Asian American Women's Success [Stories] in STEM Fields in Higher Education:
A Phenomenological Narrative Research

by

Dao Nguyen

Bachelor of Arts, Can Tho University, 1995

Master of Arts, Boston College, 2004

Submitted to the Graduate Committee of the

School of Education in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

University of Pittsburgh

2023

UNIVERSITY OF PITTSBURGH

SCHOOL OF EDUCATION

This dissertation was presented

by

Dao Nguyen

It was defended on

May 24, 2023

And approved by

Dr. Maureen McClure, Associate Professor, Department of Educational Foundations, Organizations, and Policy

Dr. Shirley Hune, Professor Emerita, University of Washington and University of California, Los Angeles

Dr. Müge Finkel, Assistant Professor, Graduate School of Public and International Affairs

Dissertation Director: Dr. Maureen Porter, Associate Professor, Department of Educational Foundations, Organizations, and Policy

Asian American Women's Success [Stories] in STEM Fields in Higher Education:
A Phenomenological Narrative Research

Dao Nguyen, PhD

University of Pittsburgh, 2023

My study used phenomenological narrative methodology to get insights into lived experiences of Asian American women (AAW) in STEM fields in higher education (HE). Conceptually, the *feminist research approach* overall guided my research inquiry. Theoretically, the *intersectionality, cultures of the academy, leadership power, cumulative advantage,* and *social cognition* framed my research design and data analysis to seek key factors most influencing the AAW's career pipeline and advancement in STEM fields in HE. The findings presented in this dissertation were from two data sources: (1) forty-eight documents related to the participants' institutions and their career pathway stories in varied STEM fields; and (2) ten in-depth semi-structured interviews with ten AAW at four-year universities across the US. My study informs that despite barriers rooted in the intersectionality of gender-based, racial, and hierarchical biases challenging them in different stages of their career pipeline, they have successfully advanced in their fields thanks to varied factors. Structurally at the macro level, they were supported by their institutional departments through their academic and work supervisors, advisors, mentors, and faculty. National, institutional, and departmental funding sources helped retain them in professional education and development. Pedagogy and leadership training programs prepared them to become tenured faculty and field leaders. They also had amicable and supportive work teams and social networks. In the family, their parents and husband provided them with encouragement and support so that they could retain and focus on their professional development.

Race-and-ethnicity-liked-community was also a significant facilitator for their life and work. Individually at the micro-level, they stood out in their fields with their significant growth mindset and mind tools – a clear vision for their career choice, positive thinking, perseverance, resilience, time and conflict management, work/study-family balance, and bi-cultural competence.

My study provides implications for the nation, organizations/institutions on how to consolidate such established higher education values as academic freedom and shared governance and to improve their policy and praxis to facilitate more AAWs to advance in STEM fields and for individual AAWs on how to prepare themselves to be successful in their STEM career in HE.

Table of Contents

List of Figures

List of Tables

Preface

I am forever grateful for the scholarship, wisdom, guidance, and support that I received from my Dissertation Committee, Professors, Colleagues, Friends, and Beloved Ones. Without their help, I could not have completed my dissertation. Their encouragement and trust in me kept me going, even when the work was difficult, and the deadlines were looming. I am truly blessed to have such an amazing support system.

I must emphasize my profound gratitude towards Dr. Maureen Porter, Committee Chair, for her unwavering support and guidance throughout my academic journey. Her wealth of professional experience and patient advising have been instrumental in my success, from coursework to dissertation stages. Dr. Porter taught me how to manage and analyze qualitative data using NVivo, as well as how to write and present findings both textually and visually. She consistently encouraged me to explore new research methodologies and methods as long as they were highly relevant to my research inquiry. Additionally, her extensive literature reviews helped to shape my understanding of my dissertation topic. Thanks to her mentorship, I feel well-equipped to tackle future research endeavors.

I am deeply indebted to the guidance and support of Dr. Maureen McClure, a Committee Member who provided me with invaluable expertise and insightful wisdom in higher education policy and strategy. Her instruction on how to conceptualize complex findings into a concise and persuasive abstract was particularly helpful. I also appreciated her patience as she listened to my ambitious and sometimes unconventional ideas, and provided guidance on how to narrow down my research inquiry, design, and implementation. Her influence and mentorship have been instrumental in my growth as a researcher.

I am forever thankful to Dr. Shirley Hune, Committee Member. Her extensive scholarship on Asian Americans and Pacific Islanders and higher education policy and leadership was invaluable in helping me to refine my dissertation. From the proposal stage, she provided critical feedback and scholarly suggestions that greatly improved my drafts. Her dedication to my work was evident in the time she spent with me, always checking in to see if I needed anything. Despite her busy schedule, Dr. Hune never failed to make time for my questions or concerns. Her guidance made my dissertation focused and rigorous, and I cannot thank her enough for her precious time and expertise.

My words are never enough to express my deep gratitude to Dr. Muge Finkel, a committee member who excels in gender and policy. I had the privilege of working on her GEPA project, which focused on gender equality in public administration. Through this project, I gained confidence in conducting two independent research studies. One of these studies served as a pilot for my dissertation, while the other was a further study after the GEPA project. I was fortunate enough to have both studies published in highly respected journals. Dr. Finkel's stance in the connection between practice, research, and policy influenced my research interests and dissertation inquiry. Her thought-provoking questions challenged me to think across disciplines and consider the personal and social identities of different groups of people.

My heartfelt appreciation goes out to ten faculty and leaders in STEM fields from ten universities across the US. Their busy schedules did not hinder them from devoting their time to long interviews to share their lived experiences in the entire pipeline of their career advancement in STEM fields in higher education. Thanks to their input, I was able to obtain the valuable rich data that I needed for my study.

xvii

always there to lend an ear and offer comfort during tough times. I learned so much from his professional insights into public policy and economics, which helped broaden my interdisciplinary knowledge and allowed me to think outside of the box when working on my dissertation. I also want to send my love to my beautiful daughters Vi Le and Thi (Katie) Le, who managed their own lives and studies with such grace and maturity. They were a source of comfort and relaxation for me after long days of work and study. I feel truly blessed to have such a loving and supportive extended family all around the world, who have always been there for me in their own unique ways.

I cannot express enough gratitude to my colleagues and friends who have been with me through thick and thin. They are like family to me, always providing me with the support I need whenever I face challenges in my studies, work, or personal life. I would like to extend a special thanks to Jorge Delgado, Shali Liu, Susan Mcclellan, Xi Wang, Anis Sundusiyuh, Midori Hasegawa, Yuh Hwang, Huiyuan Yue, Weiyan Xiong, and so many others who have inspired, guided, and helped me along the way. In addition to my close circle of colleagues and friends, I have been blessed to receive invaluable support from the Vietnamese Association in Pittsburgh and the Catholic Vietnamese Community in Pittsburgh. I would like to give a special shoutout to Father Dam Nguyen, Doctor Nghi Nguyen, Aunt Hanh Nguyen, the late Sister Lan Trinh, and Brother & Sister Tho & Trinh, who have been also like family to me. Together, they have helped me maintain a healthy balance in my academic, social, and spiritual life.

<center>**1.0 Introduction**</center>

1.1 Overview of Female Students and Faculty in STEM Fields in Higher Education (HE)

Diversity, inclusion, equity, and excellence have increasingly become an overarching drive and goal for high education endeavors. Faculty and students are both integral components of every college and university. Their access, retention, and success have been imperative topics of research literature on higher education policy and practice. Regarding diversity and representation, Davis and Fry (2019) noted that college faculty have been getting more racially and ethnically diverse, but still far less than students have. The recent notion of these authors and of many other scholars altogether persuaded me to focus my research on faculty rather than students.

As I had already studied lived experiences of woman faculty, particularly Asian American women faculty in social science fields in 2021, my research inquiry in this dissertation was centered on STEM fields.

STEM is an acronym for Science, Technology, Engineering, and Mathematics. In practice, it is defined variedly by different organizations. The Statistics in Brief 2009 by the National Center for Education Statistics (NCES) articulated:

> STEM fields can include a wide range of disciplines. For example, the National Science Foundation (NSF) defines STEM fields broadly, including not only the common categories of mathematics, natural sciences, engineering, and computer and information sciences, but also such social/behavioral sciences as psychology, economics, sociology, and political science (Green 2007). Many recent federal and state legislative efforts,

however, are aimed at improving STEM education mainly in mathematics, natural sciences, engineering, and technologies (Kuenzi, Matthews, and Mangan 2006; National Governors Association 2007). For this reason, this Statistics in Brief excludes social/behavioral sciences from the definition of STEM fields. STEM fields, as defined here, include mathematics; natural sciences (including physical sciences and biological/agricultural sciences); engineering/engineering technologies; and computer/information sciences. (NCES, 2009, p. 2)

In recruiting participants for my study, I took the definition of this NCES report of 2009 - STEM fields as a guideline. According to this report, STEM refer to mathematics; natural sciences (including physical sciences and biological/agricultural sciences); engineering/engineering technologies; and computer/information sciences.

I was even more excited with STEM fields when learning that many scholars highlighted the increasing importance of STEM in providing wide opportunities for escalating social mobility in the evolving U.S. economy (Arcidiacono, 2004; Creusere et al., 2019; Kang et al., 2021, June 17). This explains for the UNESCO's recent call for more investments in science in general in the context of globally growing crises (O'Malley, 2021, June 18). All of these together imply for a crucial role of higher education in preparing STEM fields human resources for economy and society at large.

In order to successfully prepare STEM fields human resources, higher education policy makers, administrators, and practitioners should understand well the representation and lived experiences of their institutions' students and faculty.

The data released by the National Center for Education Statistics (NCES) in February 2019 pointed out that there was a gender gap between the number of STEM field bachelor's degree holders and that of overall bachelor's degree ones:

> Overall, a higher percentage of bachelor's degrees were awarded to females than to males in 2015–2016 (58 versus 42 percent). However, in STEM fields, a lower percentage of bachelor's degrees were awarded to females than to males (36 vs. 64 percent). This pattern—in which females received higher percentages of bachelor's degrees overall but lower percentages of bachelor's degrees in STEM fields—was observed across all racial/ethnic groups. (NCES, February 2019)

Many scholars have emphasized that a bachelor's degree is like a first "ticket" in the educational pipeline to enter graduate studies and then persist a STEM career. In career retention, Melin and Correll (2022) concerned that women leave STEM fields in their career at a higher rate than their men counterparts.

Regarding scholarship of STEM fields, most recently, Castro and Collins (2020) noticed, "The majority of research on STEM fields has focused on undergraduate student experiences" (p. 34). Their claim informed a limited number of research studies on graduate students and faculty in STEM fields.

Less diversity and retention of women faculty in STEM fields, and the constraint of research literature on experiences of women faculty in STEM were key justifications for my study's focus on faculty rather than students. Moreover, my positionality as an Asian woman migrant interested in academic career in the United States of America (U.S.) inspired me to narrow

my research inquiry in this dissertation on Asian American women in particular rather than women in general.

1.2 Asian Americans and Asian American Women in STEM Fields in HE

In my study, I chose the categorization of race and ethnicity introduced by the U.S Census Bureau. Indeed, it follows the guidance of the U.S Office of Management and Budget's (OMB) 1977 Revisions to the Standards for the Classification of the Federal Data on Race and Ethnicity. Starting in 1997, OMB required federal agencies to use a minimum of five racial categories in their surveys and statistics: *White, Black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or Other Pacific Islander* and one racial category of Hispanic origin. For elaborating the Asian category to varied ethnic categories, I employed the classification of the most recent U.S. Census in 2010 and 2020 in which Asian race includes the following major ethnic groups: Asian Indian; Chinese; Filipino; Japanese; Korean; Vietnamese; and other Asian.

"Asian Americans" is a socially constructed term referring to a diverse and complex community. It is frequently used interchangeably with the term "Asians" or people of Asian descent. However, "Asian Americans" mostly refers to those who were born and raised in the U.S., or young children who were born in Asia but brought up primarily in the U.S. (1.5 generation), or any individuals who self-identify as "Asian Americans" rather than "Asians." In practice the term "Asians" is more likely to identify Asians who are temporarily in this country such as international students and scholars (Irey, 2013). Those who were born, brought up in Asia but pursued graduate studies, and currently work in the U.S. are also included into the sample of this study.

4

The Asian American population is one of the major racial groups in the United States. It has had a fast growth rate since the Immigration Act of 1965 (Hune, 2020a, 2020b; Liang & Peters-Hawkins, 2017). The period of 2000-2015 saw the most impressive growth rate of 72 percent (from 11.9 million to 20.4 million). Compared to other groups, it is the fastest growing group in the U.S. (from 0.7 percent in 1970 to nearly 6.0 percent in 2016, and predicted to be 14 percent by 2065) (Lee et al., 2018). It is estimated to be the largest racial group by 2055. Current Asian Americans (AA) are originally from more than twenty Asian countries, making it the most diverse U.S. racial group with widely different migration histories and socio-economic backgrounds (Hoeffel, March 2012; Labov & Waletzky, 1967; Lee et al., 2018; PRC, 2012; USCensus, 2010, 2020). Today, nearly four of five Asian American adults are foreign born (Lee et al., 2018).

Compared with the other minority groups, the Asian American group ranks overall high in college and university enrollment, in employment, and in household income. However, they have been persistently underrepresented and marginalized in their career advancement and leadership in academia (Chen & Hune, 2011; Chung, 2008; Espinosa, 2019; Huang, 2012; Huang, 2013; Huang et al., 2011; Hune, 1997, 1998, 2002, 2006, 2009, 2011a, 2020a, 2020b; Irey, 2013; Kawahara, 2007; Kawahara et al., 2008; Kawahara et al., 2013; Kawahara et al., 2020; Le, 2016; Lee et al., 2018; Lee & Zhou, 2015; Lee, 2018; Monzó & Hoo, 2014; Park et al., 2014; Reeves, 2014; Torne, 2013).

Since the 1970s when Asian American Studies and Critical Race and Gender Theory were introduced, there has been increasing number of research studies providing rigorous explanations for AAW's underrepresentation in academia. The overwhelming majority of the studies indicated that invisible barriers or "glass ceiling" and visible barriers or "concrete wall", connected to gender, race, and cultural stereotypes and prejudice have contributed to "leaks" in the educational

and professional pipelines of AAW (Chen & Hune, 2011; Chin, 2012, 2013, 2020; Chung, 2008; Homma-True, 2017; Huang, 2012; Huang, 2013; Huang et al., 2011; Irey, 2013; Kawahara, 2007; Kawahara et al., 2008; Kawahara et al., 2013; Kawahara et al., 2020; Kim et al., 2010; Lee et al., 2018; Li, 2014; Mukkamala & Suyemoto, 2018; Park et al., 2014; Torne, 2013; Williams et al., 2016).

