for my project.
(FOR A NON PROFIT) Through my research, I have found out about (organization name) and its commitment to STEM education in Puerto Rico. Would a director, employee or volunteer of this organization be available for a ~30 minute in person interview in January 2024? I am excited about this project and would love the opportunity to learn more about your organization and how your work is improving STEM education in Puerto Rico.

Thank you for your consideration and please let me know if you have any questions.

SPANISH

Buenas tardes,

Mi nombre es Mackenzie Mueller. Soy una estudiante universitaria de cuarto año en Pacific Lutheran University (PLU) en Tacoma, Washington, donde estudio Matemáticas e Estudios Hispánicos. A lo largo de mis estudios, he desarrollado un fuerte interés en trabajar para mejorar las oportunidades matemáticas para grupos históricamente marginados en las carreras de STEM (ciencias, tecnología, ingeniería, y matemáticas), como mujeres y/o poblaciones latinas.
He recibido una beca de investigación de mi universidad para explorar el tema del cambio en el sistema de educación STEM en Puerto Rico y sus efectos en las estudiantes que se identifican como mujeres. Esta beca me proporciona financiamiento para viajar a San Juan, Puerto Rico, en enero de 2024 para investigar este tema en persona. El propósito de este proyecto es obtener una mejor comprensión del sistema educativo en Puerto Rico, cómo está cambiando y si esto ha afectado a las mujeres en STEM. Me gustaría poder compartir estos resultados con los demás en PLU y también con audiencias más amplias. Como mujer en STEM, este tema es de gran importancia para mí.
A través de mi investigación, he descubierto acerca de (nombre de la organización) y su compromiso con la educación STEM en Puerto Rico. ¿Estaría disponible algún director, empleado o voluntario de esta organización para una entrevista en persona de aproximadamente 30 minutos en enero de 2024? Estoy emocionada con este proyecto y me encantaría la oportunidad de aprender más sobre su organización y cómo su trabajo está mejorando la educación STEM en Puerto Rico.
Gracias por su consideración y por favor, háganme saber si tienen alguna pregunta.

Atentamente,
Mackenzie

INTERVIEW QUESTIONS

For EDUCATORS

1. Can you describe the current state of STEM education in Puerto Rico? What are its strengths and areas that may need improvement?
2. In your experience, what challenges do STEM educators face in Puerto Rico, and how have these challenges evolved over the past decade?
3. Have you noticed any shifts in student interest and enthusiasm for STEM subjects over the years? If so, what factors do you believe contribute to these changes?
4. Puerto Rico has faced various economic and environmental challenges. Have these factors had any discernible effects on STEM education, resource availability, or student engagement?
5. How has the participation of female identifying students in STEM subjects evolved during your teaching career in Puerto Rico? Have you noticed any changes in their representation or enthusiasm for STEM fields?
6. In your opinion, what strategies or initiatives have been effective in encouraging female identifying students to pursue STEM education, and have these strategies evolved in response to changing dynamics?
7. What advice would you offer to policymakers and educators looking to strengthen STEM education and support STEM educators in Puerto Rico?

For NON PROFITS

1. Could you provide an overview of your organization's mission and objectives in promoting STEM education in Puerto Rico?
2. How has your organization evolved and expanded its initiatives over the past decade to support STEM education in Puerto Rico?
3. In your experience, what are the key challenges and opportunities that non-profit STEM organizations face in Puerto Rico, and how have these evolved over time?
4. Given the economic and environmental challenges Puerto Rico has faced, how has your organization adapted to continue its STEM education initiatives and provide resources to students?
5. Could you describe any specific programs or initiatives your organization has undertaken to promote the involvement of female identifying students in STEM fields in Puerto Rico? Have you observed any notable changes in female student engagement as a result of these efforts?
6. How does your organization address gender diversity and inclusivity in STEM education, and have you seen any shifts in female identifying student involvement during your organization's history?
7. In your view, how can policymakers, businesses, and individuals better support the efforts of non-profit STEM organizations like yours to strengthen STEM education in Puerto Rico?

QUALITATIVE ANALYSIS REPORT IN PROGRESS. PLEASE SEE TEMPORARY WRITE UP BELOW.

The STEM Education System in Puerto Rico and its Effects on Female-Identifying Students

My qualitative research done in January 2024 focused on the state of the STEM education system in Puerto Rico and its effects on female identifying students. During my month living in San Juan, I met with a total of five STEM teachers and two STEM non-profit organizations. Interviews were conducted fully in Spanish (as I am fluent) and lasted between 10-30 minutes each.

The main results of my findings showcase that STEM educators lack sufficient funding for STEM materials in classrooms, which means often material costs come from educators' own pockets. Interest levels for STEM education and STEM activities have increased within the last 10 years, and female students have become more represented in these fields. However, their representation compared to that of male-identifying students is still lower than what STEM educators would like to see.

STEM nonprofits also tend to lack sufficient funding, but they make do with what they have. I spoke with a director of the Puerto Rico Science Technology and Research Trust (PRSTRT), who explained one of their most popular programs sends boxes of STEM materials out to children all over the island. The children then join zoom sessions with members of the PRSTRT to put together the contents of their boxes. This nonprofit organization also conducts summer camp sessions and specifically tries to recruit female-identifying students to participate.

Overall, similar responses were given to many of my interview questions, and clear trends arose in terms of female-identifying student participation in STEM areas. Teachers earn much less than they would teaching on the mainland US, and many spoke to how that has affected their STEM teaching experiences.