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Underrepresented Minority Students Find Balance in STEM: Implications for Colleges and Teachers of Agriculture

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Abstract

The current study explored challenges, support mechanisms, and successes experienced by postsecondary students enrolled in a STEM-based (i.e., science, technology, engineering, and math) minority student program within a College of Agricultural Sciences. Students faced challenges in the form of academic rigors, balancing school and life responsibilities, and unique cultural interactions. To counter-balance identified challenges, students articulated social support from peers and academic advisors as well as financial support from the STEM-based minority student program. In combination, the balance of challenges and support was suggested as an essential element to underrepresented student growth and success. Practical recommendations for facilitating successful balance to further underrepresented student success within colleges of agriculture are discussed.

Keywords: underrepresented minority students, challenges, supports, multicultural scholars program, STEM education

Introduction

In higher education, as in life, everyone has the responsibility to model inclusiveness and provide the support needed for all people to succeed. Unfortunately, STEM-related disciplines (i.e. science, technology, engineering, and/or math) in higher education are falling short of providing equal opportunities for all students (National Science Foundation, 2013). Racial and ethnic disparity within postsecondary STEM education is a significant challenge; with negative consequences including less diverse educational settings, fewer unique ideas and solutions being offered within critically important STEM careers, and fewer diverse role models in STEM (Mau, 2016).

In combination with underrepresentation, minority students who select a STEM major are faced with a variety of challenges (Ross et al., 2012). Research suggests underrepresented students are more likely to be first generation college students (Dennis et al., 2005; Harrell and Forney, 2003; Phinney and Haas, 2003; Terenzini et al., 1996) who lack the immediate family support of someone who has experienced college life and understands the challenges and resources available (Harrell and Forney, 2003). Additionally, balancing differing expectations between family and college life (Tseng, 2004), the demographic composition

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and social climate of campus (Smedley et al., 1993), and the financial burdens of college (Ross et al., 2012) are additional challenges for underrepresented students in STEM.

The challenges faced by underrepresented students have impacted not only recruitment into STEM disciplines, but also retention. Looking across all demographics, an average of 51.7% of students are retained to completion of a four-year, STEM degree (National Center for Educational Statistics, 2012). Unfortunately, for underrepresented students the picture is much bleaker, with the greatest rates of attrition among Black (29.3% retention to completion) and Hispanic (23.1% retention to completion) students (National Center for Educational Statistics, 2012).

The need to support underrepresented students interested, and enrolled, in STEM is dire, and many strategies (e.g., mentoring, transition programs, peer support networks) have been implemented to support underrepresented students (Dennis et al., 2005; Harrell and Forney, 2003; Phinney and Haas, 2003). However, support strategies should not stop with implementation; research is needed to ensure strategies enhance student success. To address the need for research, the current study analyzed the experiences of students enrolled in a postsecondary, agricultural-STEM degree supported through a STEM-based minority student program.

Contextualizing

A phenomenological approach was used to explore the successes and challenges of 10 multicultural students enrolled in an undergraduate, agricultural-STEM degree. Full exploration requires both contextualization of the study and situating the participants within the study.

The Multicultural Scholars Program (MSP), implemented through the College of Agricultural Sciences at Oregon State University, offers scholarships to students with diverse cultural/ethnic backgrounds and/or first-generation college students interested in Agriculture, Natural Resources, Food Science, or Human Health and Nutrition. In addition to scholarships, MSP provides students with faculty and peer mentoring, internships, and involvement opportunities on and off campus. Throughout the manuscript, the terms multicultural and underrepresented are used to represent the demographic profile of MSP students, which includes students classified as traditionally underrepresented, rural, low-income, and first-generation college students.

Compelling evidence of past student success within the MSP at Oregon State University make the program worthy of research. First, the MSP has been successfully grant funded since 2009, enabling faculty to interact with students before and after finishing the degree. The duration of the program has also provided an opportunity to track participants who continue into employment or graduate school. At the time of data collection, since the establishment of the MSP in 2009, the six-month placement percentage (i.e., proportion of students employed or enrolled in graduate school

six months after completion of undergraduate degree) was 100%. From the inception of the MSP, employers have been keen to interact with and hire graduates who combine diverse backgrounds, agricultural knowledge, and STEM proficiency.

