EVALUATING THE BARRIERS FACED BY NATIVE HAWAIIAN AND PACIFIC ISLANDER UNDERGRADUATE STUDENTS IN SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS

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I certify that I have read this thesis and that in my opinion, it is satisfactory in scope and quality as a thesis for the degree of Bachelor of Science in Global Environmental Science.

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ABSTRACT

This study evaluates the barriers faced by Native Hawaiian and Pacific Islander (NHPI) undergraduate students in Science, Technology, Engineering and Mathematics (STEM) at the University of Hawai‘i at Mānoa (UHM). First, a literature review was conducted in which potential barriers were identified. A survey was then distributed to NHPI undergraduate STEM majors at UHM to understand the prevalence of these barriers within this group of students. The survey results were then analyzed. Based on the survey results, a website was created to help dismantle these barriers, featuring information and resources regarding scholarships, undergraduate opportunities, tutoring, and NHPI role models in STEM.

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1.0 Introduction

1.1 Motivation

Science, Technology, Engineering, and Mathematics (STEM) affects every aspect of a Pacific Islander's life. The Pacific islands experience unique challenges posed by climate change, including rising temperatures, sea-level rise, saltwater inundation of freshwater resources, coastal erosion, extreme weather events, coral bleaching, and ocean acidification (US Fish and Wildlife Services, 2011; Tribble, 2008; Barnett, 2005). Climate change poses an immediate threat to low-lying Pacific islands and leaves many of these islands vulnerable. Sea-level rise threatens coastal developments and causes habitat loss of endangered species. Effects on fisheries and agriculture of these islands can disrupt food security. Although many Pacific islands rely on groundwater as their primary freshwater source, changing precipitation patterns threaten this supply (Tribble. 2008). Similarly, other aspects of climate change pose additional challenges for Pacific islands and require immediate and continuous adaptation.

Addressing the climate change challenges faced by Pacific islands requires in-depth STEM-based knowledge, research planning and policymaking. In addition, a STEM framework is needed for informing the protection and monitoring of island resources. As Pacific islands begin to see the devastating effects of climate change, the urgency for understanding, adaptation, and mitigation grows.

Climate scientists, as well as other geoscientists, provide critical evidence for informing environmental decisions. However, most scientists based in Pacific islands are non-NHPI, which can be problematic for many reasons (Richardson, 2002; White House Initiative, n.d).

A high turnover rate in these jobs can create disconnect in navigating and understanding the ins and outs of the job, and requires that increased resources be spent for re-hiring and re-training (Richardson, 2002). Therefore a better business model would be to hire Indigenous NHPI people because they are more likely to stay on the island for long-term careers.

Another advantage of Indigenous representation is Indigenous knowledge, which is highly complementary to scientific knowledge (Kimmerer, 2013). Indigenous knowledge reconceptualizes the resilience and self-reliance of Indigenous peoples, underscores the importance of their own philosophies, heritages, and educational processes, and fills ethical and knowledge gaps in Eurocentric education, research, and scholarship (Aikenhead & Ogawa, 2007). For Pacific islands, where Indigenous cultures and ways of knowing are important, the merging of Indigenous knowledge and scientific knowledge is essential. The motivation for Indigenous people to perform this work may be more deeply rooted and representative of the community's long-term interests and values.

1.2 Geography/Demographics

The NHPI demographic includes populations of Polynesian, Micronesian, and Melanesian backgrounds, all of which differ in language and culture (Grieco, 1997, White House Initiative, n.d). The largest Pacific islander group in the United States is Polynesian, which includes natives of Hawai'i, Samoa, Tonga, and Tahiti. The second largest group is Micronesians, which includes natives of the Mariana Islands, Federated States of Micronesia, The Republic of Palau, and The Republic of the Marshall Islands. The Melanesian group includes natives of Fiji, Papua New Guinea, and the Solomon Islands (White House Initiative, n.d) .

Despite the importance of NHPI representation in STEM, NHPI populations are among the most underrepresented groups in STEM (Teranishi et al., 2019). In general, Indigenous people are less likely to attend college than other ethnic groups, partly due to low levels of academic, pre-college preparation (Pavel, 1999), but also due to socio-economic inequities (Levine, 2015). In particular, at the University of Hawai‘i only 11% of STEM students currently enrolled in Fall 2020 are NHPI (Institutional Research and Analysis Office, 2020). This is less than half of the 26% NHPI enrollment at UH Mānoa (Institutional Research and Analysis Office, 2020).

1.3 Barriers

The goal of this literature review is to identify challenges faced by NHPI populations that may cause their underrepresentation in STEM higher education. This literature review is not comprehensive of all NHPI communities, but instead provides examples of how various barriers are present in selected Pacific Island communities.

1.3.1 Cultural Barriers

A 2016 report from the National Science Foundation (NSF) workshop on “Recognizing and Removing Barriers to STEM careers for Native Hawaiians and Pacific Islanders,” listed various potential barriers. The first set involved cultural challenges, which included lack of intersection between science and culture, and lack of cultural sensitivity of non-native teachers (Kerr et al., 2018; Levine, 2010). It is essential to look at the history of the Pacific islands and the different cultural, religious, and familial influences in order to identify and understand the cultural barriers.

Family. A similarity found across Pacific island cultures is the importance of family, specifically respect for parents, elders, chiefs, and others in authority (Hezel, 2013). In many

Pacific islands, close-knit multi-generational families and communities are common (Handy, 1950; Ratliffe, 2010). In contrast, small nuclear families predominate in the continental US (Yau, 2017). Hezel (2013) describes family as "the heart of the identity of an islander." The influence of family can, however, create a barrier to student success. Family obligations such as religious and traditional practices may interfere with students' success, in that these obligations can take priority over students' studies (Ratliffe, 2010). This lifelong sense of family obligation can create a conflict within Western educational structures based on individualism, and requires cultural understanding on the part of educators to better facilitate student success (Ratliffe, 2010).

Family support while pursuing STEM higher education is vital to success, though lack of support is a common experience for NHPI students. Due to a variety of challenging circumstances, such as low socio-economic status and low educational attainment, parental involvement can be limited and in some cases non-existent (Ratliffe, 2010; Tran et al., 2010). Lack of support is not strictly a lack of involvement or intentional discouragement to pursue a STEM degree. In some cases, parental support is present, but there may be a lack of financial means to obtain extra help (Lee, 2015). For example, some parents might support the idea of their child pursuing a STEM degree but may be unable to take extra measures to ensure their child can succeed, such as paying for STEM tutoring (Harris Interactive, 2011).

While strong familial obligation and/or lack of familial support can form a barrier, family may also positively contribute to success. For some NHPI students, family influence can motivate them to pursue STEM and encourage them to persist through challenges faced (Vakalahi, 2008).

Cultural disconnect. It is important that students understand that culture is not lost, but rather, valued and how it can be integrated into the process of pursuing higher education (Tran et al, 2010). The implementation of Western curriculum and an absence of cultural perspective from non-native teachers in STEM subjects creates a lack of intersection between science and Indigenous knowledge (Kerr et al., 2018). Increasingly, throughout many Pacific islands, K-12 education follows a Westernized curriculum, and successful STEM students must learn to make connections and navigate in Westernized STEM curricular spaces.

