# Cultivating a Budding Engineer: A Marginalized Female High Schooler's Journey Towards an Engineering Career (Fundamental)

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## Abstract

In this auto-ethnographic case study, we explore the life experience of a marginalized high school girl, Mira (pseudonym), who is a first-generation American born to parents from an undeveloped nation and a marginalized group with great desire and excitement for pursuing a career in engineering. Her personal background, which we address in this study, reveals a complex of traditions, challenges, and aspirations. Such factors depict the nuanced interaction between culture, pursuing education, and an engineering-targeted career in an evolving country such as the US. The primary goals of this study are to identify the motivators that drive her interest in engineering, investigate the impact of her familial background, and assess the impact of her involvement in extracurricular activities, specifically her involvement through the summer research experience at a four-year college in the southeast region of the US. This study is centered on a single case study, which is herself. In line with this study, the guiding research questions are: (1) What fundamental factors drive Mira's interest in engineering? (2) What challenges does Mira face, and how do they affect her personal and professional development? And (3) how do diversity and representation affect Mira's experiences and career paths in STEM fields? This study employed an auto-ethnographic approach. The purpose of autoethnography is to challenge the subject-object distinction by putting the researcher's perspective on the phenomenon being researched. The auto-ethnographic framework also allows for analysis of the varied interactions between factors that have influenced her interest in engineering. Additionally, a qualitative technique with an auto-ethnographic framework allows the researcher to look deeply into the participant's experiences, motives, and reflections. Auto-ethnography is a suitable approach to self-reflect, bringing valuable personal views into her experience. In support of this approach, she relates her experience actively engaging in hands-on experiments, problem-solving, and collaborative projects. These experiences contributed significantly to her practical knowledge and enthusiasm for engineering. The findings of this study reveal the complex chain of factors affecting her interest in engineering and provide valuable views to educational institutions, policymakers, and parents, assisting in developing successful methods to inspire and encourage the future generation of engineering experts. In conclusion, this study shows the future generation in which varied abilities are recognized, encouraged, and honored, guaranteeing that the ambitions of numerous young girls, especially from marginalized groups, find a place in the creative and constantly evolving field of STEM, especially engineering.



*Keywords*: Inclusion, female representation, STEM education, career, auto-ethnography, diversity

## Background

Promoting engineering education is critical for fostering economic expansion and innovation. However, entering careers in the STEM fields can be very challenging for members of underrepresented groups, such as women, minorities, and people from low socioeconomic origins (Kiernan et al., 2023). Research shows that persistent prejudices and biases function as severe hurdles, discouraging these people from pursuing professions in STEM (Wong et al., 2022). Gendered expectations and misconceptions about innate abilities not only diminish confidence and self-efficacy (Clark et al., 2021) but also obstruct academic and professional development in STEM domains (O'Connell & McKinnon, 2021). Additionally, access to quality STEM education is unevenly distributed, with marginalized groups enduring the burden of limited resources and educational support (Jackson et al., 2021). This consistent disparity further aggravates academic gaps, delaying the development of STEM perspectives among underrepresented groups (Casad et al., 2020). As we look deeper into these issues, it becomes noticeable that breaking down barriers to inclusion and opportunity is critical to achieving the entire potential of STEM professions and advancing an equitable future for all.

### *STEM Education and Underrepresented Groups*

Despite STEM education's crucial significance, the path to achievement in this area remains filled with challenges, particularly for underrepresented groups such as women, minorities, and people from low-income backgrounds (Casad et al., 2020). According to research, common stereotypes and biases may prevent members of underrepresented groups from pursuing careers in STEM fields. Stereotypes regarding gender roles and innate skills affect academic and career choices by jeopardizing confidence and self-efficacy (Hughes & Gaspard, 2020; Nosek et al., 2009). Access to high-quality STEM education supplies may be restricted in underprivileged communities. Academic gaps result from poor funds, a lack of resources, and poorly trained teachers in underprivileged schools, which interfere with developing STEM abilities (National Academies of Sciences, Engineering, and Medicine, 2017; Barton & Tan, 2010).