Most recently, Castro and Collins (2020) agreed with Chinn (2002), "AAW signify an underrepresented group whose 'knowledge, values, and practices" (p. 34) are "missing from the knowledge base established by the dominant group" (p. 320)

In STEM fields, the Pew Research Center Report of 2018 and Williams et al. (2016) highlighted that AAW had a better status than other minority women in terms of their representation and competence. However, in contrasting to men and white women, the number of AAW scientists and engineers at senior levels have still lagged behind (Castro & Collins, 2020; Wu & Jing, 2011). Wu and Jing (2011) emphasized that the number of AAW employed by colleges and universities in tenured-track position or as full professors made up the smallest proportion in compared to their counterparts in other races and gender. Relating to this underrepresentation, the AAW leaders' representation in full professors, deans, or university presidents is also minimal. The number of AAW in non-faculty positions (postdocs, researchers, lab assistants, non-tenured faculty) accounts for 80 percent of the total AAW in academia. Castro and Collins (2020), Ong (2002), Ong (2005), Ong (2011), Ong et al. (2016), Ong et al. (2018), Ong et al. (2011a), and Ong and MEC (1979), agreeably conceptualized that, "***AAW women occupy a paradox space in STEM fields, simultaneously overrepresented as Asian Americans and underrepresented as women***" (Castro & Collins, 2020, p. 34).

2.0 Problem Statement, Research Purposes, Research Questions, My Positionality, and Organization of the Dissertation

2.1 Research Problem Statement

As noted in the Introduction, STEM fields has been increasingly important in the national development in the context of escalating mobility and global crises. My recent systematic review of research studies published in recent two decades on AAW and leadership in the academy revealed that the scholarship body of AAW in STEM leadership is extremely small. Among 26 research works selected for my deep review, there is only one study (Williams et al., 2016) explicitly on women's retention in STEM, in which AAW are included in the examination of this study. Expanding my search for further research literature with a key phrase "Asian American women in STEM", I obtained five more works published in recent two decades (Castro & Collins, 2020; Chen & Buell, 2018; PRC, 2012, 2018; Wu & Jing, 2011). The majority of these research works included AAW in STEM as one of the subject-groups in their whole examinations. Only Castro and Collins' (2020) study puts AAW as a centered subject group in their investigation. The sample included AAW who were pursuing doctoral programs and were within 5 years of earning their degrees in STEM fields.

The Introduction section above and this section shed light on ***three phenomena*** triggering my research inquiries – (1) an *emerging overrepresentation* of AAW in STEM relative to other racial female groups in the US, (2) a *persistent underrepresentation* of AAW in leadership, particularly in higher levels of leadership in STEM fields in HE, and (3) a *dearth of research works* on the AAW's trajectories from early to later stage in their STEM career.

2.2 Research Purposes

With those research justifications, my dissertation had ***three primary purposes***: first, seeking success factors/interventions empowering them to overcome the obstacles and to advance in their career in STEM fields in the whole pipeline from professional education to leadership (academic and non-academic post in HE); second, pointing out factors obstructing AAW women's advancement in STEM fields in each stage of their professional education and career pipeline; and finally, enriching the knowledge base on AAW in STEM fields in HE.

Put differently, my first purpose was to explore the success stories of the AAW to construct success factors of their better status in STEM in compared to other racial female groups in the US. The second purpose was to explain their underrepresentation and marginalization in leading positions in STEM. And the third aim was to consolidate, enrich, and/or challenge contemporary scholarship of AAW in STEM.

Beyond the two key purposes of my study mentioned above, the ultimate goal of my dissertation was to provide higher education institutions, communities, family, and other stakeholders with viable strategies and interventions to facilitate more AAW to advance their STEM career. Specific recommendations for individual AAW who want to retain and sustain in STEM fields on how to cope with barriers was another highest goal of my study.

2.3 Research Questions

With clear research purposes in mind, I designed a research study to look for rigorous answers to three research questions. A couple of sub-questions are to seek further explanation and exploration:

1. *What factors and interventions empowered the AAW to advance in their career in STEM fields in HE in the U.S?*

2. *In the journey to success in STEM fields in HE, what were the biggest obstructions the AAW had to face?*
    - What were fundamental roots of those challenges?
    - Did those roots stand separately or intersect?

3. *At which level of the society (macro-, meso-, micro-level) did the success factors and interventions, and obstructions operate?*

2.4 My Positionality in the Study

I am an Asian woman in academia. I worked as an instructor at a university and then as an associate researcher at a research institute in my home country, Vietnam. My professional field is in higher education. I did not feel I am underrepresented in my working place there. But many of my Asian American friends here in the US feel otherized than their colleagues of the majority group.

When I came to the U.S. for my Ph.D. journey, I started realizing that Asian American faculty have been underrepresented in academia. This is despite Asian Americans having been stereotyped as the "model minority" in the US because of their large enrollment at elite

universities, high household income, and high employability. As an Asian woman aiming to work in academia in the U.S., I have had a particular interest in the status and feeling of Asian American women faculty in order that I could be well-prepared for my future career. More specifically, I would like to examine which challenges they have faced and which opportunities they have enjoyed on the process of their attaining advanced degree of professional education, seeking a professional job, retaining in it and advancing in their career. I also expected that the findings of my dissertation study would inform policy makers most viable recommendations to improve the current eco-systems (policy and climate) for professional development for Asian American women faculty in particular and non-white women faculty in general.

As a woman originally from an Asian country and on the way to long-term work in the academy, I will benefit from communicating and getting insights into perspectives and feelings of Asian American woman faculty. My research positionality apparently reflects my own gender, race, ethnicity, and occupational status as Milner IV (2007) articulated, "Narrative and non-narrative should be captured by the researcher, experienced by the research participants, and told by people of color" (p. 391). In addition, "ingrained nature of race and racism" in critical theory is also reflected in my study as noted by Milner IV (2007, p. 391) I pre-assumed Asian American female faculty like other minority women found "it difficult to even recognize the salience, permanence, effects, and outcomes of racism because race and racism are so deeply rooted and embedded in our ways and systems of knowing and experiencing life" (p. 390). I hope that my findings would help transform current policies through "the exposure of racism" in professional development of Asian American female faculty (p. 391).

Given that my presumption for persistent gendered, racial, and hierarchical discrimination in HE toward Asian American female faculty, I intentionally wanted to uncover it by getting

insights into it. From revealing barriers AAW have been facing in STEM fields, I would be able to propose viable structural changes to eliminate the discrimination and also suggest doable "remedies" for unjust practices. I also understand the reality that Bell (1980) inserted, "the interest of blacks [and other people of color] in achieving racial equality will be accommodated only when it converges with the interests of whites" (p. 523).

Different from many previous studies, I studied the AAW's lived experiences in their STEM professions from their success stories. In other words, my study's participants were academic and non-academic leaders who have successfully anchored their career in STEM. They shared their past painful and favorable stories they had in the whole pipeline from professional education to faculty/administration and leadership. From their narratives I could figure out structural and personal factors forming barriers and supporting sources for their success stories.

In summary, my gender and racial position, and goal for my long-term career in the academy strongly stimulated me to navigate opportunities and challenges of Asian American women faculty in STEM fields in the U.S.

2.5 Organization of My Dissertation

This dissertation is organized into eight sections. The first section – Introduction – provides an overview of female students and faculty in STEM fields in higher education, then goes deep into Asian Americans in general and Asian American women in STEM fields.

From understanding of AAW's representation in STEM, the next section focuses on my research problem statement, research purposes, research questions, and articulation of my positionality in this study.

The third section provides scholarly definitions of structural and personal factors in higher education; career success and leadership in higher education; and nuance of the "pipeline" metaphor. The rest of this section concentrates on the review of studies on women of color in higher education and success in STEM fields; AAW leaders in higher education generally and in STEM particularly. The last part of this section presents key metaphors used to describe barriers the AAW faced in their pathways to leadership and their leading practices.

Following the literature review is the fourth section of conceptual/theoretical and analytical frameworks for my study design. This section also elaborates research philosophical, epistemological, and methodological stances framing my study.

By default, the next section is of the methodology and methods. Strategies to ensure trustworthiness of my study, and summary of my research progress by academic semester are also included in this section.

The sixth section presents major and minor findings of my study. There are three sub-sections basically alongside my research questions. The first sub-section gives the demographics and general features of institutions of the ten AAW in my study. The second sub-section informs rigorous answers to my first research question - *What factors and interventions empowered the AAW to overcome the barriers and advance in their career in STEM fields in HE in the U.S?* And the last sub-section provides responses to my second research questions - *In the journeys to success in STEM fields in HE, what were the biggest obstructions the AAW had to face?* In each sub-section, the findings are organized into three levels of the data analyses adhering to macro-, meso-, and micro-levels in society. Indeed, this is the way to answer the third research questions – *At which level of the society (macro-, meso-, and micro-level) did the success factors and interventions, and obstructions operate?*

The seventh section is for Discussions and Contributions, arguing how far my study findings have contributed to (1) the established scholarship of AAW in STEM fields in HE in terms of supporting, enriching, and challenging the current knowledge base; (2) praxis related to STEM fields in higher education; and (3) research methodology and methods. While discussing those aspects, this section also highlights the impacts of organizational behavior and cultures of academy on AAW development in STEM in HE. In personal dimension, this part illuminates the factors regarding social cognition, mindset, mind tools, human-social-cultural capitals, and leadership power the AAW possessed to enable them stand firmly in adversities and to move forward in their career. The part on the contributions of this study to praxis related to STEM fields in higher education presents specific suggestions for agents at macro-, meso- , and micro-levels. The suggestions are integrated primarily from this study's results, my established knowledge of higher education, organizational behaviors, policy and practice. The specific implications from the participants in my study are also noted in detail in this section.

The Conclusion summarizes key significance of my study, and provides implications for further studies.

This dissertation has four appendices – IRB approval, introductory script, email message template, and interview protocol. Five figures and five tables provide further illustrations for my textual presentation.

3.0 Literature Review

As my study aimed to seek facilitating and obstructing factors in career advancement of AAW in STEM fields in higher education, the first part of this section reviews literature on structural and individual factors in higher education. The next part locates the nuance of the term "success" used in the tittle and throughout this dissertation. Then, the implicit meaning of the metaphor "pipeline" is provided based on the review of research studies of Asian American Studies. The rest part of this section features specific images of women of color (WoC) and AAW in HE and in STEM fields depicted in existing research literature.

3.1 Structural and Personal Factors in Higher Education

3.1.1 Structural Factors

Stephens et al. (2015) defined ***"structural factors"*** as "the environmental and material resources that can guide a student's behavior, such as money and parental support" (p. 6). From their point, I used the term "structural factors" with much broader coverage in my study. "Structural factors" in my dissertation include environment and resources of family; community; institution, and nation (original countries and the U.S.). They also counted such social constructs as gender, ethnicity, and class. All are associated with tangible and intangible value, culture, and policy.

More specifically, my study also borrowed perception of educational institution theorists on the impact of the specific characteristics of education systems on choice of study field and career. Characteristics may be "extended period of compulsory education, the provision of pre-school education, single-sex versus co-education schooling, regulation of the maximum class size, regulation of the length of the school day, late ability tracking, higher educational spending, and the existence of bursary systems" (Yazilitas et al., 2013). In profession, institutional perspectives refer to governance, organizational culture and behavior, and policy facilitating retention and promotion of members in an organization. My study made uses of these dimensions of institutional theory to illuminate factors contributing to and challenging AAW's success in STEM fields in HE.

3.1.2 Personal Factors

Personal factors are the attributes of individuals such as self-efficacy, personal characters and traits, skills, abilities, and others related to personal characteristics (Stephens et al., 2012). Drawing from theories of social cognition and leadership power, my dissertation closely looked at how AAW in STEM fields perceived their own strengths and weaknesses and what power bounded to their profession and leading authority they used to overcome challenges and influence others in their organizations.

To make it more concrete, my query for individual factors of AAW stemmed from the view of Social Cognitive Theory (SCT) viewpoint introduced by Bandura (1986). According to this theory, human behaviors and choices are primarily explained through self-efficacy beliefs, outcome expectations, and goal representations. Self-efficacy beliefs are denoted by "people's judgment of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p. 391) They are related to the question "Can

15

I do this?" Outcome expectations refers to a "person's estimate that a given behavior will lead to a certain outcome" (p. 193). They address the question "If I do this, what will happen?" Goal representations are identified by determinations of individuals to engage in a particular activity. They are associated with the question "What will I have to do to get what I want?".

Among these three factors, self-efficacy is the strongest impact on human behavior and choice. The justification for this consideration is that most people will hesitate to deeply engage in an activity unless they are quite confident in their own capacity to do well a certain task. Self-efficacy beliefs can thus be regarded as a person's choice of activities, including educational choices (Yazilitas et al., 2013). In my study, I examined self-efficacy of AAW in STEM fields in terms of their outcome expectations, and goal representations.

Related to self-efficacy, my study also relied on mindset conception. Dweck (2007) scholarly defined that a mindset is a self-perception or "self-theory" that people hold about themselves. Overall, she categorized two types of mindset – fixed mindset and growth mindset.

She articulated that with a fixed mindset, people believe their "qualities are carved in stone" (Dweck, 2007, p. 6). In this way of thinking, they spend their time documenting their intelligence or talent instead of developing them. They also believe that their fixed intelligence or talent could make success, no need to make best efforts.

Alternatively, "In a growth mindset, people believe that their most basic abilities can be developed through dedication and hard work—brains and talent are just the starting point. This view creates a love of learning and a resilience that is essential for great accomplishment," (Dweck, 2007, p. 7).

Since the AAW participants of my study were at a certain leading posts, in order to identify individual factors constructing their career advancement, I also examined the leadership power

highlighted by Warren Bennis. He noted that leadership is the capacity to make vision turned into practice. Before him, Eisenhower also emphasized that leadership is the art to get people to fulfill their tasks as the leader intentionally want it to be done. Their conceptions are consistent with Goleman (1995) and Thomas and Thomas (2003), "Leadership is influencing team members to do the right thing" (p. 7). In a broader sense, "Influence" is to change people's beliefs and behavior. If he or she is able to change others' beliefs and behaviors, we could say he or she has the power of the leader. People usually think of negative aspect of power because they refer it to coercive and authoritarian styles of leadership. In fact, in the study of leadership, "power" is literally used with "motivation" and defined as "a desire to have impact, to be strong and influential" (McClelland & Burnham, 1995, p. 128). Without power, a leader cannot make things done. The "Power Base Inventory" developed by Thomas and Thomas (2003) elaborated six general types of power a leader could have. They grouped them into two categories based on sources and effects. The first group is *Personal Power Base* developed by the individual leader consisting of Information, Expertise and Goodwill. Their influence effect is the commitment of the team members. The second one is *Position Power Base* provided by the organization including Authority, Reward and Discipline. The Authority and Reward give out the influence effect of compliance while the Discipline does resistance. With the first one, "team members essentially decide that they want to accomplish the leader's purpose - because information shows them it is desirable, because they trust the leader's judgment, or because they admire and support the leader...Team members act out of their own choice and feel empowered" (p. 8). In contrast, the second category "produces compliance at best and resistance at worst....Team members perform task activities only out of a sense of obligation or to achieve rewards (or avoid punishments) from

the leader....Team members tend to feel controlled by the leader and relatively disempowered" (Thomas & Thomas, 2003, p. 8).

In fact, the nuance of the Personal Power Base is convergent that of mind tool. The term "mind tool" pertains to soft skills and hard skills. Achyuta et al. (2018), Melin and Correll (2022), and Richard (n.d) shared the point that soft skills - abilities and behaviors - enable people to work well with others. They specifically include such personality traits as teamwork, communication, problem solving, which could make people "well-rounded" and "work well with others". These authors also distinguished soft skills from hard skills, which is technical, cognitive, and other achievement-related abilities. They emphaszied the combination of soft skills and hard skills could promote people's employability, retention, and progress at work.