On the other hand, awareness of the cultural disconnect and lack of a place-based curriculum can provide motivation for students to intentionally break this barrier. Kerr et al. (2018) notes that "some students pursuing STEM degrees have become rebellious against educational situations they see arising from colonialism; for example, students pursuing environmental science, biology, and ecology see the need for greater native cultural perspectives."

Identity and Stereotype Threat. Negative stereotypes can be harmful to student success. Stereotype threat refers to being at risk of confirming a negative stereotype about one's social group (Steele & Aronson, 1995). Some NHPI students report experiencing negative stereotypes in their academic environment which convey that educational attainment is rarely associated with Pacific islanders (Tran et. al., 2010; Vakalahi, 2008). Negative stereotypes toward Native Hawaiians include that they are not capable of learning math or speaking "proper" English (Sheridan, 2017; Trask, 1999). Another relevant example is the stereotype toward Micronesians from the Federated States of Micronesia who move to Hawai'i, Guam, or the continental United States where some encounter racism, discrimination, poverty, and prejudice, and are seen as "a burden on public assistance" (Kerr et al., 2018). This

misconception leaves NHPI students with the extra pressure to battle the stereotype, and this can cause undue stress. Stereotype threat can leave students with little ambition to pursue higher education, especially in STEM (Kerr et al., 2018).

1.2.2 Awareness and Exposure of opportunities

Another barrier faced by NHPI students is the lack of exposure and awareness to opportunities in STEM-related careers (Kerr et al., 2018). In many Pacific islands, particularly the more underdeveloped islands, most STEM careers are occupied by non-natives. This is partly because there are few natives qualified to fill these positions, which is a problem that needs to be pro-actively addressed by educational institutions (National Academy of Sciences, 2011). However, until they do, this creates a false perception that these positions are not meant for native people. The lack of representation emphasizes the need for native role models in STEM-related careers (Kerr et al., 2018). For many students, role models and mentors can boost their confidence and be a critical factor in their decision to pursue STEM higher education (Tran et al., 2010).

1.3.3 Geographic Barriers

Geographic location can deter NHPI populations from obtaining higher education. While some Pacific islands have two-year (e.g., American Samoa, Papua New Guinea, and Palau) or four-year colleges (e.g., Hawai‘i, Fiji, and New Zealand), most do not. Thus, for many NHPI students, obtaining a college-level education requires they move far from home (Kerr et al., 2018).

1.3.4 K-12 Education

Pre-college STEM education is vital to preparing students for success in achieving a STEM degree. However, many NHPI students both in Hawaii and across the Pacific lack a strong background in STEM foundational courses from their K-12 education (Levine, 2015; Kerr et al., 2018). One reason for this is the insufficient training of K-12 teachers in STEM subjects. In Hawai‘i, the lack of qualified STEM teachers is particularly prevalent in public schools in lower socio-economic areas, which are disproportionately attended by NHPI (Department of Business, Economic Development and Tourism, 2018).

Furthermore, across the Pacific, a lack of resources and technology can hinder the quality of STEM education, limiting what can be taught, and ways students learn (Levine, 2015). Only a few Pacific Islands (e.g., Papua New Guinea, Northern Mariana Islands) have K-12 schools which offer Advanced Placement (AP) or International Baccalaureate (IB) curriculum and this advanced coursework is generally only offered within private schools (College Board, 2020).

Consequently, only a minority of Pacific Islanders meet college readiness benchmarks for math (30%) and science (25%), which falls short of the comparable figures of 42% and 38% for the general population (ACT & APIASF, 2016). Alarmingly, one study found that only 9% of NHPI students in California schools were ready for college-level math (Sablan, 2015).

1.3.5 Financial Barriers

Financial Assistance. Due to the high cost of higher education in the U.S., student success and degree completion are directly influenced by financial assistance (Teranishi et al., 2019). Many students rely on financial aid and scholarships to obtain a college degree, which

emphasizes the need for readily available information on these resources (Vakalahi, 2018). Additionally, many NHPI students in the U.S. find themselves faced with competing priorities between work and school, making it difficult to succeed in STEM (Tran et al., 2010).

2.0 Methods

This study utilized qualitative and quantitative analysis techniques to understand the challenges faced by NHPI undergraduates in STEM at the University of Hawai‘i at Mānoa (UHM).

2.1 Literature Analysis

A literature analysis was conducted to identify potential barriers that NHPI students may face when pursuing STEM majors. However, the literature on this narrow topic was found to be very limited. The literature review was therefore expanded to include challenges faced by various minority groups (not just NHPI) in STEM, challenges faced by NHPI populations in higher education (not just STEM), and the different factors that may contribute to each challenge.

First, a comprehensive search of peer-reviewed journals, conference papers and reports were completed based on a wide range of terms including but not limited to: NHPI students in STEM; NHPI students in higher education; minorities in STEM; and barriers to NHPI students in STEM. Then, the reference section of each source was searched to find additional sources. Finally, the OneSearch database was utilized to access books and articles available

in the UHM online library and articles and books from databases including ProQuest. This literature review is presented in Section 1.0 Introduction above.

2.2 Survey

Following the literature analysis, a survey was created to gain insight on which barriers identified in the literature are most prevalent and relevant to NHPI undergraduates pursuing STEM at UHM. This survey is described under Section 2.3 Data.

The survey contained a total of 29 items, 24 of which addressed various barriers. Thirteen items addressed cultural barriers, including lack of intersection between science and culture (3 survey items), family (4 survey items) and identity/stereotype threat (6 survey items). Eleven survey items addressed other barriers, including awareness and exposure of opportunities (4 survey items), geographic barrier (1 survey item), K-12 education (2 survey items) and financial barriers (4 survey items). The distribution of these 24 survey items among the different barriers is shown below in Table 1. The survey also included three demographic items: area of study, ethnicity, and gender. Lastly, the survey contained two open-ended questions for students to suggest resources that they would find helpful on a website, and to offer any additional comments.

Table 1. Likert Scale Survey Items						
Cultural Barriers						
Family	**Cultural Disconnect**	**Identity & Stereotype Threat**	**Awareness and Exposure**	**Geographic**	**K-12 Education**	**Financial**
My family obligations take time away from my studies	My STEM classes are grounded in local communities and contexts.	My cultural background has influenced my decision to pursue my major	I am aware of the different career paths available to me with my degree	I chose UH Mānoa due to its proximity to home	My K-12 education prepared me for my STEM college courses	I worry about not having enough money to pay for school
My family was influential on my decision to choose a STEM major	I understand how the material I learn can be applied outside the classroom	My ethnicity affects how my peers interact with me	I have mentors who help me plan for my future		Good K-12 education	I struggle to balance school and work
My family encouraged me to obtain a college degree	Being able to relate the subject material to my personal experience	My ethnicity influences how teachers interact with me	Having a good mentor			My primary funding source for tuition, books and housing
Supportive family		Stereotypes about my ethnic groups bother me	Having a role model			My secondary source of funding for tuition, books and housing
		I am capable of succeeding in STEM				
		Studying hard				

The survey utilized Likert scale items, multiple-choice items and open-ended response items. Likert scale items measured agreement and importance on five-point scales ranging from "strongly agree" to "strongly disagree" and from "extremely important" to "not at all important", respectively. Multiple-choice items required a single answer choice. Multiple choice items evaluated primary and secondary sources of funding. Multiple choice demographic survey items asked for respondents' current major, ethnicity, and gender. These items were placed at the end of the survey, after the barrier items, to avoid potential effects of stereotype threat (Hughes, 2016). Lastly, open-ended questions asked students about what kind of information would be helpful on a website and for additional comments.