The lack of diverse guidance and role models in STEM careers may be a barrier for marginalized people. While there are current efforts to improve high school student's interest in the STEM field (e.g., Yeter et al., 2023; Burley et al., 2016; Youngblood et al., 2016), the availability of influential people with different backgrounds and mentoring programs are essential resources for offering direction, encouragement, and motivation (Chemers et al., 2011; Shapiro & Williams, 2012). Scholars and policymakers emphasize the significance of early experiences and support in fostering teacher's teaching confidence (Hammack et al., 2024; Moonga et al., 2023) and student's interest, confidence, and foundational skills in pursuing STEM careers (Burley et al., 2016; Yeter et al., 2016), the various obstacles experienced by underrepresented groups in the field of STEM.

Furthermore, early exposure to STEM subjects through interactive, inquiry-based learning may encourage students' enthusiasm and passion. Science exhibitions, collaborative experiments, and engineering workshops are a few programs that help debunk and increase accessibility to STEM disciplines (Maltese & Tai, 2011; Bybee, 2010). Recruiting minority students in STEM requires the development of equitable and encouraging learning environments. Setting priorities for diversity, equity, and inclusion in educational settings and initiatives may help students feel more valued and lower obstacles to achievement (Cech et al., 2011). Creating mentorship initiatives and presenting different role models may help underprivileged individuals get motivated and guided. Connecting with experts who have faced similar issues fosters endurance and self-worth (Thiry, Laursen, & Hunter, 2011; Estrada et al., 2016).

Furthermore, promoting diversity and guaranteeing that the advantages of STEM-related careers are available to everyone depends on recognizing and resolving the difficulties encountered by underrepresented groups. Guidance, early exposure, and educators' awareness of practices in providing positive environments are vital to overcoming obstacles and enabling people from underrepresented backgrounds to find opportunities and succeed in STEM fields (Casad et al., 2021).

## Significance of the Study and Research Questions

The study intends to gain insight into the fundamental processes that sustain Mira's passion and interest and to shed light on the dynamics, including familial background, cultural influences, and personal experiences, that shape the aspirations of young people pursuing STEM careers (Ellis et al., 2011). Examining the underlying mechanisms that preserve her enthusiasm and interest is critical and investigating these aspects will shed light on the hidden dynamics that form the goals of young individuals pursuing such engineering-focused majors. In line with this goal, the following are guiding research questions:

1. What fundamental factors drive Mira's interest in engineering?
2. What challenges does Mira face, and how do they affect her personal and professional development?
3. How do diversity and representation affect Mira's experiences and career paths in STEM fields?

## Methodology

An auto-ethnography approach was used as a research method through reflective thought and cultural evaluation to investigate and comprehend personal experiences within a larger socio-cultural framework (Keles, 2022). Autoethnography is defined as an in-depth examination of the lived experience of knowledge formation (Dauphinee 2010; Löwenheim 2010). This research method was chosen for this study to examine and communicate the difficulties experienced by a high school female student seeking to be an engineer, particularly in the context of gender stereotypes and a lack of suitable female role models. Moreover, a qualitative approach was used to combine personal narratives and cultural analysis. In contrast, the researcher may understand how socio-cultural factors influence personal identity and aspirations construction. In this case, being a female, first-generation American expands the story by requiring Mira to balance cultural norms and personal goals.

### *Autoethnographic Case Studies in STEM Education*

Auto-ethnography is a qualitative research technique that incorporates components of ethnography and autobiography. The application of auto-ethnographic case studies evolved as a valuable method in the context of STEM (science, technology, engineering, and mathematics) and engineering education to grasp the personal experiences of individuals working in these fields. In auto-ethnography, researchers analyze and contextualize their own experiences and perspectives through broad social and cultural settings (Martin & Garza, 2020).

Auto-ethnographic case studies are used in STEM education for different reasons. First of all, it gives academics and educators an environment to investigate the complex interactions that take place between individual experiences and the larger socio-cultural elements that shape STEM education. This approach makes it possible to gain a complete and detailed comprehension of the difficulties, achievements, and viewpoints of those working in STEM education. Moreover, auto-ethnography in STEM education provides an opportunity to respond to the individualized experiences of both educators and students.  This allows researchers to investigate the STEM learning environment in a more comprehensive and humanistic way, bringing to light elements that could be missed in more conventional quantitative research. By emphasizing individual experiences, researchers intend to move forward to a more inclusive and considerate approach to STEM education.