3.2 Career Success and Leadership in Higher Education

In my dissertation, the term "**success**" refers to *career success* within higher education as Arthur et al. (2005) defined that career success is "the accomplishment of desirable work-related outcomes at any point in a person's work experiences over time" (p. 178). In my study, I chose formal leading position (academic and non-academic) as one of key indicators of AAW's success in their career in STEM fields in HE. This explained for my interchangeable use of "success" and "leadership" in this dissertation.

The formal leading positions referred to both academic and non-academic (administrative) positions. The academic position included vice president/vice provost in charge of academics, dean/associate dean, department chair or vice chair, director/associate director of

academic center/division/unit. And the non-academic position referred to president, vice president/vice provost in charge of other areas than academics, director/associate director of non-academic center/division/unit or so.

In addition, AAW with widely recognized achievements denoted by awards and honor tittles in their fields were also selected to be invited to participate in my study. AAW who chose to deeply engage in their STEM profession and become leaders in their research teams or project teams rather than formal leading positions were also included in my study sample.

3.3 Pipeline

My study not only examined experiences of AAW in STEM at the point of their success in their career in STEM, but also deepen their narratives about their whole pipeline from their professional education (undergraduate and graduate studies) to faculty and leadership appointment. The term "pipeline" used in my study refers to the progression of AAW's career in higher education. This nuance of "pipeline" is borrowed from the perspective of Chen and Hune (2011)

> The pipeline has been used as a metaphor in academe to describe the progression of students, who serve as the talent pool, into faculty positions... Increasingly, the image is being applied to the advancement of faculty through the hierarchical ranks and beyond to leadership roles, especially college and university presidencies. (p. 164).

In my dissertation, career advancement of each participant was traced back from their professional education stages (undergraduate and graduate studies) to their professional advancement stages (pre-tenured, tenured faculty, leadership in their fields).

3.4 Women of Color (WoC) in Higher Education

Women of color is "a phrase used to describe female non-white females. The political term "women of color" surfaced in the violence against women movement. In the late seventies it unified all women experiencing multiple layers of marginalization with race or ethnicity as a common issue" (WOCN, https://wocninc.org/about/).

Anderson et al. (2021) also affirmed that the term "women of color" and the acronym BIWOC (Black, Indigenous, Women of Color) used in their study are "constructed population descriptors in an effort to (de)center and contrast their shared, but diverse experiences as unique and distinct from White women's" (p. 537).

Although the number of WoC leaders has been going up, they are persistently underrepresented due to "triple jeopardy" related to gender, race, and ethnicity (Sanchez, 2007, p. 174; Sanchez-Hucles et al., 2012; Sanchez-Hucles & Davis, 2010). Negative female stereotypes by males, and prejudice on female leaders, and favoring male leaders are key barriers preventing women from advancement in their career. Stereotypes impact their self-perception and others' perceptions on their competence as effective leaders (Wellington, 2003). For example, African American women have been seen as "Mammy, Sapphire, and Jezebel" associated with the images

of "baby nurses, cooks, domestic workers; irrationally angry, "loud, tough, strong, less sensitive, and uneducated"; and innate hypersexual women respectively (West, 1995, pp. 141, 149, 152).

For AAW, Robinson (1996) reported that in many cases people associated them with mail order brides, and hence foreigners lacking knowledge of U.S. culture and practices. Many researchers such as Chung (2008), Kawahara et al. (2013), Kim et al. (2010), and Li (2014) also pointed out that AAW were connected to the image of quiet, unassertive, submissive and passive, cute and small, and invisible women as worker bees, incapable of being leaders. At work, their accomplishments were underrecognized. Competent AAW women were stereotyped as "dragon ladies" to be feared and removed rather than as leaders to be promoted (Huang, 2013; Li, 2014; Valverde & Dariotis, 2019). It was even worse that they were exoticized and subject to sexual harassment (Hune, 1998; Lee et al., 2018; Lee & Zhou, 2015; Li, 2014).

Like African American and Asian American women, Hispanic women face almost the same challenges. Stereotypes, marginalization, and tokenism hinder their pathways to advance in the academy. At work, they were linked to "superlative femininity and passivity", and being silent women (Canul, 2003, p. 319; Jenkins, 2009, February 23; Montas-Hunter, 2012). At home and in society, they are stereotyped as "baby-machine, poor and uneducated" (Canul, 2003, p. 174).

Limited career opportunities leading to limited work experiences cumulated for promotion in the career ladder is a typical challenge shared by WoC in general (Oakley, 2000). Turner (2002) studied female undergraduate students, graduate students, and faculty of color and revealed that in order to succeed in academia most of the studied WoC had to lose themselves, particularly in their journeys of graduate studies and tenure process. As a minority in their institutions, they had adapted their attitude and behavior to the majority.

From review of the existing research literature on women of color in higher education, I understood AAW faced the same types of biases and barriers rooted from gender and race as the other women of color confronted. And from this awareness, I posited my dissertation as a further study to navigate both facilitators and obstacles of AAW's career pathway in STEM.

3.5 Women of Color's Success in STEM Fields

Many research studies and statistics disclosed the predominance of White males and the underrepresentation of WoC in STEM, particularly in physics, astronomy, engineering, and computer science (Camacho, 2013; Espinosa, 2011; Johnson et al., 2011; Ko et al., 2014; NSF, 2013, 2015; Ong, 2002; Ong, 2005; Ong, 2011; Ong et al., 2016; Ong et al., 2011a; Sosnowski, 2002; Tate & Linn, 2005; Varma, 2002; Varma et al., 2006).

In order to explain the persistent underrepresentation of WoC in the pipeline at different stages of STEM career, Brown (2000), Carlone (2007), Ong (2011), Ong et al. (2016), Valenzuela (2006), Varma (2002), and Varma et al. (2006) conducted research studies and found social and interpersonal factors as major obstacles for WoC in STEM fields. They left their fields because they did not feel they belonged to their institutions. They reported being isolated and subjected to racial, sexualized and gendered micro-aggression in their professional environment. Fox et al. (2009), and Malcom and Malcom (2011) argued that existing interventions such as tutoring, teaching how to enhance self-confidence, or socializing them into science and engineering were necessary, but not supportive enough to make WoC feel STEM fields welcoming places for their long-term career advancement. With this deep understanding, these scholars proposed that a fuller-

scaled social and cultural reform should be conducted at the classroom, departmental, and institutional levels.

Responding to the above scholars' calls and agreeing with the point of Hess et al. (2013), Ong et al. (2018) recommended that

> For the sake of retaining women of color in STEM, more attention must be paid to the safe social spaces, or counter-spaces, which offer support and enhance feelings of belonging in STEM. It is imperative to understand the formal and informal structures and relationships that support them, as well as enable them, to contribute innovative knowledge and perspectives in STEM and to serve as role models for the next generation…Many women of color do persist in STEM education and careers, due, in part, to counter-spaces in which they participate in various settings. If STEM fields are to benefit by the knowledge and perspectives of their diverse members, STEM educators need to understand why counter-spaces are of utmost importance to help WoC persist in a STEM culture that marginalizes them, and to explore creating counter-spaces in central academic spaces in STEM education. (pp. 207-208).

Carlone (2007), Joseph (2012), and Ong et al. (2018) noticed that students of color should be paid special attention and supported. Students of color were most "vulnerable to opting out of STEM, given that institutional and interpersonal slights and pressures occur at a critical point in time when their decision to persist in STEM education and careers may be affected" (Ong et al., 2018, p. 208). Their point on students persuades me to include lived experiences of AAW in their

educational stage in my in-depth interviews in addition to professional and leadership stages of the career pipeline.

3.6 Asian American Women Leaders in Higher Education

In spite of their high rate in higher education enrollment, employment, and household income, Asian Americans, especially AAW, remain persistently underrepresented and marginalized in leadership, particularly at top leadership levels (AAUW, 2016; Chen & Hune, 2011; Espinosa, 2011, 2019; Hune, 1997, 1998, 2002, 2006, 2009, 2011a, 2020a, 2020b; Lee & Zhou, 2015; Park et al., 2014; Prinster, April 22, 2016)

AAW in HE have almost the same pathway to advance to leadership as other minority women. They first made their best efforts in building their own academic credibility by earning advanced graduate degrees. Once they were hired as tenure-tracked faculty, they accumulated documented accomplishments through their teaching, research, and services. In this way, they improved their visibility and leadership capacities in dealing with institutional politics and complexities at work (Lee et al., 2018; Torne, 2013). Once on leadership trajectories, they continuously learned how to negotiate and successfully deal with stereotypes, discrimination, and injustice related to their multiple identities (Kawahara et al., 2013; Torne, 2013).

In leadership pipeline, Chen and Hune (2011) closely examined Asian American and Pacific Islander (AAPI) women's trajectories from Ph.D. to campus president, based on the 2007 national statistical data from the U.S. Department of Education. The authors analyzed the "gains" and "leaks" of AAW's journeys to the executive leadership. The "gains" were increasing trends of

AAPI female students enrolled in higher education. However, the number of AAPI female faculty, particularly in the top leadership posts was modest. The "gains" and the modest number of AAPI female faculty, especially tenured faculty, revealed "leaks" in the pipeline in moving from doctoral studies to advanced positions in academia (full professoriate rank and campus presidents).

After Chen and Hune's (2011) study, a big number of scholars such as Chen and Buell (2018), Chin (2012), Chin (2013), Chin (2020), Homma-True (2017), Huang (2013), Kawahara et al. (2020), Reeves (2014), and many others provided evidence of systematic and institutional, and individual-levelled-barriers causing "leaks" in AAW's paths to leadership.

The systematic and institutional barriers included prejudice and stereotypes related to gender, race, and culture; unjust treatment of their institutions in hiring, evaluating, and promoting. Li and Beckett (2006) conceptualized those barriers as socio-cultural, political, academic issues. Alternatively, Chin (2020) named the barriers as pairs of contrasts confronting AAW in leadership journeys – men versus (vs.) women behavior in leading, Western vs. Asian culture, work vs. home responsibilities. Most recently, Kawahara et al. (2020) added another pair of contrasts labeled "duality in leadership role." At one end, AAW leaders experienced decision-making power by their leading position; but at the other end, they underwent "the micro-aggressions of being ignored, dismissed, or mistreated based on the intersectionality of race/ethnicity, gender, social class, size, and other identity dimensions and social locations" (p.86). The metaphors of "icy", "chilly" or "strange" or "perpetual foreign syndrome" are among terms AAW used to describe their feeling about their workplace.

Individual-levelled-difficulties such as disadvantaged socio-economic status, language barriers, and heavy home-work responsibilities. Moreover, Lee (2018) shed light on another obstruction facing AAW in the academy - their feeling of inferiority. They had self-doubts and

lacked self-confidence in their potential leadership competence. This author explained that AAW's inferior self-awareness was rooted in their "immigration experiences and upbringing within a male-dominated cultural tradition" (p. 96). The author emphasized that Asian cultural traditions did not "necessarily encourage individualism, self-empowerment, personal will or autonomy" (p. 100) and required women to tie themselves closely to family responsibilities, especially children-bearing and rearing. All of these restricted AAA's opportunities to advance to leadership positions.

In order to support AAW in overcoming those barriers to advance to leadership, structural factors should be strengthened and improved. For example, Chin (2012) drawing from her own experience proposed that HE institutions should sustain the established principles of academic freedom and shared governance as "big equalizers" (p. 155). Chen and Hune (2011) also suggested that systematic and transformative changes should be made to eliminate discrimination related to gender, race, and culture. Later, Wu (2015) implied that the institutional values of excellence and equity; diversity and inclusivity greatly contributed to AAW's success in academia. Apparently, the recommendations of Chen and Hune (2011), Chin (2012), and Wu (2015) reflected the overarching views of Hune Shirley over years (Hune, 1997, 1998, 2006, 2011a, 2020a, 2020b) on institutions - (1) the academy as an agent of social change, and (2) also as a venue for racism, gender discrimination, xenophobia, and other injustices to persist. In fact, the suggestions of these scholars are convergent with the point raised by Tierney et al. (2004). They proposed that the notion of competence and authority should be defined based on culture and social constructs. A diverse environment featured by a "culturally pluralistic" atmosphere should be nurtured for all members of institutions to "achieve fully" (p. 15).

In addition to structural supports, Chung (2008), Huang (2013), Irey (2013), Lee et al. (2018), Monzó & Hoo (2014), Nguyen (2020), Paik et al.(2018), Reeves (2014), and Torne (2013)

highlighted the importance of multiple mentorship for AAW in different stages of their development from pre-tenure to tenure and leadership stages (in executive and academic posts). Multiple mentors include their peers, senior colleagues, supervisors, social agents, and family members. The mentors advocated, empowered AAW, and validated their efforts. They also provided effective recommendations whenever AAW faced problems or difficulties at work, in family, and social life. A big number of contemporary works also underscore family supports and role models in the family. Family play a key role in financial and mental support for AAW in their educational and career pipeline (Chin, 2012; Huang, 2012; Irey, 2013; Kawahara, 2007; Kawahara et al., 2013; Lee et al., 2018; Paik et al., 2018; Reeves, 2014; Torne, 2013; Wu, 2015).

Culture is another factor closely examined by previous studies. In one way, some of cultural norms (such as collectivism, submissiveness to grandparents and parents in family, and seniors at work) somewhat obstructed AAW's advancement to leadership, but in the other way, some did help them sustain in practicing leadership. Lee (2018) analyzed that the Asian-based culture values contributed to fostering AAW's high performance in learning and working as well as nurturing their passion for life-long learning even though they had already earned leading positions. The author also emphasized that their Asian culture built in them a strong conformity to norms, emotional self-control, collectivism, humility, and achievement recognition. These characters were definitely essential for a leader of an organization.

Regarding personal factors, lived experiences of AAW's leadership in academia presented in the contemporary research studies informed effective strategies to cope with personal, social and institutional barriers and to advance to leading positions. After deep review of all the personal strategies shared by AAW leaders in the contemporary studies, I crystalized them into two categories. The first one referred to *mindset*. It was related to thinking. Studied AAW perceived

"challenges, struggles and conflicts as part of being a leader" (Kawahara, 2007, p. 27). They also realized the necessity of having dominant culture efficacy and bicultural competence, which made them pertinently flexible in dealing with complexities in their leading practices (Kawahara, 2007; Kawahara et al., 2008; Lee et al., 2018; Paik et al., 2018; Wu, 2015). Meanwhile, they understood the importance of "using power (ability to bring people together and to use a strategy to achieve one's objectives) and politics (a system of finding allies, and enlisting people to intervene on their behalf…WoC senior leaders viewed politics as a means to get things done and to emerge with a win-win situation) to achieve goals" (Huang, 2012, p. iii). They also learned that WoC leaders have used politics for their communities, to obtain benefits, not for oneself but to achieve a broader goal of their organizations. Their strategic mindset also referred to their sense of belonging to their communities. From this, they were able to clarify their values and self-define their own strengths, which enhanced their confidence in moving up in their trajectories to leadership (DeBlaere, 2020).