The next step involved determining whether or not I needed to submit an application to the UH Institutional Review Board (IRB). IRB approval is required for research that is deemed "human subjects research", to ensure protection of the rights and welfare of participants (U.S. Food and Drug Administration, 2019). To answer this question, my advisor contacted the UH IRB office on August 5, 2020 and we were informed that IRB approval was no longer necessary. The IRB representative that we spoke with (Kristin Bacon), wrote: "Whether or not you submit a human subjects' application is all about your intent…. If this is an evaluation where the intent is to inform SOEST, then it is not human subjects research. This is true even if there is a wider dissemination of the results." Since my intent was precisely to gather information to inform SOEST so that NHPI students could be better supported, I did not have to apply for IRB approval.

The survey was distributed as a Google form and was intended to be completed in 6-7 minutes. A screenshot of the survey is included in the Appendix. The survey was distributed

on October 13, 2020 to seven listservs and one social media channel with a large number of subscribers in my target audience (NHPI undergraduates in STEM at UH Mānoa). The seven listservs include: SOEST Maile Mentoring Bridge, Native Hawaiian Student Services, Decolonizing STEM, Native Hawaiian Science & Engineering Mentoring Program (NHSEMP), SOEST student services, Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) ‘Ilima Chapter, and SOEST ’Ike Wai Scholars. Although many of these listservs primarily serve graduate students, there is also some undergraduate participation. The social media channel is called Discord and serves my fellow GES students. The survey was also sent to 7 personal contact individuals. The survey was active for two weeks from October 13, 2020 until October 26, 2020. In order to maximize response, an email reminder was sent out two days prior to closing the survey.

2.3 Data

Survey responses were collected from 29 undergraduates. The response rate cannot be computed because the survey was shared through Listservs, social media channel, and personal contacts, so the amount of people the survey was distributed to is unknown. Of the 29 responses, four indicated ethnicities not encompassed under the definition of NHPI used in this paper (see Section 1.2) and therefore did not meet the stated criteria of this study. These four responses were removed, resulting in a final dataset of 25 survey responses. Pie-charts showing the ethnicity and gender demographics of survey respondents are given in Figure 1 and 2, respectively. Of the 25 participants, 9 identified as male and 16 identified as female. No student reported a non-binary gender. Eighteen students identified as Native

Hawaiian. The remaining identified as Samoan (3), Chamorro (2), Tongan (1), and Ni-Vanuatu (1). No respondent reported more than one NHPI ethnicity.