Auto-ethnographic case study approaches have been extensively used in several studies to investigate different aspects of STEM education. For example, an auto-ethnographic case study by Smith and Johnson (2017) examined the experiences of engineering educators making the switch from industry to university. The study focused on the difficulties people encounter when transitioning to new pedagogical settings and the influence of industrial views on instructional strategies. Moreover, Brown and Williams (2019) investigated the relationship between genders in a computer science classroom using auto-ethnography. The study explored the first author's personal journeys as female teachers, underscoring the varied connections established between gender identity, classroom dynamics, and STEM education. Chen and Lee (2020) used a different auto-ethnography study to examine how cultural diversity affected group projects in an engineering design course. The research provides insight into how different cultures affect team-based STEM project methods for problem-solving, communication, and collaboration.

The aforementioned studies demonstrate how auto-ethnographic case studies can be tailored to find unique STEM education perspectives. These studies have improved our understanding of the sociocultural aspects of STEM education. As the subject of STEM education grows, auto-ethnography is an excellent methodological tool for recording the evolving and various experiences within it.

### *Instruments*

When conducting an auto-ethnography, Mira provides an opportunity to share and explore her experiences through reflective journals and personal narratives, providing a comprehensive understanding of the influences that have guided her toward a STEM profession (Chang, 2008). These narratives were used to include valuable qualitative data that offers in-depth details about her identity, socio-cultural influences, and motivations. The researcher records her journey by including key moments, challenges, and the progression of her ambitions.

### *Analysis*

The personal narratives were analyzed through a systematic and reflective process, uncovering important themes. The researcher transcribed and documented Mira’s personal narratives. This phase included thoroughly capturing the participants' statements and experiences in written form, ensuring that no details were omitted. The researcher applied thematic coding techniques to find common themes and patterns in personal narratives. This comprised thoroughly classifying portions of text that were relevant to a specific theme. For example, codes consisted of "family influence," "gender stereotypes," "passion for space exploration," and "career aspirations." After the initial coding process, the researcher examined the coded segments to discover broader patterns and categories within the data. This stage included reducing and structuring the coded segments into more manageable units of study, such as themes.

## Findings

Several preliminary themes emerged from the personal narratives.

### *Passion and Motivation*

Mira’s exposure to Mars Exploration Rover (MER) missions and space launches sparked her interest in space exploration and engineering. She finds the genius of spaceship design, the feelings of those involved in space missions, and the excitement surrounding launch ceremonies to be fascinating. A study (e.g., Nourbakhsh et al., 2006) infusing an MER-focused activity in an informal setting showed that it was an effective educational tool to improve students' engagement and interest in STEM. Additionally, the accomplishments of those who came before Mira and the seemingly limitless possibilities that lie ahead inspire the person as she pursues her interest in space exploration and engineering. This theme represents a great fascination with the complexities of space travel as well as a desire to actively participate in pushing the limits of human knowledge and discovery. Moreover, it stands for a sense of purpose and ambition to advance human exploration based on a strong conviction in the transformative potential of scientific research and innovation.

### *Challenges and Growth*

Despite being a hard worker, Mira experienced many challenges and discouragements throughout her academic and professional career. These obstacles included a lack of representation in her field of interest, discrimination that harmed her confidence, and questions about her abilities to pursue the intended career (e.g., Zorzano, 2020). This theme not only focuses on the challenges faced by female individuals in male-dominated fields such as engineering but also on the opportunity for personal growth and development. Despite these challenges, she discovered empowerment and purpose through advocacy and leadership positions. As she is a member and now director of a robotics organization, she actively works to make the community more welcoming and inclusive of female members. A confirmatory empirical study indicates that such engineering-focused involvement might lead female students to pursue their careers in STEM fields (e.g., Tomko et al., 2021).

### *Gender Stereotypes and Discovery of Role Models*

As a female engineer, Mira faced difficulties with gender stereotypes that cast doubt on her competence and her goals. She faced difficulties with gender stereotypes that cast doubt on her competence and her goals as a female engineer. Existing studies (e.g., Cheryan, Plaut, Davies, & Steele, 2009; Cheryan et al., 2011) also reveal that such incompatible among females due to the lack of confidence in STEM fields and even such interests in STEM fields might be judged by their male peers (e.g., Park et al., 2011). The lack of female role models in this field intensified the aforementioned issues, making it challenging for her to locate appropriate role models and gain confidence in her career goals. This theme emphasizes the prevalence of gender prejudices and the significance of diverse representation in STEM disciplines, especially engineering.