The second category of personal strategies as I conceptualized was *mind tools*. They were related to AAW's personalities and life and work skills. Existing literature revealed that such key personalities as resiliency and perseverance, self-empowerment by academic and work credibility, determination in struggling against injustices, integrity, and pride and confidence helped AAW overcome invisible barriers (Chin, 2020; Irey, 2013; Kawahara, 2007; Kawahara et al., 2008; Kawahara et al., 2013; Lee et al., 2018; Ng, 2017; Paik et al., 2018; Torne, 2013; Wu, 2015). Moreover, their work and life skills in work-family balance, professional and social networking for getting and giving mentorship, interpersonal and cross-cultural communication enabled them to handle well their own weaknesses and barriers (Duero & Villegas, 2018; Valverde & Dariotis, 2019).

In summary, the lived experiences of AAW in leadership journeys and practices occupied most of the current scholarship of the field. Their lived experiences were characterized by invisible barriers related to their personal and social identities. The recent research studies confirmed the important role of structural factors (institutions, social forces, and family) in supporting AAW to overcome barriers. Meanwhile, the contemporary research also informed personal factors supporting individual AAW to advance in their career in higher education.

3.7 AAW Leaders in STEM Fields in HE

In STEM fields, AAW's representation implies a different image relative to other minority woman groups. PRC (2012, 2018) and Williams et al. (2016) highlighted a better image of AAW than other minority women in terms of their representation and competence. Williams et al. (2016) articulated that "AAW in STEM, at least in theory, are in a different situation than Latinas and Black women. First, Asian-Americans are not an underrepresented minority in STEM. Second, Asian-Americans are seen as equal in competence to whites (Fiske et al., 1999), particularly in technical matters" (p. 24).

However, in contrast with men and white women, AA female scientists and engineers have still lagged behind in their STEM careers (AAUW, 2016; Castro & Collins, 2020; Wu & Jing, 2011). "The percentage of AAW employed by colleges and universities who are tenured or who are full professors is the smallest of any race/ethnicity and gender" (Wu & Jing, 2011, p. 2). Relating to this underrepresentation, in leadership AAW's representation in full professors, deans, or university presidents is also minimal. The number of AAW in non-faculty positions (postdocs, researchers, lab assistants, non-tenured faculty) make up even 80 percent of the total AAW in

academia. Agreeing with Ong et al. (2011b) and Wu and Jing (2011), Castro and Collins (2020) conceptualized that "AAW occupy a paradox space in STEM fields, simultaneously overrepresented as Asian Americans and unrepresented as women" (p. 34). Their notion about "paradox space" in STEM fields of AAW shaped my research inquiry to be more focused on their emerging overrepresentation as Asian Americans in STEM and their persistent underrepresentation as women in STEM.

3.8   Metaphors Used to Describe Barriers the AAW Faced on Their Pathways to Leadership and Their Leading Practices

This part of my literature review was entirely inspired by the recent research work of Porter and Fahrenwald (2022). Their study sought how women leaders in education viewed their leading space via metaphors they used to describe the space and atmosphere at their educational work settings. Founded on their point that metaphors help build basic understanding of the world and also shape our attitude and behavior to make changes, I decided to pick up the most significant metaphors employed in the existing research studies to visualize obstacles the AAW faced on their pathways to their leadership and to imaginarily describe their leading practices in HE context.

The first metaphor most widely used in existing research works was "*glass ceiling*" (Chin, 2012; Li, 2014; Torne, 2013; Wu, 2015). The authors employed "glass ceiling" to describe invisible barriers facing AAW women on their paths to the top level of formal leadership in academic settings. Johns (2013) provided history and nuance of this metaphor in formal documents

The glass ceiling, a phrase first introduced in the 1980s, is a metaphor for the

invisible and artificial barriers that block women and minorities from advancing up

the corporate ladder to management and executive positions. In 1991 the US Congress found that, despite a dramatically growing presence in the workplace, women and minorities remained underrepresented in management positions in business and that artificial barriers were inhibiting their advancement. Consequently, in Title II of the Civil Rights Act of 1991, Congress enacted the Glass Ceiling Act establishing the Glass Ceiling Commission" (Johns, 2013, p. 1)

In media, "glass ceiling" was first used by Hymowitz and Schellhardt (March 24, 1986) in their article on the Wall Street Journal for invisible challenges confronting ethnic minorities as they moved up to the top of the organizational hierarchy.

From "glass ceiling", the second metaphor, *bamboo ceiling,*" was coined in "Breaking the Bamboo Ceiling: Career Strategies for Asians" by Hyun (2005). It specifically referred to invisible barriers facing Asian Americans as professionals. The author mentioned "bamboo ceiling" as stereotypes and racism impeding Asian Americans' progress in their organizations. Kawahara et al. (2013), Li (2014), and Paik et al. (2018) coupled "bamboo ceiling" with barriers facing AAW on their leadership pathways and practices. In addition, Paik et al. (2018) noted about barriers related to clear-cut norms or rules or official policies by using the metaphor *"(concrete) wall"*, which were introduced by Hyun (2005), Kitano (1997), Takaki (1998), and further elaborated by Eagly and Carli (2007). They emphasized, *"[Concrete wall]* is long gone in the U.S. [It refers to] explicit rules and clear-cut norms. For example, educational opportunities which were closed to them. Job opportunities are also limited to women due to subjective view of senior policy-makers…Division of labor is also a concrete wall (men should be breadwinner and women should be homemakers)". (p. 2-3)

The next two metaphors "*ultra-feminist blossom lotus*" and "*dragon ladies*" were used in the research works of Huang (2013) and Li (2014) when they presented stereotypes about Asian Americans as "model minority". Li (2014) noted

> While there are similarities between the oppression of Asian American women and other women of color, Asian American women face a distinct set of barriers as a result of their history in the United States. This history shaped the perception of Asian American women as outsiders, ultra-feminine lotus blossoms, dragon ladies, and model minorities. These stereotypes, both positive and negative, have contributed to discrimination against Asian American women. (p. 149)

Another metaphor was "*revolving door*" used in Huang's (2013) work entitled "From revolving doors and chilly climates to creating inclusive environments for pre-tenure Asian American faculty". It visualized a challenge facing AAW faculty in their institutions. They had to fulfill tons of service responsibilities around their key academic jobs (teaching and researching), but their multiple services were not credited to their tenure track - "Despite the countless hours of service to the university and communities of color, these activities are not often counted toward their tenure requirements" (p. 93).

All of those barriers, stereotypes, discriminations, injustices related to gender, race, ethnicity, and culture together created a "*chilly or icy climate*" for AAW (Huang, 2013; Irey, 2013). They felt it was hard to connect to their colleagues in departments. They even faced student resistance in classroom because of their foreign accent and origins (Hune, 2011a). They usually struggled with isolating or exclusionary feeling at work.

Moreover, Williams et al. (2016) took the metaphor "*walk a tightrope*" coined by Fiske et al. (1999) to reflect voices of women in general and AAW in particular about their pressure at

work due to gender bias. They struggled "between being seen as too feminine, and so liked but not respected – or too masculine, and so respected but disliked" (p. 26). In addition, drawing from works of Derks et al. (2011) and Moss-Racusin et al. (2012), Williams et al. (2016) affirmed that gender bias against women (including AAW) caused conflict among women in many cases, especially in masculine domains like STEM. A tendency of distancing from women peers were also widely found in women who were discriminated against in their early careers. The authors continued using metaphors "*tug of war"* and *"queen bee*" to reflect these tough situations.

The last two metaphors I found in my literature review are "*ebb and flow of life*" and "*uncharted waters amidst opposing waves*". Kawahara (2007) visualized an emergent and evolving process of AAW development to leadership with the metaphor "ebb and flow of life". This nature of their journey was quite different from men, who normally have a clear plan for their leading career. During AAW development process, their self-awareness, growth, interests, and experiences weave together. Chin (2020) described her journey to academic leadership exactly as uncharted waters amidst opposite waves

> My journey was one of dichotomous opposition as I navigated uncharted waters due to the way my ascribed identities intersected with my experienced identities. The value systems of my family and culture often opposed that of my professional and Western acquired culture. I needed to define my roles and place in areas where my professional colleagues and I had little experience with someone like me. (p.183)

In conclusion, my literature review revealed that the contemporary research studies on AAW's leadership in academia widely used at least eleven metaphors - glass ceiling, bamboo ceiling, concrete wall, dragon ladies, ultra-feminist blossom lotus, revolving door, icy or chilly

climate, walking a tightrope, tug of war and queen bee, ebb and flow of life, and uncharted waters

amidst opposing waves - to visually reflect invisible barriers, stereotypes, discrimination, and other

challenges AAW faced in their leadership development journeys and their lived experiences in

their careers. This review on key metaphors used in the established literature on lived experiences

of AAW women in leadership provided me with helpful hints for my interview question design

and finding presentation, which is visualized and conceptualized.

4.0 Conceptual/Theoretical and Analytical Frameworks for Design of My Study

The conceptual/theoretical and analytical frameworks of my dissertation were grounded on the philosophical assumptions of "*being*" worldview in ontology and *constructivism* in epistemology with constituent perspectives of *interpretivism, critical inquiry,* and *feminism*. Under these philosophical foundations, I took the *feminist research approach* as the overall concept under which the concepts of *science as a social construct*, *women and development,* and *critical race feminism* specifically frame my research inquiry into AAW's success in STEM fields in HE. Drawn from this conceptual framework, the theories *of intersectionality, cultures of academy, leadership power, cumulative advantage, and social cognition* guided the strategies of my data collection and analysis.

Figure 1 below holistically visualizes my study's conceptual/theoretical and analytical frameworks. The research procedure (methodologies and methods) is also integrated into this figure to capture the whole image of my research from philosophical stances to inquiry strategies.
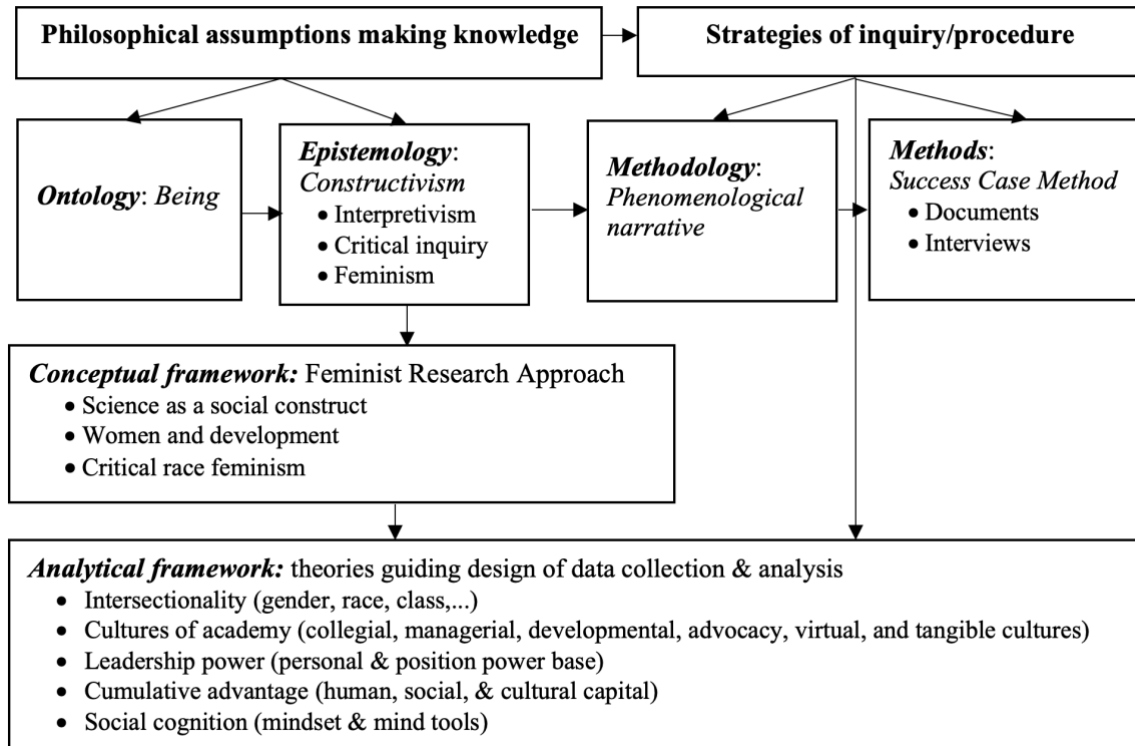
Figure 1 Conceptual and Analytical Frameworks Founded on Philosophical Assumption. (Adapted from Carter and Little (2007), Chia (2002), Creswell (2003), and Gray (2004))

4.1 Ontology

My overall research inquiry was grounded on the *being* ontology. I held that the existence of AAW in STEM fields in HE is *being.* It "is seen as being composed of clearly formed entities with identifiable properties" (Gray, 2004, p. 17). Their "identifiable properties" are characterized by their social and personal elements. In my study, I perceived that their entities "are held to be stable, they can become represented by symbols, words, and concepts" (p. 17).

4.2 Epistemology

From the lens of *being* ontology for AAW's existence in STEM in HE, I shaped my specific inquiry on the constructivist epistemology[1]. The truth and meaning of their success in STEM fields in HE were not independent from the external world (family, community, institution, country), but created by their interactions with the world. Their success meaning was constructed, not discovered. I posited that each of them constructed their own meaning in different ways in spite of being related to the same phenomenon of underrepresentation and success in HE. I also stood on the point that the meanings of different individuals in the same group or the same structure might share similar opportunities and challenges for their career advancement, for example. In return, these similarities among them could inform bases for arguments on existing structure.

Under the constructivist view, the specific inquiries into structural and individual factors influencing their lived experiences justify my choice of *interpretivist*, *critical inquiry*, and *feminist* perspectives framing my study.

4.2.1 Interpretivism

My study of systematic review in 2020 (my comprehensive paper) informed that interpretivism has the biggest share in the research body of the AAW and leadership field. Gray (2016) affirmed that interpretivism is closely associated with constructivism. It is widely used in

---

[1] Epistemology is "theory of knowledge embedded in the theoretical perspective" Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). Sage.

social sciences, which "often deal with actions of individuals" (Gray, 2004, p. 20). Crotty (1998) also clarified, "Our interest in the social world tend to focus on exactly those aspects that are unique, individual and qualitative" (p. 68). As noted in my research purposes, through close examination of lived experiences of AAW in STEM fields, I would figure out their success and challenge factors. Their stories on how they moved along the pipeline from professional education to faculty and leadership featured by both barriers and facilitators were interpreted for their feelings, attitudes, choices, behaviors, and interaction with their internal and external world.

4.2.2 Critical Inquiry

Critical inquiry is "a meta-process of investigation, which questions currently held values and assumptions and challenges conventional social structures" (Gray, 2004, p. 23). Under a Marxist perspective, critical inquiry aims both to understand the world and to look for effective ways to change it. There are four key assumptions under the critical inquiry perspective: (1) Ideas are mediated by power relations in society, (2) Certain groups in society are privileged over others and exhort an oppressive force on subordinate groups, (3) What are presented as "fact" cannot be disentangled from ideology and the self-interest of dominant groups, and (4) Mainstream research practices are implicated, even if unconsciously, in the reproduction of the systems of class, race, and gender oppression (Gray, 2004, p. 24). With the lens of critical inquiry, my study would argue what structural and personal factors challenged AAW's advancement in STEM fields. And I would also proposed necessary structural and personal changes to make AAW more represented in their fields.