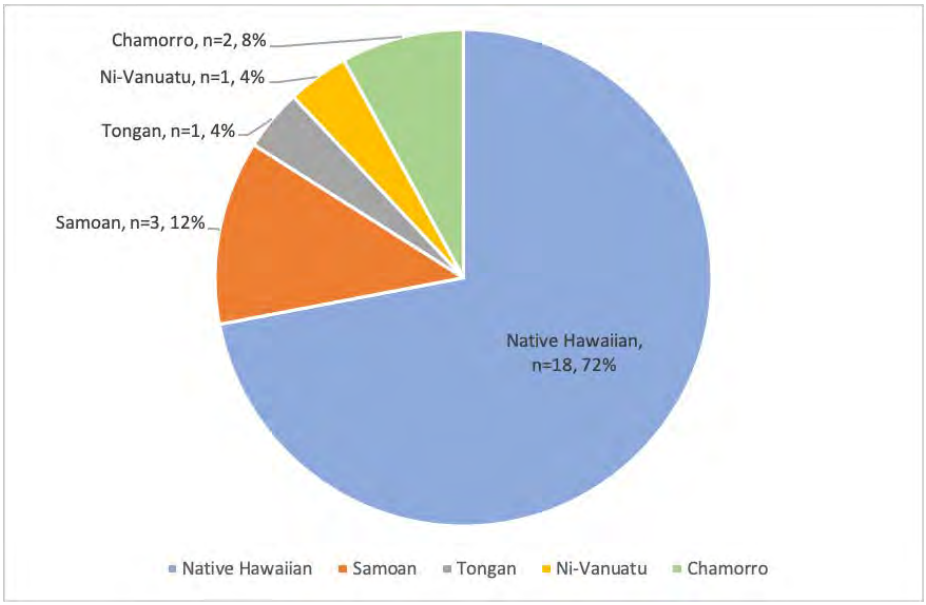

Figure 1: Ethnicity of the survey respondents

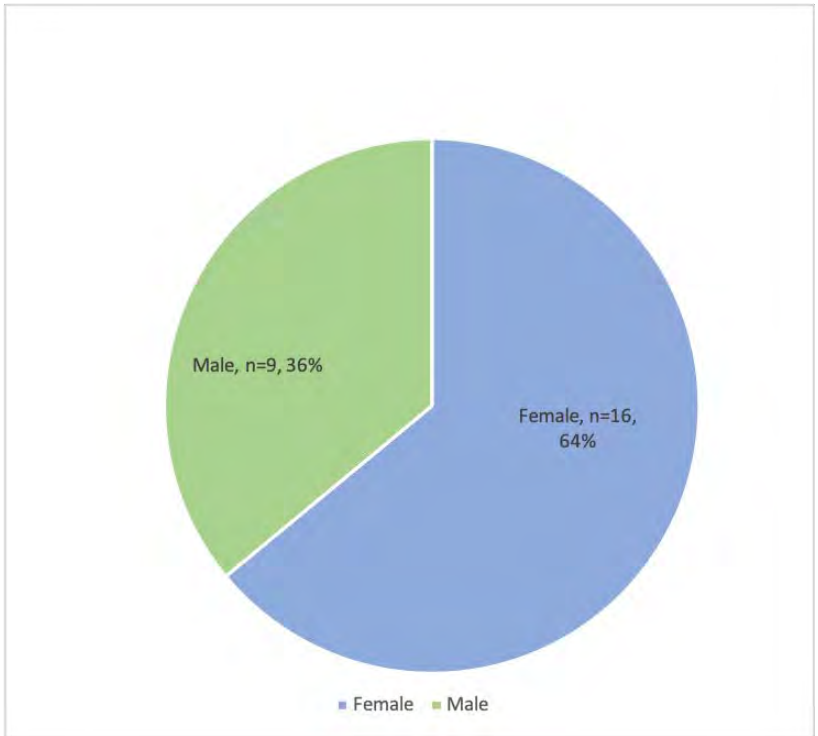

Figure 2: Gender of the survey respondents

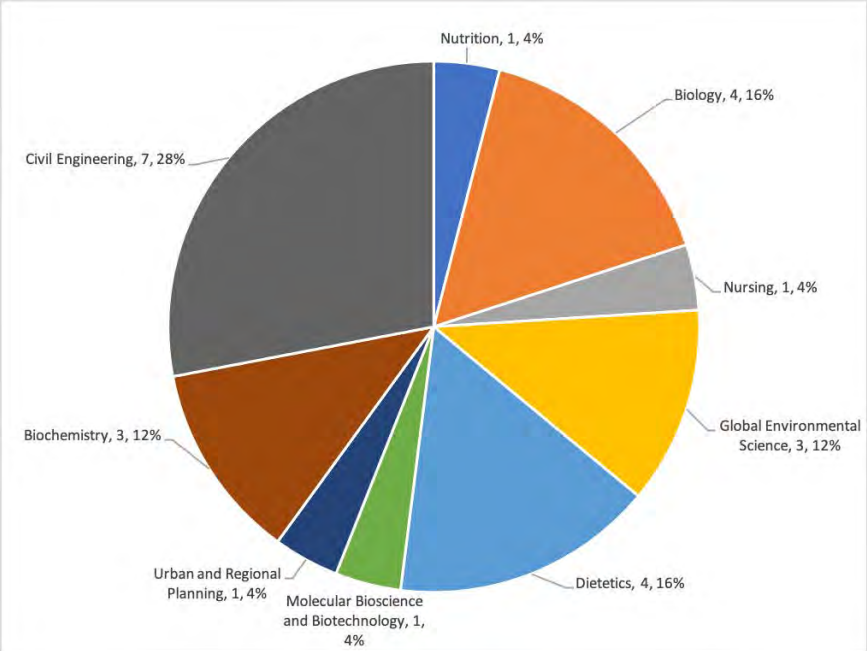

Figure 3: Intended degree of the survey respondents

2.4 Methods

Quantification of Likert Responses. Two five-point Likert scales were used in the survey, measuring agreement and importance. For the agreement questions, the Likert scale ranged from "strongly disagree" to "strongly agree". For the importance questions, the Likert scale ranged from Not at all Important to Extremely Important. To allow for quantitative analysis, all Likert scale responses were converted to integers as shown in Table 2 (Bruno et al, 2020).

Table 2: Likert Scale Quantification: Quantification of Likert responses to Agreement and Importance survey items on a scale of 1 to 5.

LIKERT SCALE RESPONSE QUANTIFICATION					
	1	2	3	4	5
AGREEMENT SURVEY ITEMS	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
IMPORTANCE SURVEY ITEMS	Not at all Important	Slightly Important	Moderately Important	Very Important	Extremely Important

Descriptive Statistics. After converting Likert scale responses to their respective numerical values, the following basic descriptive statistics were computed: mean, standard error of the mean, median and mode. The means were then rounded to their closest whole number to allow for translation from numbers back to responses. These statistics were computed for the dataset as a whole and also for each barrier type, and results were compared across barrier types. Multiple-choice items were analyzed as proportional data and shown in pie charts. These results are reported in Section 3.0 Results and Discussion below.

2.5 Website Development

After collection and analysis of survey results, a website was created using the platform Weebly to provide resources around the most prevalent barriers identified. Additional resources were added based on the open-ended survey responses. The target audience of this website is NHPI undergraduates pursuing STEM at the University of Hawai‘i at Mānoa, although other groups might also find this website useful.

3.0 Results and Discussion

3.1 Likert Scale Responses

Descriptive statistical analysis of the Likert scale responses is shown in Table 3, which includes the mean, standard error of the mean (SEM), median and mode. Likert scale responses were distributed among their respective barriers, and the means and SEMs are shown in Figures 3-7, 10 and 11. The small sample size and large error bars make it difficult to significantly differentiate among the means. In the absence of statistically significant comparisons, the means are reported, and a possible interpretation of the results is presented.

Table 3: Likert Scale Data Analysis				
Section A. Family (see Figure 3)				
Survey Item	Mean	SEM[1]	Median	Mode
My family obligations take time away from my studies[2]	3.0	1.3	3.0	2.0
My family was influential on my decision to choose a STEM major[2]	3.0	1.4	3.0	2.0
My family encouraged me to obtain a college degree[2]	4.2	1.1	5.0	5.0
Supportive Family[3]	3.8	1.3	4.0	5.0
Section B. Cultural Disconnect (see Figure 4)				
Survey item	Mean	SEM[1]	Median	Mode
My STEM classes are grounded in local communities and contexts [2]	3.1	1.0	3.0	3.0
I understand how the material I learn can be applied outside the classroom[2]	4.0	0.5	4.0	4.0
Being able to relate the subject material to my personal experience[3]	3.9	1.3	4.0	5.0
Section C. Identity & Stereotype threat (see Figure 5)				
Survey Item	Mean	SEM[1]	Median	Mode
My cultural background has influenced my decision to pursue my major [2]	3.8	1.2	4.0	4.0
My ethnicity affects how my peers interact with me [2]	2.9	1.2	3.0	4.0
My ethnicity influences how teachers interact with me[2]	2.8	1.0	3.0	3.0
Stereotypes about my ethnic groups bother me [2]	3.3	1.3	3.0	5.0
I am capable of succeeding in STEM[2]	4.5	0.6	4.0	5.0
Studying hard[3]	4.4	0.6	4.0	5.0

Table 3 cont.

Section D. Awareness and Exposure to Opportunities (see Figure 6)				
Survey Item	Mean	SEM[1]	Median	Mode
I am aware of the different career paths available to me with my degree[2]	4.1	0.9	4.0	4.0
I have mentors who help me plan for my future[2]	3.9	1.3	4.0	5.0
Having a good mentor[3]	4.2	1.0	4.0	5.0
Having a role model[3]	3.5	1.3	4.0	5.0
Section E. K-12 Education (see Figure 7)				
Survey Item	Mean	SEM[1]	Median	Mode
My K-12 education (elementary through high school) prepared me for my STEM college courses[2]	3.7	0.9	4.0	4.0
Good K-12 education[3]	3.6	1.0	4.0	4.0
Section F. Financial (see Figure 10)				
Survey Item	Mean	SEM[1]	Median	Mode
I worry about not having enough money to pay for school[2]	4	1.3	4.0	5.0
I struggle to balance school and work[2]	3.4	1.0	3.0	3.0
Section G. Geographic (see Figure 11)				
Survey Item	Mean	SEM[1]	Median	Mode
I chose UH Mānoa due to its proximity to home [2]	3.4	1.4	4.0	4.0

[1]Standard Error of the Mean
[2]For this question type, survey respondents were asked to: *Please rate your agreement with the following statements.*
[3]For this question type, survey respondents were asked: *How important are each of the following to your success as a student studying in your area or major?*

3.1.1 Cultural Barriers

Family.