Additionally, Mira reflects on her early experiences of not seeing many Indian women in engineering positions. She finds comfort and encouragement in the stories of leaders like Dr. Kalpana Chawla, whose accomplishments represent their own goals. These famous people serve as significant inspirations, emphasizing the importance of acknowledging and honoring multiple contributions to science and technology. Confirming with the existing studies, inspirational figures as role models can motivate females toward STEM interests (Cheryan et al., 2015; Gilberth, 2015). This theme emphasizes the importance of storytelling and historical narratives in creating a sense of belonging and empowering others. Also, it relates to the significance of being a female role model and the effect of finding similar role models on one's sense of identity and aspirations.

## Conclusion, Implications, and Future Directions

The study discussed above has various implications for educational institutions and policymakers, with a focus on creating diversity, inclusiveness, and support for people pursuing careers in STEM disciplines, especially engineering. This study investigates the experiences and reflections of a young girl from an underrepresented community who wants to work in the STEM field, specifically engineering. Based on her narratives, the participants often expressed feelings of loneliness and a lack of relatable role models in their respective fields. This lack of representation in STEM, particularly among women and people from underprivileged backgrounds, contributes to beliefs of uncertainty and unease about pursuing STEM jobs.

Additionally, prominent role models, such as Dr. Kalpana Chawla, inspired Mira and facilitated the significance of diverse representation in STEM disciplines. The role model encouraged and motivated the participant to pursue her passions despite societal constraints and preconceptions. Intrinsic reasons, such as curiosity, passion, and a desire for intellectual challenge, drove the participant to pursue STEM education. Also, access to mentorship, tools, and inclusive settings was crucial in promoting confidence and independence for the participant. In conclusion, by emphasizing the stories and experiences of women and people from various backgrounds in STEM, the study provides young girls with realistic role models who motivate and empower them to pursue their dreams despite societal constraints. More importantly, the study serves as a call to action for educators and policymakers to foster inclusive environments that encourage and support young girls from underrepresented groups to pursue STEM careers, especially engineering, thereby contributing to more diversity and creativity in these disciplines.

***Educational Institutions***

Educational institutions may expand the curriculum to include more diverse perspectives and female role models in STEM (Konowitz et al., 2022). Introducing students to the narratives and accomplishments of women, minorities, and people from various cultural backgrounds can motivate and empower underrepresented groups to pursue careers in STEM (Cheryan et al., 2015; Gilberth, 2015). Institutions, including K-12 and higher education, should develop more inclusive and supportive environments for students interested in STEM. This involves offering mentorship programs, networking opportunities, professional development for teachers, and resources suited to the needs of different student demographics. Such efforts align with Yeo et al.’s (2024) preliminary work that teachers use verbal and non-verbal cues to facilitate an inclusive environment that can positively impact students' engagement in engineering activities.

Another study conducted by Holmes, Redmond, Thomas, and High (2012) suggests that getting mentorship after-school programs for year-long support from female college engineering students positively enhanced middle school female students’ attitudes and behaviors as well as their interest in STEM fields. Educational institutions may vigorously advocate STEM programs and extracurricular activities that supply students with hands-on learning experiences and expose them to real-world applications of STEM values. Encouraging involvement in robotics clubs, space exploration efforts, and engineering-related competitions may help students develop an interest in and appreciate these disciplines (Burley et al., 2016).

***Policymakers***

Policymakers may set policies and efforts in place to increase diversity and representation in STEM professions. This could involve sponsoring initiatives to support underrepresented groups in STEM education, offering scholarships and grants to students from a variety of backgrounds, and encouraging diversity in employment practices within STEM fields and organizations. Policymakers may help to close the STEM participation and attainment gap by investing in projects that give access to STEM resources and mentorship opportunities. Moreover, policymakers should prioritize ensuring equitable access to STEM resources and opportunities for all students, regardless of socioeconomic standing or background (Reilly & Hurem, 2021). This could include investing in STEM infrastructure in underserved schools, increasing STEM education accessibility in rural and distant places, and tackling structural barriers to STEM participation. Further research should investigate Mira's educational and career path over time to explore the change in her interest, motivation, peer influence, and resilience towards STEM fields. Additionally, an intersectional study can be considered to investigate marginalized students, similar to Mira's situation, to compare the challenges and how they overcome them. Finally, exploring how institutional support influences her engagement and interest in STEM can provide a valuable output for mounting effective approaches to help marginalized students in STEM majors.