4.2.3 Feminism

Under feminist perspectives, women are regarded as an oppressed social class. Feminism is closely associated with Marxism and critical inquiry in the view that "what a person knows is largely determined by their social position" (Gray, 2004, p. 24). Williams and Mary (1996) advocated that due to their dominant position, men's knowledge about the world was distorted. Conversely, women were subjected to the dominance, thus having a less distorted social experience possibly a generated less distorted knowledge of the world. Feminist research on personal experiences and feelings and emotion of women helps reflect knowledge of the world more rationally.

In my study, AAW were the key subjects to be studied. They were embodied by at least three identities – Asian ethnicity (race), women (gender), and family background (class). Their underrepresentation and marginalization informed that they were an oppressed social class. A deeper understanding of their personal experiences and perceptions would provide more knowledge of AAW in general and in STEM fields in higher education in particular.

4.3 Conceptual Framework under Lenses of *Being* Ontology and *Constructivist* Epistemology

Overall, my research inquiry was guided by the *feminist research approach* proposed by Harding (1987). In her work entitled "Introduction: "Is there a feminist method?", she introduced a new approach for feminist research in which feminism is regarded a methodology (a theory and analysis of proceeding research) and epistemology (a theory of knowledge responding to inquiry)

rather than a method (a technique to collect evidence). With this new approach, she suggested three additional features for feminist research - (1) women's experiences in the plural; meaning "women's and men's experiences, desires, and interests differ according to class, race, and culture" (p. 7); (2) feminist research is not only on women, but for women and, where possible, with women; and (3) the researcher positioned as subjective rather than objective. – women's experiences in the plural; feminist research on, for, and with women; and the researcher as subjective rather than objective.

Under this umbrella approach, I chose *science as a social construct*, *women and development*, and *critical race feminism* as three key concepts guiding my research inquiries. In terms of methodology, I took the *phenomenological narrative research* as a qualitative methodology to construct a new understanding of the phenomenon of AAW's overrepresentation as Asian Americans, but underrepresentation as women. My findings therefore highlighted both shared and distinctive gendered and environmental factors, which have challenged in one way but contributed in another way to retention and advancement of AAWs in the STEM fields in HE. The two dominant metaphors – "*pipeline*" and "*labyrinth*" – guided my research focus. I examined the whole pipeline of AAW's career, from professional education to faculty and leadership. Their career pathways are not simple and straight but of "twists and turns" as in a labyrinth.

4.3.1 Science As a Social Construct

My dissertation depended on the review of Castro and Collins (2020) on science as a social construct founded by Barton and Osborne (2001), Coil (2017), Harding (1993), Harding (1998) Godfrey-Smith (2009), Nader (1996), Petitjean et al. (1992), Principe (2011), and Shanahan (2009).

Historically, science has been widely viewed as a Western development, originally evolving from the European Scientific Revolution and transmitting via colonialism and imperialism. Under this development history, science is apparently embedded with Western, Eurocentric, White, male paradigms; which implies the construction of (1) race and gender within science, (2) what is legitimate knowledge and inquiry, and (3) who gets to do science (Godfrey-Smith, 2009; Harding, 1993; Harding, 1998), cited by Castro and Collins (2020, p. 35).

Accordingly, science could be deemed a body of knowledge, an epistemology, and as an identity frame. As a body of knowledge, science is specific and its validity methods are featured by rationality, logic, and curiosity (Harding, 1993; Nader, 1996). As an epistemology, science stands on the knowledge system of human objectivity (Coil, 2017; Harding, 1993) as Nader (1996) noted - a way of "knowing that embodies curiosity with empiricism" (p. 1). As an identity frame, science works as a denotation of identity (Barton & Osborne, 2001).

To sum up, given that the AAW in STEM fields in HE were subjects of my study, I grounded my inquiries in the viewpoint of science as a social construct in which their successes were influenced by both social and personal structure.

4.3.2 Women and Development (WAD)

The concept of women and development (WAD) was introduced after the 1950s and 1960s, when most colonized countries gained independence. Women who actively participated in the struggle for independence perceived that they could work with men to contribute to nation building activities (Sorensen, 1998). This concept also emphasizes the power of women in society from their own knowledge, work, goals, and responsibilities. This implies that the society should recognize the role of women at home and workplace to make the society better in terms of

41

diversity, justice, equality, and equity.

In fact, women and development (WAD) approach is closely associated with the neo-Marxist feminist approach, which emerged in the second half of the 1970s. It posited that "women always have been part of development processes" and that "the WAD perspective focuses on the relationship between women and development processes rather than purely on strategies for the integration of women into development. Its point of departure is that women always have been important economic actors in their societies and that the work they do both inside and outside the household is central to the maintenance of those society (Rathgeber, 1990, pp. 492-493).

Under the light of the WAD concept, I chose AAW in STEM fields as the central focus of my study. I presumed that their career success would contribute to the construction of a better just society in various ways. Their increasing representation in society would help to enrich and consolidate the status of AAW in STEM fields. In their leadership roles, they would be in a better "power" to facilitate the underrepresented and underprivileged to advance if they choose to do so as part of the larger diversity and inclusion mission of many HEIs.

4.3.3 Critical Race Feminism Theory (CRFT)

Critical Race Feminist Theory (CRFT) rooted in Critical Race Theory (CRT) examines power relations from arguments on gender, race, class, and all social oppression forms (Delgado & Stefancic, 2001; Sulé, 2009).

CRT was introduced and championed in the 1970s by scholars named Derrick Bell, Kimberlé Crenshaw, Richard Delgado, Mari Matsuda, and Patricia Williams. Their perspectives in CRT provided alternative legal lenses to struggle against racism and advocate for social justice.

They believed that the U.S. is a racialized and white privileged society. Their point was affirmed by Lipsitz (2006) and Stanley (2007) arguing that the system of white privilege is racist. Since the 1970s, CRT has been applied in various disciplines including Education, Law, Women's Studies, and Ethnic Studies, to counter the dominant narratives in those fields (Ladson-Billings, 1998; López, 2003; Taylor, 2009; Vue & Newman, 2010). Broadly, CRF shares intention to issues not only of race and gender but also of other identities in their intersectionality nature. It insists that race and gender are inter-related and are "endemic" to this society (Crenshaw, 1991; Sulé, 2009). They are "endemic because both affect how non-majorities (e.g., non-whites, women, women of color) are viewed through a distorted lens" (Irey, 2013, p. 19).

In higher education, universities are predominated by the ideology of whiteness, patriarchy, and classism, which has colonized, marginalized, and silenced racialized students, faculty, and staff of color (Bannerji, 2000; hooks, 2003; Razack, 1998).

The Critical Race Feminism theorists highlighted the importance of reflecting voices of diverse individuals, especially underrepresented individuals by examining their lived experiences. They not only positioned an individual's identity and experience of the world in their own racial identifications, but also considered the individuals' class, gender, nation, sex and so on. Over the recent decades, CRFT has framed many research studies on lived experiences of ethnic groups of Asian Americans, Latinos, and Indians (Brizee et al., August 2015).

In the year 2021, some states banned or restricted teaching CRT in schools arguing that CRT has undermined American values.[2] My inclusion of CRFT in my conceptual framework

---

[2] https://www.newsweek.com/critical-race-theory-banned-these-states-1599712;
https://www.universityworldnews.com/post.php?story=20210612085115831

was a way to contribute to restating the scholarly and practical strength of Critical Race Theory in framing research studies on women of color. I supported Wong's point cited in Greenfield (2021, June 12) that,

> CRT is an analytical tool that allows us to view through a more critical lens how institutions, laws, and policies contribute to replicating or reproducing racial inequality even under explicitly color blind or race neutral regimes…CRT holds that race is a social and not a biological construct. In practice, however, the social construction of whiteness or blackness through American history creates not only different social categories but a hierarchy that places – or functions to maintain – the position and power of white Americans…A key tenet of CRT is the removal of racial hierarchies.
>
> (https://www.universityworldnews.com/post.php?story=20210612085115831)

4.4 Analytical Framework (Theories Guiding Data Analysis) under Conceptual Framework

There were six theories guiding the strategies of my data collection and analysis – *Intersectionality, Organizational Behavior, Cultures of Academy, Leadership Power, Cumulative Advantages (human, social, and cultural capitals), and Social Cognition.* These theories shaped what documents I collected to study in depth and in breadth, and what questions I asked during the study interviews. I also I also used them as analytical tools to sort through, categorize, and determine themes on the bases of words, phrases, and quotes from the documents and interviews. In other words, I framed my coding and theming collected data on these theories.

4.4.1 Intersectionality

Intersectionality was first coined by Crenshaw (1989) and Crenshaw (1991), and further developed by scholars across years (Collins, 2000; Crenshaw, 1989, 1991; Dill & Zambrana, 2009; Pittman, 2010; Purdie-Vaughns & Eibach, 2008; Steinbugler et al., 2006). The term "intersectionality" refers to "the phenomenon of the merging and mingling of multiple markers of difference or "intersection" (Crenshaw, 1989, p. 246). Later in 1992, she additionally criticized the contemporary U.S. law as a white-supremacist-patriarchal mechanism that marginalized women of color. She also argued that the failure of antiracist and feminist activism in supporting WoC from oppression were due to isolating considerations of race and gender. She thus proposed a deeper examination of the intersection of race and gender on every issue facing WoC. Under the light of established intersectionality theory, Ngunjiri and Hernandez (2017) elaborated that, "The term intersectionality refers to the complexity of experiences in social and organizational settings due to the confluence of race, class, and gender, amongst other identity characteristics" (pp. 250-251).

In adopting intersectionality theory, when designing the data collection and analysis, I deeply examined race and gender as well as other structural factors to seek most salient variables of AAW's experiences in STEM fields in higher education.

4.4.2 Cultures of Academy

According to the perspective of Bergquist and Pawlak (2008) in specific contexts like in

the academy, individual success is strongly influenced by institutional culture. They pointed out six cultures - collegial, managerial, developmental, advocacy, virtual, and tangible cultures. The collegial culture referred to the traditional nature of campus settings and the origins of North American higher education in England's and Germany's Oxbridge Model emphasizing academic faculty culture, liberal arts traditions, and research and scholarship. Managerial culture stressed on the effectiveness and efficiency of institutional management. It originated from the Catholic Church and was under the Jesuit influence. The developmental culture was associated with faculty development, curriculum expansion, and institutional research. The advocacy culture was embraced in faculty unions, collective bargaining, and academic freedom. Virtual and tangible cultures were the two added cultures in the 2008 edition of their book. The virtual one was as "the technological invention "such as the internet, computers, cell phones and "the advent of online and virtual universities" (p. 131). This culture in their view has impacted personal and professional lives in higher education. The second added culture was the tangible one. It is characterized by space, architecture, and pedagogy of the institution and it had some impacts on the leadership.

In my dissertation, I used the term "cultures of academy" interchangeably with "institutional policy, values, and climate".

4.4.3 Leadership Power

In terms of leadership power, Bennis (2009) defined that, "Leadership is the capacity to translate vision into reality" (p. 35). Before him, the U.S. Statesman Dwight Eisenhower (1890-1969) also emphasized, "Leadership is the art of getting someone else to do something you want done because he wants to do it". Their conceptions are consistent with the view of Goleman (1995) and Thomas and Thomas (2003) that, "leadership is influencing team members to do the right

46

thing" (p. 7). In a broader sense, "influence" is to change people's beliefs and behavior. If he or she is able to change other's beliefs and behaviors, we could say he or she has the power of the leader. Zaleznik (1992) inserted that power use is required for leadership to impact others' thoughts and actions. In reality, the term "power" is sometimes mistakenly referred to coercive and authoritarian styles of leadership. In fact, in the study of leadership, "power" is literally used with "motivation" and defined as "a desire to have impact, to be strong and influential" (McClelland & Burnham, January-February 1995, p. 128). Without power, a leader cannot accomplish things. The "Power Base Inventory" developed by Thomas and Thomas (2003) elaborated six general types of power a leader can have. The six general types are grouped into two categories based on sources and effects. The first group is *Personal Power Base* developed by the individual leader consisting of Information, Expertise and Goodwill. Their influence effect is the commitment of the team members. The second one is *Position Power Base* provided by the organization including Authority, Reward and Discipline. Authority and Reward influence compliance while Discipline makes team members obliged to fulfill the duties. With the first one, "team members essentially decide that they want to accomplish the leader's purpose - because information shows them it is desirable, because they trust the leader's judgment, or because they admire and support the leader...Team members act out of their own choice and feel empowered" (p. 8). In contrast, the second category "produces compliance at best and resistance at worst....Team members perform task activities only out of a sense of obligation or to achieve rewards (or avoid punishments) from the leader…Team members tend to feel controlled by the leader and relatively disempowered" (Thomas & Thomas, 2003, p. 8)

My study mainly adhered to perception of Thomas and Thomas (2003) to get insights into what types of the power AAW leaders employed and how they practiced them at work. In my

dissertation I considered power types as personal factors contributing to AAW's success in STEM fields.

4.4.4 Cumulative Advantage Theory (regarding human, social, cultural capitals)

Cumulative Advantage Theory (CAT) was originally developed by Merton (1988). He defined cumulative advantage as "the ways in which initial comparative advantage of trained capacity, structural location, and available resources make for successive increments of advantage" (p. 606). In my study, I relied on CAT to seek what specific cumulative advantages the AAW contributed to their academic career advancement in HE. To make the cumulative advantages conceptualized, I categorized them into human capital, social capital, and/or cultural capital. I inquired if all three of them worked together to support my study's participants in their career pipeline.

4.4.4.1 Human Capital Theory

HCT was proposed by Schultz (1961) and Becker (1993), based on the perception of Adam Smith straightly considering human-beings as capital or widely called "human capital". Schultz (1961) defined that, "All of the acquired and useful abilities of all the inhabitants of a country as a part of capital" (p.2). Becker (1993) also implied that human capital refers to acquired knowledge, health, and others which brings about cultural, nonmonetary and monetary gains. My study looked for what human capital type had made the AAW successfully move up at work.

4.4.4.2 Social Capital and Cultural Capital

There are a wide variety of definitions for social capital and cultural capital. My study adhered to perception of Bourdieu (1986) on both social and cultural capitals. He defined that, "Social capital is the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintances and recognition" (p. 247). Based on his perspective, my study looked for what social and professional networks had cumulated and influenced the advancement of the AAW in STEM fields.