All students within the MSP are enrolled in an agricultural-STEM major housed within the College of Agricultural Sciences at Oregon State University. The STEM-focused major is an academically rigorous degree focused on the development of skills necessary to be successful in research and STEM-related careers. During data collection, MSP students at Oregon State University, including participants in the current study, were conducting research on a variety of topics including: Alzheimer's, disease transmission in crops, obesity, bee pollination, quality of medical care, and wastewater research. Additional accomplishments of MSP students included research grants, national scholarships, journal publications, international research, competitive internships, and campus leadership opportunities. Furthermore, many graduates of the MSP were pursuing advanced degrees in areas including public health, leadership, oceanography, and psychology. Taken together, the accomplishments of MSP students illustrate a program successfully engaging underrepresented students in post-secondary, agricultural-STEM education.

The financial, academic, and personal support structures provided by the MSP were unique to students of the MSP and make the participant group both distinctive and worthy of analysis. Providing financial, academic, and personal support to underrepresented populations is a commonly stated goal of higher education institutions. Therefore, analyzing the impact of identified supports, coupled with participant enrollment in an agricultural-STEM major, position the current study to be worthwhile, valuable, and broadly applicable to colleges and teachers of agriculture.

Theoretical Framework

Past research illuminates a variety of challenges faced by underrepresented college students. However, the MSP at Oregon State University has a record of outstanding success among underrepresented students. Therefore, in framing the current study, a theory was sought which connected challenges with the potential for success among students. The theory of challenges and support (Sanford, 1966) emerged as an ideal theory for the experiences of students in the MSP. The theory of challenges and support acknowledges challenges as an effective method for developing skills, and states, "*people do not change unless they encounter a situation to which they cannot adapt with the use of devices already present*" (Sanford, 1966, p. 44). Additionally, the theory of challenges and support suggests without adequate support systems, students may not be able to find the required balance. In a discussion of the theory of challenges and support, Evans, Forney, Guido, Patton, and Renn indicated: "*If the environment presents too*

much challenge, students can regress to earlier, less adaptive modes of behavior; solidify current modes of behavior; escape the challenge; or ignore the challenge if escape is impossible. If there is too little challenge in the environment, students may feel safe and satisfied, but they do not develop.” (2010, p. 30).

As a metaphor, a balancing scale was used to illustrate students' experiences in the MSP (see Figure 1). The process of using a balancing scale involves comparing known weights with unknown objects/substances to determine a precise weight. MSP has given students an opportunity to develop the skill of balancing challenges and support, an important component to success during college (Sanford, 1966). Using the balance scale metaphor, experiences of students will be described as either challenging weights, supportive counter-weights, or successful balance.

Methodology

The purpose of the current study was to examine the experiences of MSP students in an agricultural-STEM major, framed by Sanford's theory of challenges and support. Of particular interest were challenges students experienced, support systems students utilized, and the balance students achieved between challenges and supports.

A phenomenological research design was used to consider the perceptions and experiences of students within the MSP (Creswell, 2012). The phenomena of interest included experiences in an agricultural-STEM major and the MSP. Participants shared experiences and perceptions through individual interviews, Minorities in Agriculture, Natural Resources, and Related Sciences (MANRRS) newsletters, and personal student biographical statements.

Participants

The study included 10 students simultaneously participating in the MSP and enrolled in BioResource Research. Participants ranged from sophomores to seniors and had all been involved in the MSP for at least two years. Participants represented a variety of cultural backgrounds and self-identified as Mexican, Vietnamese American, African American, and Mexican American. To protect the identities of the participants, pseudonyms were used.

This research is based on work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award numbers 2009-38413-

05243 & 2011-38413-30039. Funds included scholarships for participants, opportunities to travel to the national MANRRS conference, participate in summer internships, access to academic resources, peer mentoring, personal advising, faculty research projects, faculty mentors, and dedicated advisors. Students participating in the MSP were actively involved in the local MANRRS chapter and interacted heavily with the MSP advisor, who also served as the MANRRS advisor.

Data Collection

Individual interviews with students and textual analysis of program artifacts were used to collect data. Individual interviews allowed for a more open expression of the sociocultural differences between participants and removed the potential hindrances of peer influence in responses. Student and program artifacts, consisting of student biographical statements and the MANRRS newsletter were also analyzed, affording exploration of participant voices among a variety of data sources.