**References**


Barton, A. C., & Tan, E. (2010). We be burnin'! Agency, identity, and science learning. *The Journal of the Learning Sciences*, *19*(2), 187-229.

Burley, H., Williams, C. M., Youngblood, T. D., & Yeter, I. H. (2016, June). Understanding “failure" is an Option. In *2016 ASEE Annual Conference & Exposition.*

Burley, H., Youngblood, T. D., Yeter, I. H., & Williams, C. M. (2016, June). Engineering an evaluation for a growing rocket program: Lessons learned. In *Proceedings of American Society for Engineering Education (ASEE) Conference & Exposition,* New Orleans, Louisiana. 10.18260/p.26616

Bybee, R. W. (2010). What is STEM education?. *Science, 329*(5995), 996-996.

Casad, B. J., Franks, J. E., Garasky, C. E., Kittleman, M. M., Roesler, A. C., Hall, D. Y., & Petzel, Z. W. (2020). Gender inequality in academia: Problems and solutions for women faculty in STEM. *Journal of Neuroscience Research*, *99*(1), 13–23. https://doi.org/10.1002/jnr.24631

Cech, E., Rubineau, B., Silbey, S., & Seron, C. (2011). Professional role confidence and gendered persistence in engineering. *American sociological review*, *76*(5), 641-666.

Chang, H. (2008). Chapter 3: Autoethnography as method. Walnut Creek.

Chemers, M. M., Zurbriggen, E. L., Syed, M., Goza, B. K., & Bearman, S. (2011). The role of efficacy and identity in science career commitment among underrepresented minority students. *Journal of Social Issues*, *67*(3), 469-491.

Cheryan, S., Master, A., & Meltzoff, A. N. (2015). Cultural stereotypes as gatekeepers: Increasing girls’ interest in computer science and engineering by diversifying stereotypes. *Frontiers in Psychology*, *6,* 1-8.

Cheryan, S., Plaut, V. C., Davies, P. G., & Steele, C. M. (2009). Ambient belonging: How stereotypical cues impact gender participation in computer science. Journal of Personality and Social Psychology, 97, 1045-1060.

Cheryan, S., Siy, J. O., Vichayapai, M., Drury, B. J., & Kim, S. (2011). Do female and male role models who embody STEM stereotypes hinder women’s anticipated success in STEM?. *Social psychological and personality science*, *2*(6), 656-664.

Clark, S. L., Dyar, C., Inman, E. M., Maung, N., & London, B. (2021). Women’s career confidence in a fixed, sexist STEM environment. *International Journal of STEM Education*, *8*(1). https://doi.org/10.1186/s40594-021-00313-z

Dauphinee, E. (2010). The Ethics of Autoethnography. Review of International Studies 36(3): 799–818.

Ellis, C., Adams, T. E., & Bochner, A. P. (2011). Autoethnography: an overview. Historical social research, 273-290.

Estrada, M., Burnett, M., Campbell, A. G., Campbell, P. B., Denetclaw, W. F., Gutiérrez, C. G., ... & Zavala, M. (2016). Improving underrepresented minority student persistence in STEM. *CBE—Life Sciences Education*, *15*(3), es5.

Gilbert, P. (2015). *The role of role models: How does identification with STEM role models impact women's implicit STEM stereotypes and STEM outcomes?* (Doctoral dissertation, Tulane University School of Science and Engineering).

Hammack, R., Yeter, I. H., Pavlovich, C., & Boz, T. (2024). Pre-service elementary teachers' science and engineering teaching self-efficacy and outcome expectancy: exploring the impacts of efficacy source experiences through varying course modalities. *International Journal of STEM Education, 11*(1), 4.

Holmes, S., Redmond, A., Thomas, J., & High, K. (2012). Girls helping girls: Assessing the influence of college student mentors in an afterschool engineering program. *Mentoring & Tutoring: Partnership in Learning*, *20*(1), 137-150.

Jackson, C., Mohr-Schroeder, M. J., Bush, S. B., Maiorca, C., Roberts, T., Yost, C., & Fowler, A. (2021). Equity-oriented conceptual framework for K-12 STEM literacy. *International Journal of STEM Education*, *8*, 1-16.

Keleş, U. (2022). Writing a "good" autoethnography in educational research: A modest proposal. *The Qualitative Report, 27*(9), 2026-2046.