For cultural capital, I explored if any kind of cultural capital the AAW had from their home countries and obtained in the receiving countries, particularly the US to enable them to well adapt to new living and working environments. This inquiry of my study drew from the point of Bourdieu (1986) that, "Cultural capital can exist in three forms: in the embodied states, i.e. in the form of long-lasting dispositions of the mind and body; in the objectified state, in the form of cultural goods (pictures, books, dictionaries, instruments, machines, etc.), which are the trace or realization of theories or critiques of these theories, problematics, etc.; and in the institutionalized state, a form of objectification which be set apart because, as will be seen in the case of educational qualifications, it confers entirely original properties on the cultural capital which it is presumed to guarantee" (p. 24)

4.4.5 Social Cognitive Theory

Social Cognitive Theory (SCT) was introduced by a Canadian psychologist Albert Bandura in 1986 in his book entitled "Social foundations of thought and action: A social cognitive theory". According to this theory, human behaviors and choices are primarily explained through *self-efficacy beliefs*, *outcome expectations*, and *goal representations*. Self-efficacy beliefs are denoted

by "people's judgment of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p. 391; Bandura, 1997). They are related to the question "Can I do this?". Outcome expectations refers to a "person's estimate that a given behavior will lead to a certain outcome" (p. 193). They address the question "If I do this, what will happen?". Goal representations are identified by determinations of individuals to engage in a particular activity. They are associated with the question "What will I have to do to get what I want?"

Among those three factors, self-efficacy is widely considered as the strongest impact on human behavior and choice. The justification for this consideration is that most people will be hesitant to be more greatly involved in an activity unless they are quite confident in their own capacity to do well at a certain task. Self-efficacy beliefs can thus be regarded as a person's choice of activities, including educational choices (Yazilitas et al., 2013). Based on the Social Cognitive Theory, in my study, I explored the self-efficacy of AAW in their profession (i.e., majors) and career choices (i.e., in the academy or in industry).

Relating to this factor, (Goleman, 1995) in his work "Emotional Intelligence" emphasized *self-awareness*. It is one of his five components[3] of leadership at work. He stressed that

> Self-awareness means having a deep understanding of one's emotions,
>
> strengths, weakness, needs, and drives. People with strong self-awareness
>
> are neither overly critical nor unrealistically hopeful. Rather, they are honest

---

[3] Five components of leadership at work consist of Self-awareness, Self-regulation, Motivation, Empathy, and Social skill (Goldman, 1995)

- with themselves and with others (p. 84)

My study got insights into which of these five components (self-awareness, self-regulation, motivation, empathy, and social skill) AAW leaders in STEM fields possessed and how they used them in their life and work practices.

Moreover, in my study, I connected the viewpoint of the Social Cognitive Theory to the concepts of mindset and mindtool widely known in the Psychology field.

4.4.5.1 Mindset and Mind Tools

"Mindset" normally refers to "way of thinking", self-perception, or attitude. And "mind tool" are widely thought as "way of doing" or behavior.

4.4.5.2 Mindset

Dweck (2007) scholarly defined that a mindset is a self-perception or "self-theory" that people hold about themselves. Overall, she categorized two types of mindset – fixed mindset and growth mindset

She articulated that with a fixed mindset, people believe their "qualities are carved in stone" (Dweck, 2007, p. 6). In this way of thinking, they spend their time documenting their intelligence or talent instead of developing them. They also believe that their fixed intelligence or talent could make success, no need to make best efforts.

Alternatively, "in a growth mindset, people believe that their most basic abilities can be developed through dedication and hard work—brains and talent are just the starting point. This view creates a love of learning and a resilience that is essential for great accomplishment," (Dweck, 2007, p. 7).

In my study, I navigated what type of mindset the AAW had and how it influenced their career pipeline.

4.4.5.2.1 Mind tools

In my study, the term "mind tools" is pertinent to soft skills and hard skills. Melin and Correll (2022), Achyuta et al. (2018), and (Richard, n.d) pointed out that "soft skills broadly defined as abilities and behaviors that allow employees to work well with others" (Melin & Correll, 2022, p. 1). They specifically include such personality traits as teamwork, communication, problem solving, which could make people "well-rounded" and "work well with others".

These authors also distinguished soft skills from hard skills, which are technical, cognitive, and other achievement-related abilities. They emphaszied the combination of soft skills and hard skills would "boost" people's employability, retention, and progress at work.

My dissertation sought what are the most significant mind tools the participants possessed and how their mindset and mind tools combined to push them up in their career in STEM fields in HE.

5.0 Methodology and Methods

5.1 Methodology

Given that my research was exploratory and also explanatory to understand, interpret, and construct varied meanings of the complex phenomena of AAW's leadership in STEM fields – overrepresentation as AAs relative to the other racial women groups, persistent underrepresentation as women, and marginalization in the higher level of leadership in STEM fields, I used "two apparently disparate qualitative methodologies" of phenomenological and narrative inquiries in my study (Nigar, 2020, p. 10). Since each of these methodologies has its own strengths and weaknesses, mixed use of them, which is so-called *phenomenological narrative research*, enabled me to take most advantage of their pros, and meanwhile best control their cons.

5.1.1 Phenomenological Inquiry

Phenomenological research focuses on human experience of the life-world and the unit of phenomenological analysis is often individuals as a part of the whole group of the participants in study. Creswell (2003) emphasized that in phenomenological research, the "researcher identifies that "essence" of human experiences concerning a phenomenon, as described by participants in the story. Understanding the "lived experiences" marks phenomenology as a philosophy as well as a method, and the procedure involves studying a small number of subjects" (p. 15). Creswell (1998) also clarified that phenomenology "translates into an approach to studying the problem that includes entering the field of perception of participants; seeing how they experience, live, and

display the phenomenon; and looking for the meaning of the participants' experiences" (p. 31). *A phenomenological analysis focuses exclusively on the structural level rather than the individual.* Putting in another way, the ultimate purpose of a phenomenological research is to highlight commonalities or universalities of a complex phenomenon. In my dissertation, lived experiences of AAW in STEM fields in HE were analyzed individually to seek the shared construct of their experiences impacted by shared structural barriers and facilitators, and also by shared personal strategies to advance them. The phenomenological approach used in my study strongly justified my recommendations for HEIs and individual AAW who want to be successful in STEM fields.

The report of a phenomenological research is usually a presentation of findings from in-depth interviews, which are exclusively used to collect qualitative data. The meanings of lived experiences of AAW in STEM are presented one by one individual separately. Instead, the *presentation of the findings are centered on structural/collective level*. The individuals' lived experiences are analyzed to seek meaning pattern(s) or construct(s) of the studied phenomenon. *The number of research participants in in-depth interviews is usually between 5 and 15*. And the *reliability of a phenomenological research is mostly confirmed by the participants* (Tesch, 1994).

The key drawback of phenomenological methodology is its missing the depth of unique story and unique context of each individual participant in the study. No matter the qualitative and quantitative aspects, the data collected from every single subject could provide certain meaning, in spite of being outliers. In order to fill this gap, narrative methodology is suggested.

5.1.2 Narrative Inquiry

Narrative research is "a form of inquiry in which the researcher studies the lives of individuals and asks *one or more individuals* to provide stories about their lives. This information

is then retold or re-storied by the researcher into a narrative chronology" (Creswell, 2003, p. 15). The narrative approach helps establish the collaboration between the researcher and the participants (Riessman, 2008). The curious questions of the researcher need to elicit the participants to tell their own stories, which might have not been told formerly. Etherington (2007) emphasized that in narrative research, curious questions help "thicken and deepen existing stories and invite the teller into territory beyond what is already known" (p. 600). There are two theoretical divisions – event-centered and experience-centered narrative research (Labov & Waletzky, 1967) My study was of experience-centered narrative. During in-depth interviews, I asked AAW to tell their lived experiences throughout their lifetime or life history from education in STEM to profession, and advancement to leadership. I employed experience-centered narrative because I presumed that the lived experience of each AAW in STEM differed across the time/life stages and circumstances. A single phenomenon of one AAW's success in STEM would provide varied meanings. My narrative approach was both about story-telling and listening to obtain insights into how individual AAW reinterpreted their being in the STEM world by "temporal and conceptual social interaction" (cited by Nigar (2020, p. 13) from Clandinin (2006))

The name "narrative" in methodological approach does imply the presentation style in the research report. Prevalently, "single subject research is presented in the form of a life story in order to illustrate factors thought to be at play in determining conduct" (Davidson, 1993, p. 200). The meanings of each story are interpreted to understand the unique relationship of the individual with external world. Their feelings, attitudes, and behaviors are portrayed in detail in order to infer how external world impacts their own lived story.

There are two key criticisms of narrative research. First, Davidson (1993) noted that life-story telling could not provide a "reliable route to scientific truth" (p. 201). By nature, the

interpretations of the story are usually varied depending on the researcher's perspectives. Second, while life stories give valuable insights into an individuals' lives, it cannot provide a "generalizable route to scientific truth of meanings". These criticisms are understandable! All qualitative research works are argued in this same way. In the spectrum of my dissertation, narrative inquiry had one typical limitation. Due to deep insights into individual stories rather than the whole group of studied participants, narrative research alone was not able to construct shared or universal meanings of the participants as a whole group in STEM fields. So, in order to provide persuasive implications for structural changes in the STEM fields, I used another research methodology in combination with the narrative approach. It was phenomenological research.

So far, there have been still a dearth of research studies using both phenomenological and narrative methodologies in combined mainly due to time and energy taking. Davidson (1993), Nigar (2020), and Patterson (2018) were a few literature works on phenomenological narrative research I could find in my review.

5.1.3 Phenomenological Narrative Research

Given the strengths and weaknesses of phenomenological and narrative inquiries when they are used separately, their combined use as "*phenomenological narrative research*" in one study could be useful. This new methodological approach enabled me to construct new understandings of the complex phenomenon embedded in AAW's status in STEM fields in HE. Patterson (2018) proposed that the affordance of two qualitative methodologies [phenomenology and narrative] helped the researcher to "address the multi-dimensional nature of the research phenomena" (p. 223). In my study, the phenomena of AAW's underrepresentation as women, overrepresentation as Asian Americans as a minority ethnic group, and modesty in higher decision-

making position in STEM fields were of multi-dimensional nature constructed by structural and individual factors, which were universal among them and also manifest in distinctive ways in most individuals.

Historically, using the combination of "research methodologies was straightforward and not unusual prior to the "paradigm wars" that came to the fore in the 1980s" (Patterson, 2018, p. 224) cited from Gorard and Taylor (2004)). The debates of one methodological approach over another have generated a big epistemological division in research interests. In order to prevent over-dependence on one specific approach, which has its own shortcomings, one suggestion is to "visualize a "bricolage" that allow the co-existence of reconciliations and ruptures in approaches" (Bernstein & Volpe, 2016, p. 224; Patterson, 2018). Phenomenological narrative methodology is an example. The studies of Davidson (1993), Duero and Villegas (2018), Nigar (2020), and Patterson (2018), are a few of those using and discussing phenomenological narrative approach to address complex phenomena.

Figure 2 below captures key points of the phenomenological and narrative methodologies, and the combination of them to form the phenomenological narrative approach in my study.

Phenomenological inquiry:
- Lived experiences of complex phenomenon
- Analysis of lived experiences to construct common/universal/shared meanings
- Missing unique stories in unique contexts
- Focus on problematic situation/phenomenon

Phenomenological narrative inquiry:
- *Interview questions open enough to elicit individual stories reflecting lived experiences*
- *First analysis & presentation of individual stories; then patterning/construction of shared structural meanings of lived experiences through stories told*
- *Individual & structural meanings are interpreted & constructed. Compelling suggestions for structural and personal changes are thus provided*

Narrative inquiry:
- Story-telling with coherent narratives
- Individual stories to understand individual meanings and relationship between unique individuals and unique contexts
- Not providing shared construct of varied meanings
- Focus on series/sets of experience

Figure 2 Venn Diagram of Phenomenological and Narrative Inquiries and Their Combined Model of Phenomenological Narrative Inquiry

5.2 Methods

5.2.1 Recruitment of Participants

Under the phenomenological narrative methodology, I used the *Success Case Method* (SCM) to build the strategy of participant recruitment, data collection, management, and analysis. The SCM was developed by Brinkerhoff (2003) to seek what factors have shaped individuals and organizations' success. This method has been widely used in a wide range of areas such as healthcare, rural development, child adoption, social welfare, manufacture and many others in the last decade of the 20th century and contemporary time to "determine why [a] person was successful – especially to identify the organizational factors, supervisory assistance, for example, that supported and enabled the success" (p. 20).

Brinkerhoff (2003) articulated that stories shared by successful people are in the center of SCM. "Storytelling is as old as people themselves and has always been a powerful influencer…The power of stories is well known to most of us from your life experience in general" (p. 18). Regarding data collecting instrument and procedure, he implied that a Success Case study first starts with "a search for stories of success worthy of the telling", then is proceeded with interviews with people of success stories to "uncover evidence" of the success shaping factors (p. 19). He insisted SCM has been scientific based on "solid rules and the discipline of scientific inquiry" (p. 25). Moreover, he affirmed that the interview technique in SCM literally depend on rules of good naturalistic inquiry and reporting established by Guba and Lincoln (1985).

Under the light of the SCM, I recruited the participants based on their formal leading position (academic and non-academic) and their widely recognized achievements. Diversity in terms of geographical location, type of institution (public vs. private, comprehensive vs STEM dominant), size of faculty and students, and diversity in terms of gender, ethnicity (original Asian countries/society), class (low-, middle-, upper-incomed family, STEM or non-STEM parents) were also included in the criterion for my sampling.

The interview sampling followed the guidelines of Daniel (2012) on non-probability sampling. As my study goal was both exploratory and explanatory, through the narratives of AAW participants, I searched for structural and individual factors influencing each AAW's success in STEM fields in HE. Moreover, the purpose of my sampling was to "provide illustrative example[s]" (p. 68) to be studied. The "examples" focused on their lived experiences in order to draw good lessons for other people of the same gender and race in the same social and institutional context. Limited time and financial resources was another element justifying the choice of my sampling size. The specific technique of my sampling was *purposive.* The sample size was *ten*

AAW leaders at middle level in STEM fields in HE. This sample size was *within* the range of between 5 and 15 as suggested by Tesch (1994) for a phenomenological research, and *much bigger* than the typical sample size of most narrative research (between 1 and 3). The "within" and "bigger" were rational because I designed my sample to include AAW in both academic and non-academic leadership positions[4] for comparative purpose. Moreover, in the academy, the line between academic and non-academic leading posts is rather fluid. A faculty member could be promoted to an administrative position, and then steps down and returns to their faculty position after the leadership term. I chose to examine "life stories" of AAW leaders from professional education to faculty and leadership because I had presumed that the higher positions they were, the richer their lived experiences were.

For alternative option of sampling technique, I planned to use snow-balling and convenience techniques just in case the sampling source was desperately scarce, or it was hardly able to recruit participants. It was good that I eventually did not need to use them in my study. There was a price for not using these alternative techniques – it took me a double time (one year vs. 6 months as planned) to recruit and schedule the interviews. I did spend the whole year 2022 for recruitment of participants, scheduling interviews, data collection, preliminary data analysis, and adjustment of interview protocol for follow-up stage (please see the progress of my dissertation in the last part of this section).

I relied on various sources to prepare the pool of potential participants for my study. I first searched through the lists of STEM dominant research institutions and of social sciences and

---

[4] The academic position includes vice president/vice provost in charge of academics, dean/associate dean, department chair or vice chair, director/associate director of academic center/division/unit or so. And the non-academic position refers to president, vice president/vice provost in charge of other areas than academics, director/associate director of non-academic center/division/unit or so.

humanity dominant institutions provided by the Carnegie Classification of Institutions of Higher Education 2022. I *randomly* picked up 10 institutions in each list by using random function in the excel office program, then checked to make sure if the selected institutions were from different states and of different type of institutions and different sizes of faculty and student bodies. And then I searched for Asian American faculty by the name list on the website of each selected institution.