Researcher Positionality

The lenses through which phenomenon of interest are viewed have the potential to shape data collection, interpretation, and analysis (Merriam, 1998). Researchers of the current study shared a social constructivist epistemology, in which “the mind is active in the construction of knowledge” (Schwandt, 2001, p. 31). Within the constructivist epistemology, individuals construct knowledge by combining new information with past experiences. The constructivist epistemology provided a meaning-making framework for researchers of the current study to acknowledge student personhoods as multicultural individuals, agricultural-STEM majors, and college students.

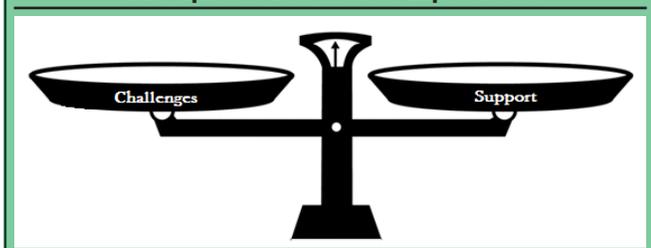
Data Analysis

Data were analyzed using established coding protocols (i.e., Auerbach and Silverstein, 2003). Specifically, an initial reading of the data with consideration to the research focus and the theoretical and epistemological lenses informed open, axial, and selective data coding (Strauss and Corbin, 1990). Importantly, the theory of challenges and support emerged and was used to organize the findings after coding the data (Walker and Myrick, 2006).

Rigor and Trustworthiness

Rigor and trustworthiness were established through measures of credibility, transferability, dependability, and confirmability (Harrison et al., 2001). To establish credibility, member checks and reflective journals were used to help identify any research biases. Furthermore, data triangulation was achieved by carefully examining participant interview transcripts, online biographies, and the MANRRS newsletter. Multiple researchers were used to analyze the data independently, and after initial coding, analyses were combined to formulate themes and final findings. After compilation of the themes, the final anal-

Figure 1. A Balancing Scale as a Metaphor of MSP Student Experiences.



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ysis was presented to participants for a member check. Participants agreed with the data, findings, and explanations. Transferability was ensured using rich, thick descriptions of the participants and the context in which experiences occurred (Maxwell, 2005). Finally, dependability and confirmability were established through an audit trail, the use of a reflective journal throughout the process, the use of multiple analysts and multiple sources of data, and receiving approval of the findings from participants (Denzin and Lincoln, 2011). Throughout the research, documents were coded B for biographies, I for interviews, and N for newsletter. Participant data were provided with a page number to link back to original data.

Findings and Discussion

From the interview transcripts, MANRRS newsletter, and student biographies, meaningful statements were coded, extracted, and clustered into four themes with a number of subthemes embedded within the overarching themes. The experiences of the MSP scholars are discussed in terms of a balancing scale where challenges and supports act as opposing forces creating an environment for optimal student growth (Sanford, 1966).

Theme One: Challenges

MSP students articulated a number of challenges associated with being enrolled in the BioResource Research, most prominent was anxiety brought about by the academic rigor of the degree program. As Henry stated, “[I am] stressed out a lot because of the fact that it is so difficult being in BioResource Research...It’s very stressful...that is the main negative is that it is just constant stress...the curriculum here is so intense and I never would have thought that I would ever be able to take on these challenges” (I-23). While the academic stress was certainly a challenging weight, the weight was made heavier by the potential impacts of being unsuccessful. As Tim articulated, “I had the pressure of what if I don’t succeed. It’s not just going to be me that’s going to be failing, there’s going to be a lot of people disappointed” (I-29).

The challenging academics spilled-over into the ability of students to balance school and life responsibilities. As Donna shared, “The hardest thing about this last year would definitely be my academic schedule. I was taking a great deal of science classes as well as trying to balance research with work...and sleep!” (B-57). The struggle to manage challenging academics and life responsibilities was exacerbated by unexpected family circumstances, as Ellen shared, “The hardest thing about last school year was during fall term. I spent Thanksgiving with my grandpa in the hospital, and was told he had a low chance of survival. Finals were very hard for me, because my thoughts were back home; however, I got through them” (B-52). The challenging nature of BioResource Research forced some students to question participation in the rigorous STEM discipline, “I just didn’t know how everything was going to work out.