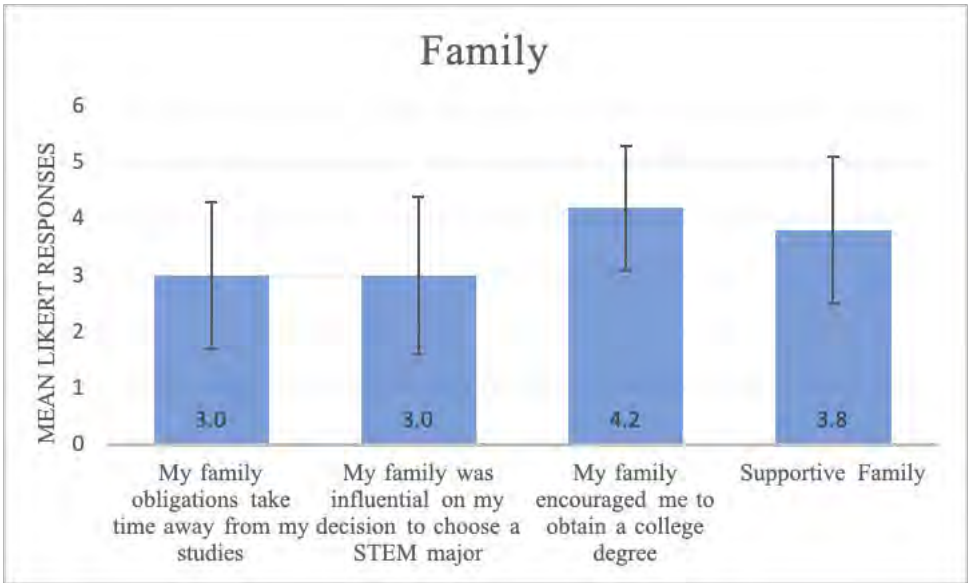

Figure 4. Mean responses for Likert-scale items related to family. Error bars correspond to ±1 standard error of the mean.

When asked if their family obligations take time away from their studies or if their family was influential on their decision to choose a STEM major, the mean reply to both questions was "neither agree nor disagree" (mean=3.0). The other two survey items in the "Family" category generated more positive responses. Although students did not seem to feel, on average, that their family was influential in their decision to pursue STEM, they agreed that their family was influential in obtaining a college degree (mean=4.2, or "agree"). Similarly, on average, students felt that having a supportive family was "very important" (mean=3.8). These results suggest that family was influential in obtaining a college degree, although not specifically a STEM degree.

Cultural Disconnect.

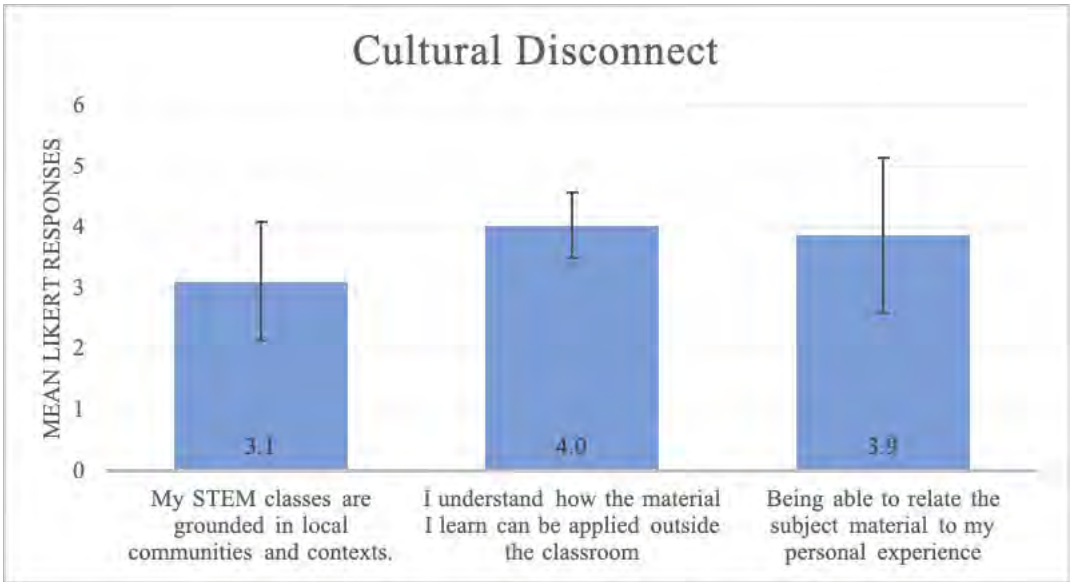

Figure 5: Mean responses for Likert-scale items related to cultural disconnect. Error bars correspond to ±1 standard error of the mean.

When asked whether their STEM classes are grounded in local communities and context, the mean student reply (3.1) translated to "neither agree nor disagree". Nevertheless, students reported high mean responses to both their ability to apply knowledge learned in class outside the classroom (mean=4.0, or "agree") and on the importance of being able to relate their classes to personal experience (mean = 3.9, or "agree"). Thus, even though students did not feel that their classes were grounded in local communities, it appears that they nevertheless feel that their learning is relevant and applicable to the world around them.

Identity and Stereotype Threat.

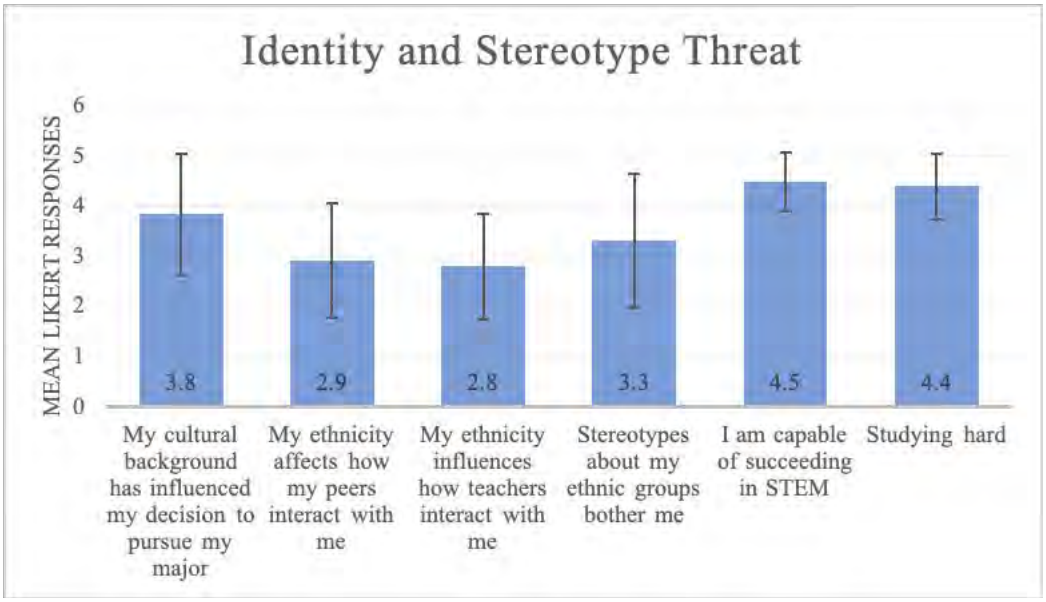

Figure 6: Mean responses for Likert-scale items related to identity and stereotype threat. Error bars correspond to ±1 standard error of the mean.

When asked whether their ethnicity influenced their interactions with teachers and peers, the average response was "neither agree nor disagree" (mean=2.8 and 2.9 respectively). Students were also asked if stereotypes about their ethnicity bother them, to which the average response was again "neither agree nor disagree" (mean=3.3). However, students agreed that their cultural background influenced their decision to pursue their major (mean=3.8, or "agree").

Irrespective of their mixed responses to the influence of culture and ethnicity, students show strong agency and control over their success in STEM. Students reported high mean responses on the importance of studying hard (mean=4.4, or "very important") and felt capable of success in STEM (mean=4.5, or "strongly agree"). Compared with all other responses, these surveys items had the highest means, as well as the smallest error bars.