In addition, I occasionally added to the search list with other sources I obtained in my daily reading and highly recommended by my academic advisor. Below are a few to many sources:

- Association for Women in Science (AWIS) Spotlight
- Valkyrie Page
- SCII Journal Page

After obtaining a list of 39 potential participants based on my sampling criteria, I started to email my invitation to all of these 39 AAW. Please see Figure 3 for the map of my study's invited and accepted AAW participants; and Table 1 for the list of the 39 AAW, who were invited to participate in my study, and time log of my contacts with them.

In the end, eleven (11) people accepted my invitation (of which one suggested the interview in Summer 2023), three (03) refused because of their maternal leave, hectic schedule, and non-Asian origin. The rest did not reply although I re-sent my invitation to them twice or triple. The sampling, recruiting, and scheduling interview took me a lot of time, almost one year – much longer than I planned for six (6) months. As I have completed my data collection of the ten participants in early Spring 2023, I should present in this dissertation my analytical results of these 10 participants rather than 11 participants.
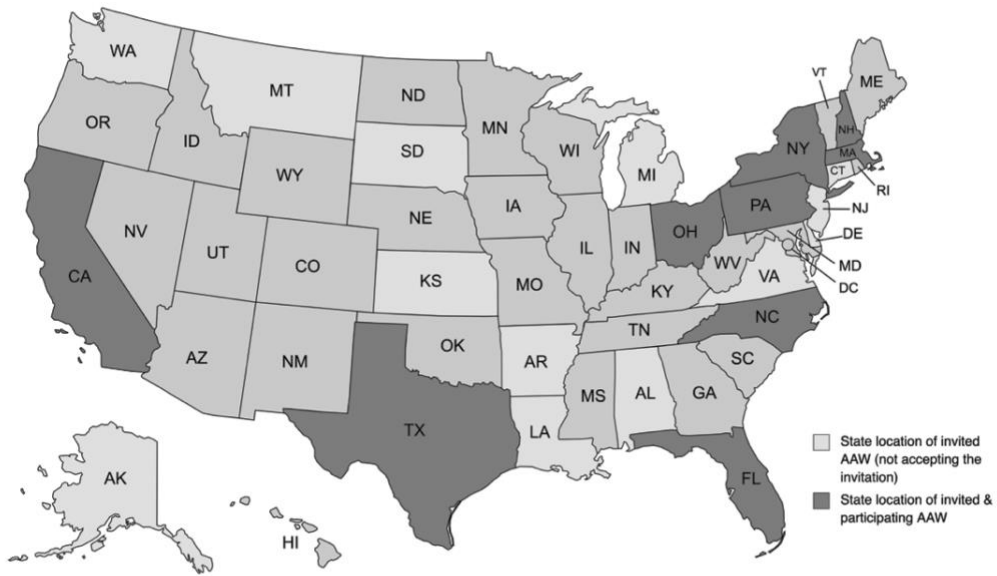
Figure 3 Map of State Location of Invited and Accepted Participants

Table 1 Log of My Participant Recruitment Process

No.	Leading positions/titles and pseudonym of participants	State	Self-identified/predicted ethnic origin	STEM field	Date of inviting email	Date of acceptance	Date/place & platform of Interview
1	Chair Mendoza	CA	Filipino	Developmental Immunology	2/10/22	2/10/22	2/28/22 via zoom
2	Manager Yang	MA	Taiwanese	Biology	6/13/22	6/14/22	6/23/22 via zoom
3	Director Balay	NY	Indian	Computer Science	7/14/22	7/14/22	7/21/22 via zoom
4	Founder Lin	TX	Chinese	Chemistry	7/19/22	7/19/22	8/19/22 via zoom
5	Professor Zhang	NH	Chinese	Medical Engineering	9/7/22	9/7/22	9/27/22 via zoon
6	Professor Chen	PA	Taiwanese & Hongkongese	Biophysics	9/22/22	10/11/22	12/2/22, office, but then via zoom because of my covid-19 positive
7	Professor Bandi	OH	Indian	Computer Science	10/20/22, 11/30/22	11/30/22	12/12/22 via zoom, but then text because of a sudden flu
8	Dean Gera	AL	Indian	Physics	11/16/2022, 12/2/2022	12/2/22	12/8/22 via zoom
9	Director Ngo	CA	Vietnamese	Biochemistry	11/30/2022, 12/02/22	12/4/22	1/4/23 via Zoom
10	Professor Pradeep	FL	Sri Lankan	Chemistry	7/14/2022, 11/7/22, 12/02/22	12/2/22	1/12/23 via Zoom
11	Chair Mendoza	NC	Bangladeshi	Electronics	11/9/22, 11/30/22, 12/7/22	12/7/22	suggested Summer 2023
12		PA	Indian	Electronics	2/20/22		
13		WA	Chinese	Bioengineering	2/19/2022; 3/23/22		
14		MA	Vietnamese	Astrophysics	2/19/2022; 3/23/22, 11/7/22		
15		MA	Indian	Mechanical Engineering	2/9/2022; 3/23/22		
16		PA	Hongkongese	Bioengineering	5/16/22		
17		CT	Japanese	Immunology	6/1/2022, 11/07/22, 12/02/22		
18		TX	?	Biomedicine	6/8/22		
19		NC	Indian	Regenerative Medicine	6/14/22		
20		SD	Chinese	Industrial Engineering	7/14/2022, 12/02/2022		
21		MI	Chinese	Engineering	7/19/22		

Table 1 Log of My Participant Recruitment Process (continued)

22	MT	Japanese	Biogeochemistry	7/19/22, 11/9/22
23	MT	Thai	Medical Microbiology	7/19/22
24	NJ	Chinese	Civil Engineering	7/19/22
25	AR	Chinese	Mathematics & Statistics	7/19/22
26	LA	Korean	Mechanical Engineering	8/17/22
27	MI	Indian	Electronical Engineering	8/18/2022, 11/30/22
28	DE	Chinese	Biology	8/18/22
29	AK	Chinese	Geomatics	8/23/22, 11/16/22
30	MA	Chinese	Physics	8/24/22, 12/7/22
31	PA	Chinese	Computer Science	8/31/22, 11/16/22
32	LA	Chinese	Civil Engineering	8/31/22
33	LA	Arabian (?)	Mechanical Engineering	8/31/22
34	FL	Chinese	Electronical Engineering	9/6/22
35	CA	Indian	Astronomy	9/7/22, 11/29/222
36	KS	Iranian	Electronical Engineering	10/31/2022, 11/7/22, 12/06/22
37	VA	Chinese (?)	Cybersecurity	11/16/22
38	AL	Indian	Chemistry	11/16/22
39	VA	Korean	Chemistry	11/16/2022, 12/2/22

Figure 4 below informs the state location and institution type of the ten participants in my study. There were six participants from public 4-year-universities in which one is Hispanic Serving University (HSI) and one is Historical Black College and University (HBCU). And the rest are four private 4-year-universities.
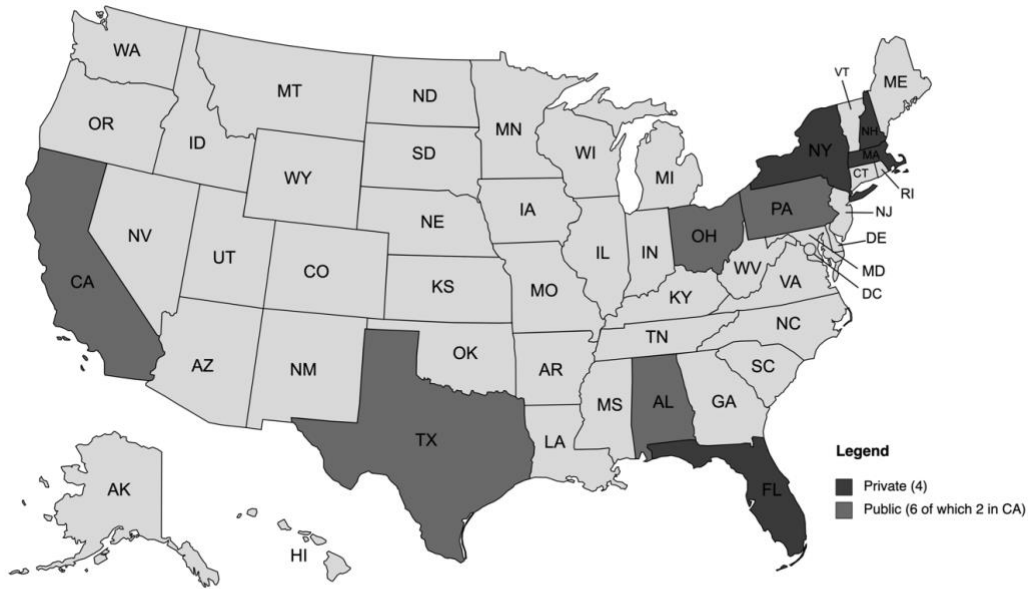
Figure 4 Map of the State Location and Institution Type of Ten AAW Participants

5.2.2 Data Sources and Data Collection

My qualitative data were collected from two sources – (1) documents and (2) in-depth semi-structured interviews. They were collected and analyzed in parallel for mutual supplementation and triangulation.

5.2.2.1 Data from Documents

Documents related to the participants such as their resumes, personal professional pages or so; and their institutions such as yearly institutional report, fast facts and figures and so on were collected. In fact, while conducting the recruitment of the participants, I collected a big part of the forty-eight (48) documents related to the ten participants and their institutions I needed. The

sources of these documents were mainly from the official websites of their institutions, departments, research labs, research centers, professional associations, their own pages embedded in their institutional websites, LinkedIn, YouTube, and their personal sharing via email with me.

Table 2 Number of Documents Related to the Ten Participants' Personal and Institutional Features

Leading positions/titles and pseudonym of participants	Number of collected documents on individual participants	Number of collected documents on participants' institutions
Chair Mendoza	2	3
Manager Yang	3	3
Director Balay	1	2
Founder Lin	2	2
Professor Zhang	1	3
Professor Chen	2	4
Professor Bandi	3	2
Dean Gera	1	2
Director Ngo	5	2
Professor Pradeep	2	2
Total	23	25

5.2.2.2 Data from Interviews

The second data source was collected from ten in-depth semi-structured interviews with ten AAW leaders in STEM fields in HE. All these interviews were conducted from February 2022 to January 2023.

The interview questions were built alongside the specific inquiries noted in the research questions. The nuances of the interview questions are grounded on the conceptual and analytical frameworks presented in the Section of the Conceptual and Analytical Frameworks above. The interview also consisted of questions exploring meanings outside the established concepts, theories, and structured research questions.

Each interview lasted between 41 and 98 minutes and was audio-recorded with the participants' consent. The document data were collected prior to and in parallel with the interview data. Among ten interviews, there were nine conducted via zoom and only one conducted via text because of the participant's sudden seasonal flu (she asked me to send her the questions and she answered them in writing).

5.2.3 Limitations in Sampling

The major limitation in the participant recruitment was the small pool AAW leaders at higher levels in STEM fields in HE due to small population of AAW in leading positions.

Although the sample size reached to the planned number of participants from varied types of institutions, state locations, professional fields in STEM, ethnic groups; my study had a certain limitation in transferability of the findings due to:

- Lack of participants from mathematics, astronomy, space sciences, and agricultural sciences.

- Lack of participants at higher level of leading academic positions and at higher level of administrative positions.

- Lack of participants located in the northern and central states of the US.

- Lack of participants originally from eastern and western Asian countries.

The next drawback of my study was in the document data. While I could obtain data on institutional diversity and inclusion in terms of female and minority student and faculty representation, I failed to get this type of data at school and departmental levels. My finding on the correlation between lived experiences of the AAW and organizational diversity is not thus entirely compelling.

Moreover, due to time and resource constraint of mine as a researcher and of the participants, the interviews were mainly conducted virtually. My data therefore lacked field notes or onsite notes on tangible culture of the institution, school/department. This insufficiency made some limitation in the internal validity of my study.

With the awareness of the limitations as presented above, I would like to suggest that further studies should have a bigger sample size to include more AAW participants from better diversity of profession, regions, and ethnicity.

5.2.4 Data Analysis

The coding of document and interview data was conducted simultaneously. My coding process relied on the guidelines of Saldana (2016), and Miles et al. (2020). The general approach of my coding was a *combination of deductive and inductive approach*. With deductive approach or theory-driven top-down approach as so-called by Chi (1997), I identified nodes (as termed in Nvivo 12 language) or codes based on the established conceptual and theoretical frameworks. With inductive approach or data-driven bottom-up approach (Chi, 1997), I labeled the codes arising from my analysis of the original data with new category(ies) and theme(s). The unit of my coding analysis was first by every single document and interview transcript, then inside each document and transcript by sentence or details aligning with my inquiry. Overall, for documents, I analyzed each document by content. For interview transcripts, I analyzed each transcript as one written narrative to tell life story of each participant.

I conducted the coding process through two stages or cycles. The first stage - *open coding* - was to identify and label codes of each document and interview related to each success case. The second stage was to *refine or interpret for more analytical themes* or *categories or clusters*. My

research inquiries guided the theming and categorizing codes for success factors and discouraging factors at different levels in society in career advancement pipeline of AAW in STEM field in HE.

5.2.4.1 First Stage of Coding – Open Coding [Narrative Analysis]

In the first stage of coding, both *grammatical and exploratory methods* were employed. In grammatical method, I applied the attribute mechanics to code the descriptive data arisen from the documents and the first part of the interview protocol to explore the participants' demographics and professional education, faculty, and leadership backgrounds.

In exploratory method, I used the provisional mechanics to code the data obtained from the documents and main parts of the interview protocol regarding the structural and personal factors influencing professional education, and career advancement of the participants in STEM fields. I generated "a priori or start list" as guided by Miles et al. (2020, p. 69) and based on my analytical framework, research questions, and interview questions. In this cycle, the coding mainly followed a deductive approach. I also noted down emerging codes and labelled them as "Others" (please see Table 3 – Codebook below). In this process, I deeply read every single collected document and interview transcript. I highlighted words and lines in each response or passage giving sense of factors impacting the participants' lived experiences. Lastly, I labelled all meaningful codes closely connected with key senses responding to the research inquiry and interview questions.

The outcomes of this coding stage are narratives/stories of individual AAW in the sample with emphases on the structural and personal factors influencing their whole pipeline from professional education to faculty and leadership.

5.2.4.2 Second Stage of Coding – Pattern Coding [Phenomenological Analysis]

Saldana (2016) explained that "First [stage] coding is a way to initially summarize segments of data. Pattern coding, as a second [stage] method, is a way of grouping those summaries into a smaller number of categories, themes, or concepts" (p. 236). From codes/nodes resulted from the first stage of coding, based on the research inquiries and the analytical framework, I grouped them into several key categories/themes as parent nodes regarding structural and personal factors at three levels of society. Under each category/theme, there are subcategories/subthemes as child nodes reflecting coding labels. The outcomes of this coding stage was a list of shared success factors along with shared barriers, structural facilitators, and personal coping strategies. The Section of Findings is the outcomes of this second stage of my data coding and presented into three levels of society in analysis.