I didn’t know if [this major] was going to be what I wanted to stick with” (Matt, I-16).

The academic rigor of the STEM degree program, concerns about failing others, and difficulties balancing school and life were challenges faced across participants. If not counter-balanced, the identified challenges could likely result in additional underrepresented students opting out of a STEM degree program.

Theme Two: Support

Challenges can serve as a crucible for student growth and development, but not without support (Evans et al., 2010; Sanford, 1966). A foundational principle of the MSP at Oregon State University is to recognize challenges experienced by MSP students and provide commensurate support. During interviews, students acknowledged the presence and value of specific elements of emotional and academic supports. Ellen shared, “I’m grateful for meeting a lot of new people...we’re all close and so I feel that I have them to talk to and they understand what I’m going through” (I-10), showcasing her ability to leverage the cohort for emotional support. In addition to support from peers, the value of a dedicated academic advisor was a consistent theme among MSP students, illustrated in Mary’s quote, “There are always people to talk to when you’re feeling bad about yourself. I always talked to [advisor] after I did terrible on an exam and she would always boost my confidence and make me believe I can accomplish what I had set out to do.” (B-58).

Not only did MSP students articulate emotional benefits from working with peers and a dedicated academic advisor, students also shared academic support. As Tim noted, “I didn’t give up...because [my advisor] didn’t give up on me...and after that I just felt like this person didn’t let me quit so why should I quit on myself...I really feel like there was definitely a lot of support and a lot of faculty that were willing to help out” (I-32). Alice also identified the importance of peers in collaborative efforts to succeed in the classroom, “I have received a lot of support from my friends being in classes together we help each other study in that manner” (I-1).

In addition to experiencing support from peers, advisors, and faculty within the MSP and BioResource Research, students identified specific elements of the MSP which helped balance the scales of challenges and support. A number of students identified participation in the MANRRS organization as a powerful support, like Henry who shared, “MANRRS just opens up your eyes...and allows you to think in so many different ways to expand your mind” (I-25). Carrie also shared the power of MANRRS, specifically attending the annual conference, “MANRRS conference...was definitely a life changing experience” (I-5).

An additional element of the MSP which students found supportive were authentic experiences. Alice noted research and presentation opportunities because of her involvement in MSP, “Presenting my research poster gave me valuable experience in having conver-

sations with other professionals about my work” (N-44). Additionally, Ellen seized her internship as an authentic career development opportunity, “I got work experience out of it...I feel like I wouldn’t have been involved if I was doing another major.” (I-12).

The final MSP element which students consistently identified as supportive was financial scholarships. However, the positive impacts of financial support were not just realized by the student, but by his or her entire family, as Carrie shared, “If I had gone to my original university, my younger brother would not have been able to go to [school]. Now with the scholarship money, he will be able to have the same high school experience as me” (B-47). Likewise, Henry shared the importance of the financial support to his family, “It gives the opportunity for myself, a low-income family student, to have an opportunity to not worry about money and not worry about finances...so it allows you to focus on your schoolwork, which is very important. The weight that I have taken off my parents’ shoulders because they do not have to worry about paying my college is extraordinary...it has given me the opportunity to de-stress my parents...to not have to worry about money for my college education” (I-24).

Emotional and academic support from peers, a dedicated advisor and faculty, participation in MANRRS, and the financial support from the MSP were essential counter-weights to the challenges faced by MSP students. The identified supports were critical to balancing the scales and establishing an environment of STEM success.

Theme Three: Cultural Influencers

The influence of culture fell beyond categorization as a challenge or support because each student experienced the nexus between culture and postsecondary experiences differently. For some, culture had no perceived bearing on success, for example, “I don’t think I’ve ever felt like a minority” (Alysa, I-9) and “When I’m walking around campus I don’t feel like a minority, just when I’m in the classroom...I feel like a minority but it doesn’t really stop me from being part of the classroom.” (Paul, I-21).