3.1.2 Awareness and Exposure to Opportunity

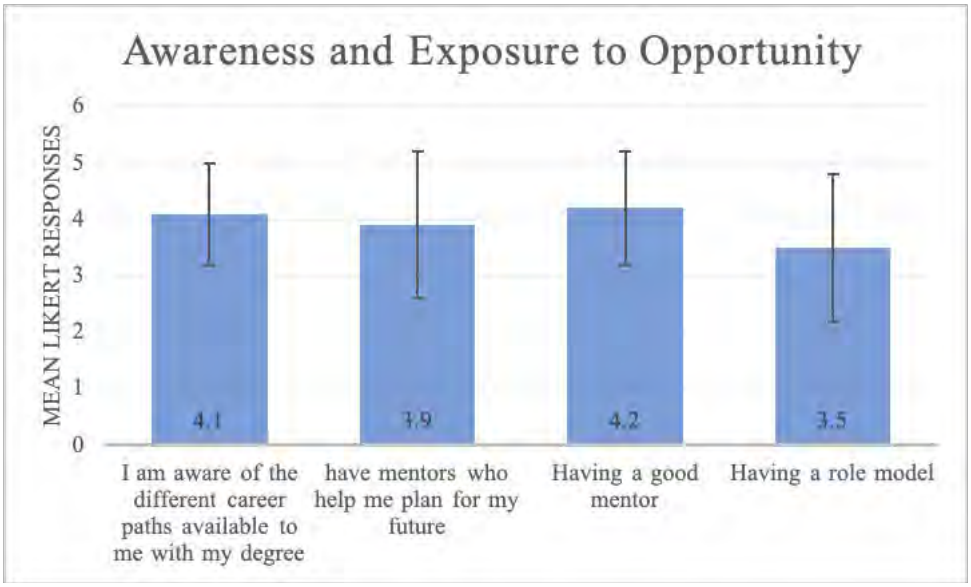

Figure 7: Mean responses for Likert-scale items related to awareness and exposure to opportunity. Error bars correspond to ±1 standard error of the mean.

Students reported positive average responses to questions regarding awareness and exposure to opportunity. Students indicated that they are aware to the different career paths available (mean=4.1, "agree") and that they have mentors who help them plan for their future. (mean=3.9, "agree"). They also reported that having a good mentor and role model is "very important to their success in STEM" (mean=4.2 and mean=3.5, respectively). These results may suggest that the presence of mentors and role models help students become aware of the opportunities available after their undergraduate education.

3.1.3 K-12 Education

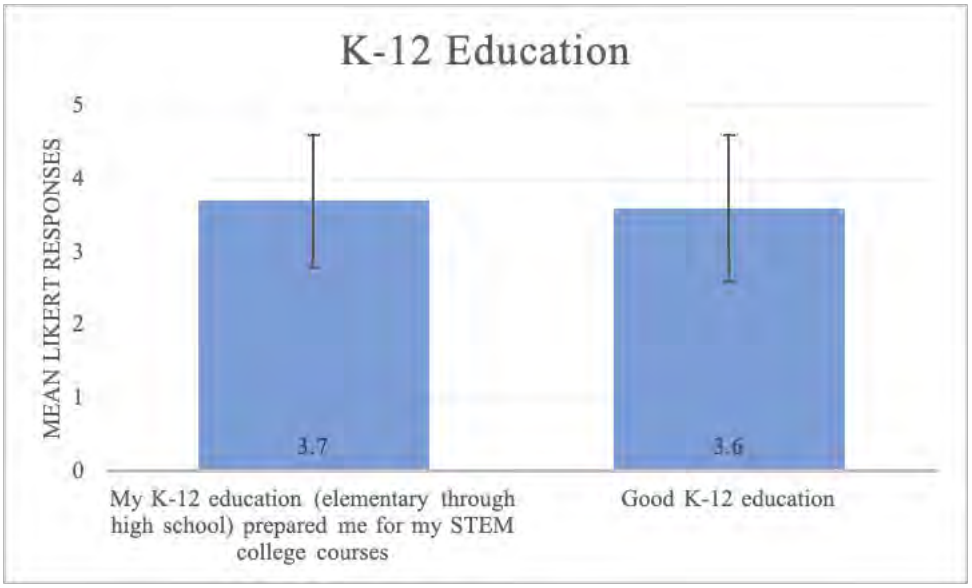

Figure 8: Mean responses for Likert-scale items related to K-12 education. Error bars correspond to ±1 standard error of the mean.

Students were asked if their K-12 education prepared them for their STEM college courses, to which the average response was "agree" (mean=3.7). When asked about the importance of a good K-12 education, the average response was "very important" (mean=3.6). Thus, participants indicated that their K-12 education is both important and effective in preparing them for college STEM courses.

3.1.4 Financial Barriers

Financial barriers were assessed using Likert scale and multiple-choice survey items. The most common primary source of funding is scholarships/grants, reported by 48% of the respondents. The most common secondary source of funding is a job, reported by 28% of the respondents, followed closely by parents/family (24%) and scholarship/grants (24%). The distribution of primary and secondary sources of funding for educational expenses is shown in Figures 8 and 9, respectively.