Kiernan, L., Walsh, M., & White, E. (2023). Gender in Technology, Engineering and Design: factors which influence low STEM subject uptake among females at third level. *International Journal of Technology and Design Education*, *33*(2), 497-520.

Konowitz, L., Lund, T., Lincoln, B., Reed, M., Liang, B., Barnett, M., & Blustein, D. (2022). Changemakers: Influences on Engagement in STEM Curricula among Underrepresented Youth. *European Journal of Psychology and Educational Research, 5*(2), 103-113.

Maltese, A. V., & Tai, R. H. (2011). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among US students. *Science education*, *95*(5), 877-907.

Martin, J. P., & Garza, C. (2020). Centering the marginalized student's voice through autoethnography: Implications for engineering education research. *Studies in Engineering Education, 1*(1).

Moonga, M., Hammack, R. J., & Yeter, I. H. (2023, June). Board 167: Exploring elementary pre-service teachers' personal engineering efficacy and engineering teaching efficacy in a science methods course incorporating engineering design activities (Work in Progress). In *2023 ASEE Annual Conference & Exposition.*

Nosek, B. A., Smyth, F. L., Sriram, N., Lindner, N. M., Devos, T., Ayala, A., ... & Greenwald, A. G. (2009). National differences in gender–science stereotypes predict national sex differences in science and math achievement. *Proceedings of the National Academy of Sciences, 106*(26), 10593-10597.

Nourbakhsh, I., Hamner, E., Ayoob, E., Porter, E., Dunlavey, B., Bernstein, D., ... & Clancey, D. (2006). The Personal Exploration Rover: Educational assessment of a robotic exhibit for informal learning venues. *International Journal of Engineering Education*, *22*(4), 777.

O'Connell, C., & McKinnon, M. (2021). Perceptions of barriers to career progression for academic women in STEM. *Societies*, *11*(2), 27. https://doi.org/10.3390/soc11020027

Park, L. E., Young, A. F., Troisi, J. D., & Pinkus, R. T. (2011). Effects of everyday romantic goal pursuit on women's attitudes toward math and science. *Personality and Social Psychology Bulletin*, *37,* 1259-1273.

Reilly, D., & Hurem, A. (2021). Designing equitable STEM education: guidelines for parents, educators, and policy-makers to reduce gender/racial achievement gaps. *International Encyclopedia of Education Volume 13*: STEM and Beyond.

Shapiro, J. R., & Williams, A. M. (2012). The role of stereotype threats in undermining girls' and women's performance and interest in STEM fields. *Sex roles*, *66,* 175-183.

Thiry, H., Laursen, S. L., & Hunter, A. B. (2011). What experiences help students become scientists? A comparative study of research and other sources of personal and professional gains for STEM undergraduates. *The Journal of Higher Education*, *82*(4), 357-388.

Tomko, M., Alemán, M. W., Newstetter, W., Nagel, R. L., & Linsey, J. (2021). Participation pathways for women into university makerspaces. *Journal of Engineering Education*, *110*(3), 700-717.

Wong, B., Chiu, Y. L. T., Murray, Ó. M., & Horsburgh, J. (2022). End of the road? The career intentions of under-represented STEM students in higher education. *International Journal of STEM Education*, *9*(1), 51.

Yeo, A., Yeter, I.H., & Limas, S.A. (2024, June). Examining teachers' enactment of engineering-focused design principles using action, speech, and gestures in elementary settings (Work in Progress). In *2024 ASEE Annual Conference & Exposition.*

Yeter, I. H., Burley, H., Youngblood, T. D., & Williams, C. M. (2016, June). Developing a questionnaire and evaluation methods for a high school rocket program. In *2016 ASEE Annual Conference & Exposition.*

Yeter, I. H., Tan, V. S., & Le Ferrand, H. (2023). Conceptualization of biomimicry in engineering context among undergraduate and high school students: An international interdisciplinary exploration. *Biomimetics*, *8*(1), 125. https://doi.org/10.3390/biomimetics8010125

Youngblood, T. D., Yeter, I. H., Williams, C. M., & Burley, H. (2016, June). STEMChoice: An examination of program evaluation data in a STEM-centered, inquiry-based program. In *2016 ASEE Annual Conference & Exposition*. https://peer.asee.org/25875

Zorzano, M. P. (2020). Gender balance in Mars exploration: Lessons learned from the Mars Science Laboratory. *Sustainability*, *12*(24), 10658.