While some students did not articulate an impact of culture, others saw culture as a benefit. Matt identified his cultures being refined through the college experience, “It’s who I am and I appreciate it...I’m going to use it as fuel to the best of my ability in a positive way. College has definitely helped me find myself in terms of culture and where I stand in both cultures.” (I-14, I-16). Additionally, Alice found strength in her minority status, stating “I am a minority...it’s offered me an opportunity to be unique in my manner and offer the different things I bring...I think it has served to my advantage” (I-2). Alternatively, students like Ellen, shared challenges with fitting in due to culture, “I always feel different from people over here... it’s kind of hard because when I say I’m Mexican they expect me to speak Spanish...it is kind of hard seeing where I fit in” (I-10). Henry also shared

a challenge due to cultural influencers as he discussed the perceived disconnect between ethnic identity and science, “The ethnic identity of a Latino/Latina is not science.... I am the only hardcore science person from my cousins and my immediate family...it doesn’t go with the ethnic background” (I-25).

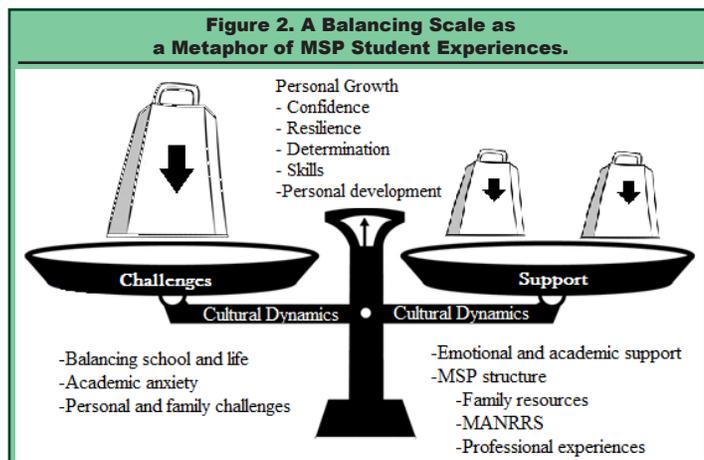
Unlike other elements of the MSP (e.g., financial support, academic rigor), the impact of culture was not consistently perceived as a challenge or support to student success; therefore, culture was classified as a “tipping point,” on the balance scale. For half the students, culture was perceived as either a positive or negligible influence on STEM success. For the other half of students, culture was a challenge as it was perceived to be incongruent with STEM-based educational experiences.

Theme Four: Balance and Personal Growth

Along with challenges, supports, and the unique embodiment of culture, students shared personal growth. Alice articulated personal growth related to organizational skills, “I found that although it was difficult, by organizing I could find time for all the things I considered important. I also realized that I would not always be able to do everything, so prioritizing helped me to focus on the things I believed mattered most.” (B-55). Chris also expressed skill growth, in communication and leadership, “What I have learned is better speaking ability with other individuals and communication methods as well as leadership skills” (I-4). In addition to specific skills, students articulated resounding themes of confidence, resilience, and determination. As Mary stated, “There were so many times I wanted to quit... You just have to keep in mind what your long-term goal is and that one bad exam will not be the end of the world, even though it feels like it...I can do anything I set my mind to...” (B-58). For some MSP students, a determination to continue the lineage of minorities in STEM emerged, as Henry shared, “I feel like I’m breaking barriers...I can be a role model to younger adults that want to move forward...I want to be a role model to younger Latinos or Latinas in the same field...especially for my younger cousins.” (I-28).

For each MSP student, experiences included a combination of challenges, supports, and growth. Challenges emerged from the academically rigorous, agricultural-STEM major and the stress of balancing school and life. Additionally, some students were challenged with a perceived disconnect between culture and choice of major. However, challenges were balanced by peer, faculty, and advisor support, MANRRS involvement, authentic experiences, and financial support. As a result, students developed skills and resilience necessary for success during and after completing the agricultural-STEM degree. For some, the MSP experience empowered a commitment to be a “role model” for future generations of scholars and professionals in STEM. Figure 2 illustrates how the MSP successfully facilitated balance for MSP students.

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Conclusions and Recommendations

The global demand for professionals in STEM, especially from underrepresented populations, is a critically important issue facing society. Research exploring educational programs successfully preparing STEM professionals from underrepresented groups can serve as roadmaps for additional programs, positively impacting more students. The MSP at Oregon State University has been a model of success through high retention, graduation, and placement rates of underrepresented STEM students. Within the current study, the experiences of students enrolled in the MSP were analyzed using Sanford's (1966) theory of challenges and support.