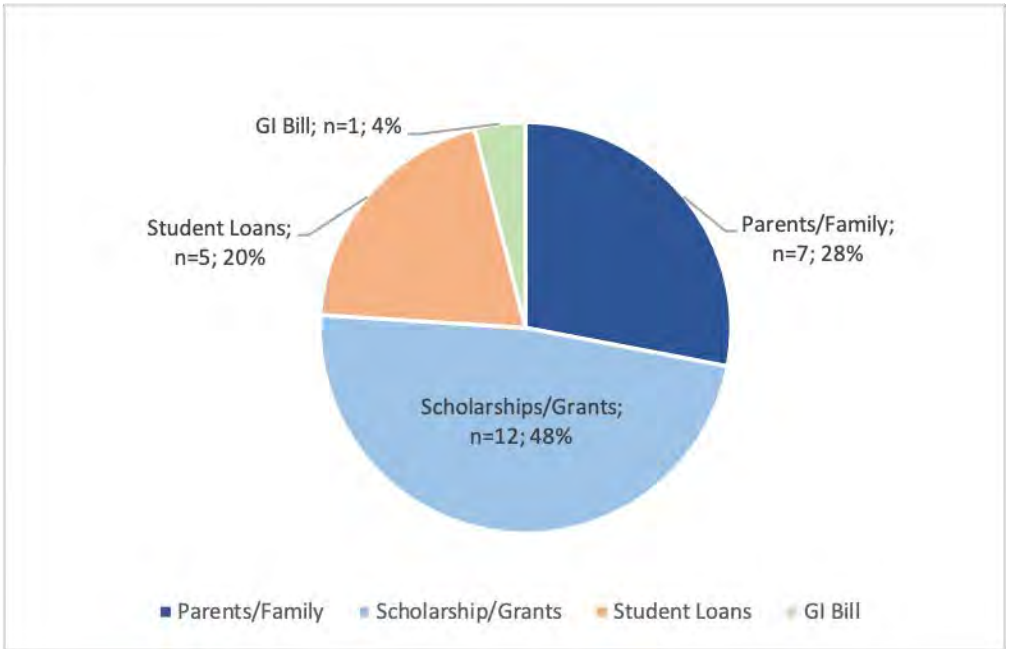

Figure 9: Primary sources of funding for tuition, books and housing

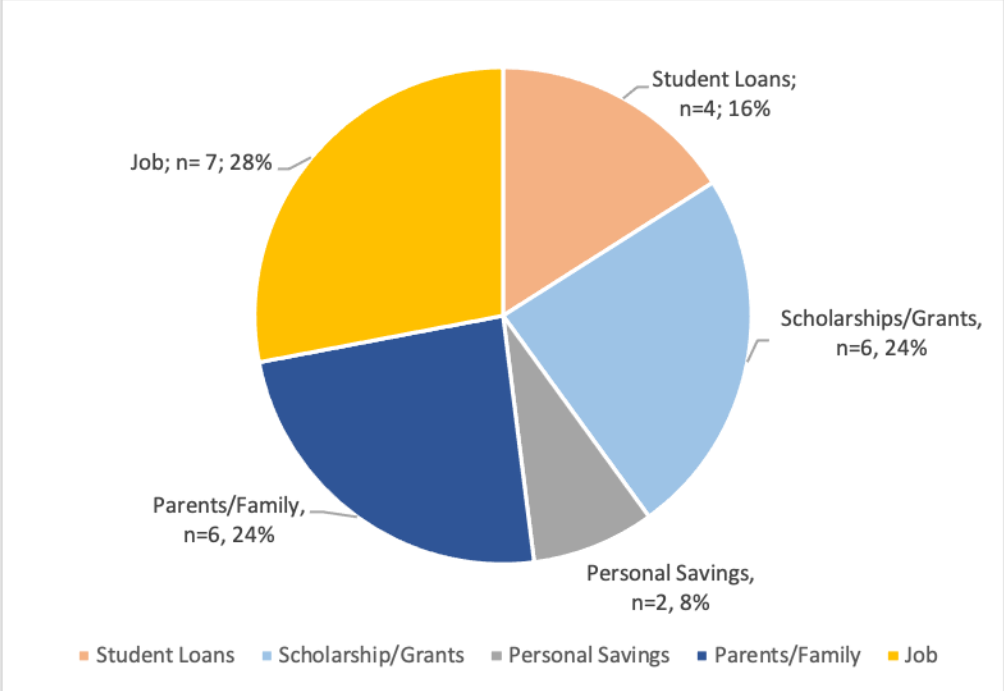

Figure 10: Secondary sources of funding for tuition, books and housing

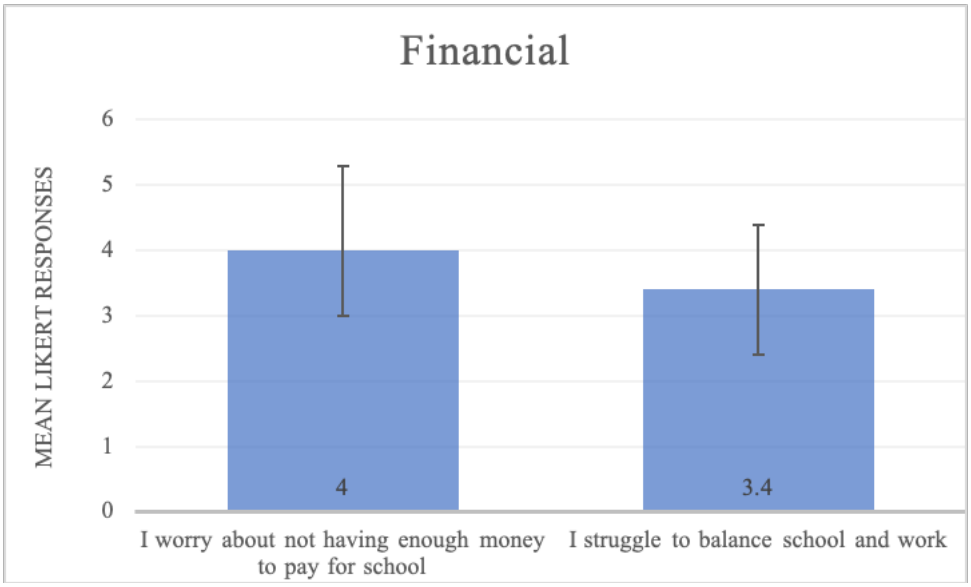

Figure 11: Mean responses for Likert-scale items related to financial barriers. Error bars correspond to ±1 standard error of the mean.

When asked if they worry about not having enough money to pay for school, the average response was "agree" (mean=4.0). As scholarships/grants are the primary source of funding for these students, and they still convey financial burden, this may suggest the need for more availability of information on scholarship/grant opportunities. Students were then asked if they struggle to balance school and work, to which the average response was "neither agree nor disagree" (mean=3.4).

3.1.5 Geographic Barriers

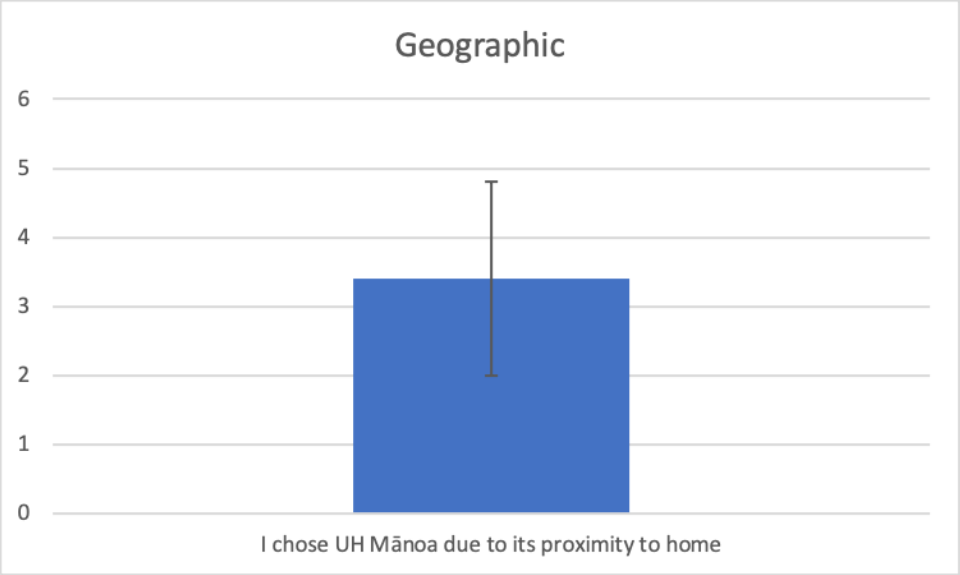

Figure 12: Mean responses for Likert-scale items related to geographic barriers. Error bars correspond to ±1 standard error of the mean.

When asked if they chose UHM due to its proximity to home, the average response was "neither agree nor disagree" (mean=3.4). For many Pacific islanders, attending college, whether it be in the Pacific or elsewhere, means moving away from home. Therefore, proximity of the school to their home may not be a determining factor, because regardless of location, attending college will still mean leaving home.

3.2 Open Ended Survey Items

The last survey items were two open-ended questions, asking respondents to suggest the types of resources or information that they would find helpful to see on a website, and to provide any additional comments. The responses are summarized in Table 4 below. The most frequently requested resources were information on scholarships (9 requests), followed by undergraduate opportunities (4), tutoring information/resources (4), and stories of other NHPI individuals in STEM (4).