Within the theory of challenges and support, challenges are seen as crucible experiences which push students to develop skills and abilities previously undeveloped (Evans et al., 2010; Sanford, 1966). MSP students in the study experienced challenges associated with the academic rigor of the STEM degree and difficulty balancing school and life because of challenging academics. The challenging environment, when paired with support mechanisms, provided an opportunity for students to grow academically and develop the ability to persist when facing challenges.

The three subthemes of challenges (i.e., academic rigor, concerns about failing others, and school and family balance) were not unique to underrepresented students. However, about half the students articulated additional challenges due to perceived incongruence between culture and a STEM degree. Perceived cultural incongruence with STEM may be the product of fewer underrepresented STEM role models and/or a lack of awareness of STEM possibilities within underrepresented communities. The perceived disconnect between culture and STEM fuels the need to develop programs like MSP which support the success of underrepresented STEM pioneers who can be role models and advocates for increased STEM participation. Within underrepresented support programs, faculty and advisors should seek to foster open communication with students to increase awareness of the unique challenges faced by students and develop support mechanisms to implement when challenges become insurmountable.

Challenges, like the ones experienced by MSP students, provide an environment for growth; support mechanisms ensure potential growth becomes reality. MSP students identified a variety of support which helped balanced the metaphorical scales. Support mechanisms included emotional support, academic support, financial resources, MANRRS, professional experiences, and positive cultural dynamics. The first two support structures (i.e., emotional and academic support), were products of influential individuals. Students indicated both academic and emotional support came from the academic advisor and peers in the MSP. Identified support mechanisms illustrate the value others can have in helping underrepresented students balance challenges.

Financial resources, MANRRS, and professional experiences were all products of the programmatic structure of the MSP. One of the unexpected findings associated with the financial support provided to MSP students was the extended impact of the support. Several students articulated the scholarships reduced family stress and provided younger siblings an opportunity to gain a better education. Funders of underrepresented scholarships should take pride in knowing support may extend beyond the recipient to support the success of the entire family, including the education of younger siblings. In addition to financial support, MANRRS and professional experiences were key mechanisms for students to expand personal visions of STEM as well as expanded networks within STEM.

Based on the synthesis of support mechanisms discussed by MSP students, two concrete recommendations are forwarded to increase student success. First, academic advisors should be empowered to serve as both academic and emotional support. Academic advisors must be aware of the additional challenges faced by multicultural students as well as possess a thorough understanding of the academic program in which students are involved. On several occasions, students mentioned the importance of having an established relationship with a sole academic advisor. Consistency in advising allows for focused attention, follow through, and relationship building; therefore, dedicated advisors for support programs, like the MSP, are encouraged when feasible. Second, authentic involvement opportunities (e.g., MANRRS, professional conferences, internships) should be implemented as methods of encouraging STEM knowledge building, professional skill development, and expanded networks. Authentic experiences are exceptional opportunities for students to become prepared to succeed in professional STEM settings.

In the current study, experiences of underrepresented students were modeled using a balancing scale of challenges and supports. Of importance, however, is to not think of support mechanisms as always reactive to challenges. Instead, faculty and advisors of programs like the MSP are encouraged to consider the potential for support mechanisms to engage students in skill-building challenges. When an environment exists in which students perceive a security network of peers, faculty, advi-

sors, and resources, the barriers to engaging in challenging experiences may be lowered.

Challenges and support were critical to the development of students enrolled in the MSP at Oregon State University. University programs, focused on building support structures for underrepresented students, can have a profound impact on retaining students in STEM majors. Based on the findings of the current study, colleges and universities are encouraged to implement similar programs and seek funding to support underrepresented students interested in a degree and facilitate employment in STEM related areas. The results of such programs and structures can be students graduating with degrees in STEM with increased confidence, resilience, determination, and skills. Successful STEM students have the potential to make significant contributions to the STEM community and can serve as role-models for future STEM professionals of all cultures. The development of potential change-makers relies on understanding how to utilize both challenges and support to help multicultural students find balance and success.

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