Table 4: Open-Ended Survey Responses	
I am planning to develop a website containing tools to help NHPI students succeed in STEM. What kind of information would be helpful to see?	
Response	# of responses
Scholarships	9
Undergraduate Opportunities (Volunteer opportunities/Internships)	4
Tutoring Information and Resources	4
NHPI Stories	4
Studying Tips	3
Further Opportunities (Post-Graduation)	2
Mentors	2
NHPI STEM news	2
Mental Health Resources	1

3.3 Synthesis of Survey Results

The Likert-scale survey results suggest that the NHPI survey respondents experienced many of the barriers included in the survey items. However, due to the small sample size and large error bars, I was unable to determine the relative importance of these barriers based on Likert-scale items. This made it difficult to determine the best resources to include on the website.

Fortunately, there was a clear consensus in the open-ended responses. The most common resources requested were scholarships, undergraduate opportunities, tutoring services, and stories of other NHPI individuals in STEM fields. These responses were used to inform the website.

3.4 Website

A website was created on the Weebly platform (https://nhpistemsuccess.weebly.com). This website contains information on the most requested tools in the open-ended responses. The website has been designed as a user-friendly tool to share existing resources available to students, particularly NHPI students. The website contains five webpages: “Home”, “Scholarships”, “Undergraduate Opportunities”, “Tutoring”, and “NHPI Stories”. The ‘NHPI Stories’ page includes names and photos of NHPI individuals in the STEM field (Barcinas, 2020). The individuals on this page were contacted and permission was granted for their inclusion on this page.

3.5 Limitations

This study has numerous limitations, a few of which are mentioned below.

First, due to federal policies protecting student privacy, contact information for all individuals in the target audience could not be obtained. Instead, the survey was shared through Listservs and personal contacts, which would almost certainly fall short of reaching all individuals under this target population.

Second, an attempt was made to find survey items that were previously validated with our target population. However, this attempt was not successful. Therefore, it is possible that the survey items do not accurately measure what they are purported to measure. Additionally, in creating a survey, some questions were phrased positively (e.g., “My family encouraged me to obtain a college degree”) while others were phrased negatively (e.g., “My family obligations take time away from my studies”), and this could introduce bias. Thus,

the presence of the barriers addressed is only one explanation for the survey responses received.

Third, due to the small sample size, and resulting large error bars, many of the mean Likert-scale responses could not be statistically differentiated. Therefore, I recommend caution when interpreting the data . I included a table that identified the means, standard error of means, mode, and median to provide better insight into the results.

Finally, my statistical analysis was dependent on converting the Likert scale responses to integers. This quantification assumes that each Likert item is equally spaced – for example, it assumes that the difference between "strongly disagree" (1) and "disagree" (2) is equivalent to the difference between "disagree" (2) and "neither agree nor disagree" (3), which may not be true for individual respondents (Sullivan & Artino, 2006, Bruno et al 2020).

4.0 Conclusion and Suggestions for Future Work

4.1 Conclusion

This study investigated the barriers faced by NHPI undergraduates in STEM at UHM. The Likert-scale survey results suggested that these NHPI students experienced many of the barriers included in the survey. However, from their responses, I was unable to determine the relative importance of these barriers. Fortunately, there was a clear consensus in the open-ended responses, in which students indicated resources that they would find helpful to facilitate their success. Based on their recommendations, I developed a website to help dismantle key barriers for NHPI students in STEM at UHM.

4.2 Suggestions for Future Work

Survey. Considering the small sample size obtained in this study, I recommend a future study that is collaborative with UHM STEM departments to obtain a larger sample size and better representation of the student population. A larger, more representative sample would allow for a more comprehensive understanding of the barriers experienced by students at UHM. A more representative sample could also reveal any potential differences among different subgroups of NHPI students (e.g., by gender, NHPI ethnicity and/or STEM fields). A larger sample including participants of different majors could also help inform departmental change to better dismantle the barriers in their specific field.

Website. It is also recommended that the website created in this study be expanded and made available to all NHPI undergraduates in STEM at UHM, so they are equipped with resources for success at the start of their undergraduate STEM careers. Currently, the website is not easily accessible to students within the UH system, as it has not yet been adopted by any UHM STEM programs. Additionally, the responsibility of this website has not been given to any ongoing university group or program. To ensure that the website maintains its relevance over time as external resources change, it is recommended that one or more STEM programs adopt this resource.

Appendix: Student survey

Student Survey

This survey is aimed at gathering information from Native Hawaiian and Pacific Islander students in STEM at the University of Hawaii at Manoa. It will take about 6 minutes to complete. Your participation is voluntary and you can stop at any time. The information you provide will be used to develop a website to address challenges faced by NHPI students in STEM. Individual responses will NOT be shared outside of this specific project.

If you have any questions about this survey, please contact Arisa Barcinas at arisatb@hawaii.edu.

Please rate your agreement with the following statements

Mark only one oval per row.

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
My STEM classes are grounded in local communities and contexts.	◯	◯	◯	◯	◯
I understand how the material I learn can be applied outside the classroom	◯	◯	◯	◯	◯
My cultural background has influenced my decision to pursue my major	◯	◯	◯	◯	◯
My family obligations take time away from my studies	◯	◯	◯	◯	◯
My family was influential on my decision to choose a STEM major	◯	◯	◯	◯	◯
My family encouraged me to obtain a college degree	◯	◯	◯	◯	◯
My ethnicity affects how my peers interact with me	◯	◯	◯	◯	◯

My ethnicity influences how teachers interact with me					
Stereotypes about my ethnic groups bother me					
I am capable of succeeding in STEM					
I am aware of the different career paths available to me with my degree					
I have mentors who help me plan for my future					
I chose UH Manoa due to its proximity to home					
My K-12 education (elementary through high school) prepared me for my STEM college courses					
I worry about not having enough money to pay for school					
I struggle to balance school and work					

My PRIMARY funding source for tuition, books and housing (select the best answer) *

Mark only one oval.

- Student loans
- Scholarship/grants
- Parents/Family
- Job
- Personal savings
- Other: _____

My SECONDARY source of funding for tuition, books and housing (select the best answer) *

Mark only one oval.

- Student loans
- Scholarship/grants
- Parents/Family
- Job
- Personal savings
- Other: _____

How important are each of the following to your success as a student studying in your area or major? *

Mark only one oval per row.

	Extremely important	Very important	Moderately important	Slightly important	Not at all important
Having a passion for it					
Being able to relate the subject material to my personal experience					
Studying hard					
Supportive family					
Good K-12 education					
Having a good mentor					
Having a role model					

What is your intended major?

_____

What gender do you identify as?

Mark only one oval.

- ◯ Male
- ◯ Female
- ◯ Prefer not to say
- ◯ Other: _____

Please select your ethnicity

Mark only one oval.

- ◯ Carolinian
- ◯ Chamorro
- ◯ Chuukese
- ◯ Fijian
- ◯ Hawaiian
- ◯ Marshallese
- ◯ Palauan
- ◯ Pohnpeian
- ◯ Papua New Guinean
- ◯ Samoan
- ◯ Tokelauan
- ◯ Tongan
- ◯ Yapese
- ◯ Other: _____

I am planning to develop a website containing tools to help NHPI students succeed in STEM. What kind of information would be helpful to see?

Any other comments?

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