5.2.4.3 Three-Level-Analysis of Collected Data

In order to seek answers to the third question regarding levels at which success and disruption factors operated, I adopted sociologists' perspectives on society. They define three major levels of society – macro-, meso-, and micro-level – which influence and shape individuals' attitude and behavior.

Macro-level analysis, examination of society as a whole, looks at the broad systems, institutions, hierarchies, and patterns that shaped a society. Macro-level analysis considers the social, political, economic, and other forces that impact societies and individuals but might not capture important facets of social interactions that occur on the micro level. At the macro level, national, institutional, and hierarchical factors as "large scale patterns" (Blackstone, 2014, p. 13) are analyzed to understand individual attitude, choice, and behavior.

Meso-level analysis – a detailed examination of a specific group, community, or organization - studies certain parts of a society. It also refers to network analysis. This analytical level examines the patterns of social ties among people in a group and how those patterns affect the overall group.

Micro-level analysis - a detailed examination of one-to-one interactions between individuals - includes studying people's behavior during negotiations, confrontations, and everyday conversations. *Micro-level* is "the smallest levels of interaction; even in some cases, just "the self" alone. Micro-level analyses might include one-on-one interaction between couples of friends", or perhaps on "how a person's perception of self is influenced by his or her social context" (Blackstone, 2014, p. 13).

In my study, macro-level analysis was used to examine what and how national and institutional, school/departmental policies and practices have facilitated and challenged the AAW in STEM fields. My meso-level analysis focused on their family backgrounds, their communities, and other professional and social networks contributing and challenging their advancement in their career. My micro-level analysis concentrated on personal factors regarding participants' mindset and mind tools to explain for their successfully overcoming the barriers to move up in the professional ladder. Figure 5 below visualizes my three-level-analysis of the collected data
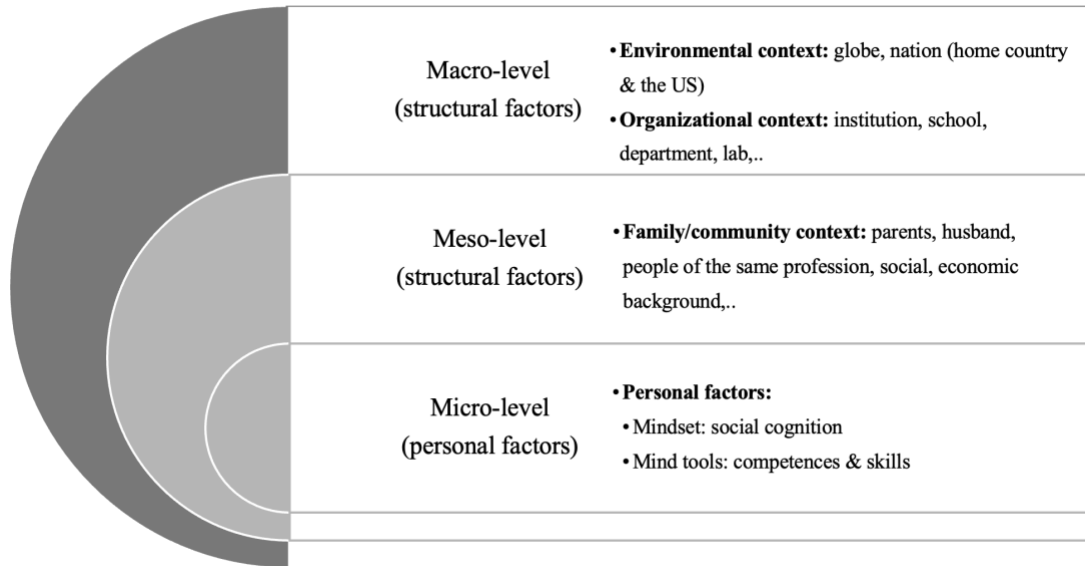
Figure 5 Three-Level-Analysis of Data

Table 3 Codebook of Data Analysis

Name	*Description*	*Files*	*References*
1-Demographics	Original race, ethnicity, socio-economic backgrounds,..	12	21
2-Academic background & career advancement journey	Undergraduate & graduate major, current academic & non-academic position, achievements,..	27	59
3-Success stories - contributing factors		0	0
3.1-Macro-level factors (structural factors)	Regarding national, institutional, and departmental feature, context, policy, environment, climate,..	5	6
3.1.1-Departmental factors		11	57
3.1.2-National factors		5	11
3.1.3-Institutional factors		15	32
3.2-Meso-level factors	Regarding parents, husband, friends, social networks, and others	2	2
3.2.1. Parents		11	20
3.2.2-Husband		7	16
3.2.3-Community & Network		4	8
3.2.4-Others		1	1
3.3-Micro-level factors (Personal factors)	Mindset & mind tool	4	7
3.3.1-Mindset	Way of thinking, self-awareness, self-efficacy, attitude,..	12	50
3.3.2--Mind tool	Personality, character, skills, capacity, competence	14	47
3.4-Other contributing factors		1	1
4-Painful or tough stories	Difficulties, barriers, challenges,..	8	95

Table 3 Codebook of Data Analysis (continued)

4.1-Macro-level	7	66
4.2-Meso-level	3	7
4.3 - Micro-level	5	19
5-Suggestions	7	15
5.1-For department & institution	4	7
5.2-For other AAW	2	2
6-Metaphors	7	12
7-Other codes	0	0

In summary, with the availability of qualitative data I collected from documents and in-depth semi-structured interviews, I proceeded the data analysis through two stages of coding – open coding for success stories and pattern coding for universalities of success stories across AAW in STEM fields in HE. I used the grammatical and exploratory techniques with the mechanics of attribute and provisional coding respectively in the first stage and the pattern method in the second stage. My coding process was both deductive and inductive. The favorable and unfavorable factors in each story were categorized into three levels of society.

5.3 Strategies to Ensure Trustworthiness of My Study

I adopted the traditional approach to ensure the quality and trustworthiness of my study measured by internal and external validity and reliability of the research design and procedure.

5.3.1 Validity

Merriam (2009) insisted that a research study must have both *internal* and *external validity*. The internal validity refers to the matching between research findings and reality (accounts as

given). The author recommended six strategies to enhance internal validity of a study – (1) Triangulation, (2) Member check, (3) Adequate engagement in data collection, (4) Negative or discrepant case analysis, (5) Researcher's position or more recently "reflexivity", and (6) Peer examination or peer review. In my study, I applied all the six suggested strategies with: (1) two data sources – documents and in-depth interviews, (2) double check of interview transcripts by the participants, (3) myself as the only person to collect the data and pilot interviews (in my milestone 2 of the Ph.D. Program as my independent study) to ensure interview questions understandable to the participants and eliciting rich data for research questions, (4) with adequate sample size for diverse, even discrepant answers, and with some open questions such as "What else would you like to share about your education, profession, and leadership pipeline?" to elicit emerging data outside the structured themes underneath the interview protocol and to avoid missing any significant data; (5) me as the researcher with my own positionality as presented in the part of my positionality as a research; and (6) regular feedback from my professors, peers, and wider audiences who participated/attended my paper sessions at the CIES2022, CIES2023, and AERA2022 Annual Conferences.

External validity in qualitative research pertains to transferability rather than generalizability in quantitative research. Guba and Lincoln (1985) noted their point on transferability, "the burden of proof lies less with the original investigator than with the person seeking to make an application elsewhere. The original inquirer cannot know the sites to which transferability might be sought, but the applier can and do" (p. 298). In order to obtain external validity, they suggested the researcher should provide "sufficient descriptive data" to make transferability possible (p. 298). I believe that my sample size of 10 participants and my thick

description of the data collection and analytical process could help ensure external validity of my study.

5.3.2 Reliability

Guba and Lincoln (1985) defined reliability in qualitative research as "dependability" or "consistency". It depends on how much the results make sense from collected data. They recommended four strategies to enhance reliability of a study - triangulation, peer examination, investigator's position, and the audit trail. The first three have been discussed above on the internal validity. The audit trail refers to detailed description of "how data were collected, how categories were derived, and how decisions were made throughout the inquiry" (Merriam, 1988, p. 172). I provided in detail as presented in the section of Methods. Moreover, Tesch (1994) highlighted that the reliability of phenomenological research is mostly confirmed by the participants. Under the guidance of the above scholars of qualitative research, besides the strategies to guarantee the internal validity I provided detailed descriptions of data collection and analysis in my dissertation. In addition, the purposive sampling for a diverse pool of participants in STEM fields from different types of institutions featured by varied student and faculty sizes as presented in the recruitment of participants above, and two data sources for triangulation supported my study reliability.

5.3.3 Data Security Management

All of the audio, visual, and textual data were saved and stored in my Pitt One Drive/Sharepoint for the optimal security and support. Only the researcher (me), my academic advisor, and authorized representatives of the University Research Conduct and Compliance

Office (RCCO) are allowed to access the stored data. If there were any incident regarding to the data security, I would report it to my academic advisor and IT administrator of my Department. Though I did not have plans to share data, I might share de-identified data in the future as required by relevant authorities.

All the identifiers and details implying identifiers of the participants and their institutions were removed from the data stored on OneDrive/SharePoint hosted by Pitt.

The identifiable data including the participants' names, professional titles, institutions, and related information had been collected and stored temporarily in the Pitt One Drive/Sharepoint during the process of screening and recruiting the participants of the study. When the recruitment were completed, these identifiable data were immediately coded/encrypted when finally stored in the location noted above.

Besides on the Pitt One Drive/SharePoint, all the files and folders of and related to my study's data were temporarily stored in my personal Apple computer and protected by passwords. This computer was used only by me and also protected by an access password. My computer was regularly scanned by the anti-virus software AVG installed and updated. Moreover, the operating system on my computer were kept up-to-dated. Importantly, the File Vault was enabled on my Apple computer and all drives which were used to store my study's data were encrypted. When my data collection and analysis were completed in early March 2022, all of the data were transferred to and officially stored on my Pitt One Drive/SharePoint for the best security.

As the interviews were conducted virtually (except for one via text sent via my Pitt email), Zoom platform with my Pitt account log-in was used to create the audio recordings.

5.4 Summary of My Dissertation Study Progress by Semester

After my dissertation overview had been approved by the Faculty Committee in early January 2022, my implementation of this dissertation study experienced four stages by semester:

5.4.1 Stage 1 - Spring 2022

- o Applied for IRB approval
- o Collected part of document data to recruit participants of in-depth interviews
- o Conducted the interview with the first participant
- o Revised the interview questions
- o Continued collecting document data to triangulate the interview data and to recruit more participants
- o Initially analyzed the collected data
- o Presented literature review study and further study plan at CIES 2022 and AERA 2022 to get feedback from bigger audience in across disciplines.
- o Enriched the Introduction, Literature review, Conceptual framework, and methodology chapters of the dissertation.

5.4.2 Stage 2- Summer 2022

- o Conducted three interviews
- o Continued collecting document data to triangulate the interviews' data and to recruit more participants.
- o Continued analyzing collected document and interview data
- o Started writing initial results
- o Prepared and submitted paper presentation proposal to CIES2023. The proposal was about findings of the first three interview and document data.

5.4.3 Stage 3 - Fall 2022

- o Conducted four interviews
- o Continued collecting document data to triangulate the interviews' data and to recruit more participants.
- o Continued analyzing collected document and interview data
- o Continued writing the analytical results
- o Started writing the dissertation
- o Paper presentation proposal to CIES2023 was accepted.

5.4.4 Stage 4 - Spring and Early Summer 2023

- o Conducted collection of the document and interview data related to the last two participants.
- o Continued analyzing collected document and interview data
- o Continued writing dissertation
- o Submitted a full dissertation to the Faculty Committee Chair (mid-March) and Members (the third week of April)
  - o Revised the dissertation as the feedback and suggestions of the Committee Chair and Members (late April and first three weeks of May)
  - o Defend the dissertation (May 24, 2023)
  - o Submit the official version of the dissertation to Pitt Library System (June)

6.0 Findings

In this section I divide my findings presentation into three sub-sections. The first sub-section is the demographic and institutional features of the ten AAW in my study. All names noted in this section and in the table in the previous section are pseudonyms to protect the participants' identifiers while their leading positions and titles reflect their true positions at the interview timepoint. The second sub-section informs rigorous answers to my first research question - *What factors and interventions empowered the AAW to overcome the barriers and advance in their career in STEM fields in HE in the U.S?* And the last sub-section provides responses to my second research questions - *In the journeys to success in STEM fields in HE, what were the biggest obstructions the AAW had to face?* The findings in the second and third sub-sections are presented in three levels of the data analyses adhering to macro-, meso-, and micro-levels in society. This three-level-presentation answers my third research question - *At which level of the society (macro-, meso-, micro-level) did the success factors and interventions, and obstructions operate?*

The purpose of my taking three levels (macro-meso-, and micro-) in my findings presentation is to make my data analytical interpretation more conceptualized and pragmatized following inter-disciplinary perspectives of sociologists, educational administrators and educators, and organization/business managers.

In this section, at macro-level, I point out what and how national and institutional policies and practices challenged and/or facilitated the AAW in STEM fields. At meso-level, I shed light on roles of family (mainly parents and husband), communities, and social and professional networks on the AAW's pathways to career advancement in STEM fields in HE. At micro-level, I concentrate on personal factors regarding the participants' mindset and mind tools.

79

6.1 Demographics of the Participants and General Features of Their Institutions

Among the ten interviewees, two women were US-born scholars (2nd generation of their family in the U.S. at the interview timepoint) - one Filipino-American professor and another Chinese-American professor having parents from Taiwan and Hong Kong (China). Another woman from Taiwan was adopted by an American family and raised in the United States (1.5 generation). Three women arrived from India, two were originally from mainland China, one was from Sri Lanka, and one was from Vietnam. These seven women were the 1st generation.

In discipline, three of the ten scholars were in chemistry and related to chemistry (biochemistry), two in computer science, one in physics, one in biophysics, one in developmental immunology, one in mechanical engineering, and one in biology. Although they were varied in STEM fields, they had almost the same pipeline to their career advancement – pursuing undergraduate, then graduate studies and postdoctoral research (except for Director Balay, Professor Brandi, and Dean Gera. They did not take postdoctoral positions). While teaching and doing research (except for Manager Yang as a research and program manager of a lab), all of them engaged deeply in other academic and academic-related activities such as department chairing (Dr. Mendoza and Dr. Gera), directing a research center (Dr. Ngo), co-founding and co-directing a research lab (Dr. Balay), co-founding a professional business (Dr. Lin), and joining professional associations (Drs. Lin, Chen, and Ngo). All of them won awards and honors in their profession. Three participants - Director Balay, Founder Lin, and Doctor Zhang - experienced living and learning across three countries – first their home country, then Argentina/Canada/Japan, and lastly the U.S.). Table 4 below summarizes demographics and profession of the ten women in my study.

Table 4 Demographic, Marital, and Professional Features of the Participants

Leading positions/titles and pseudonym of participants	Self-identified ethnicity	Genera-tion in the US	Marital status	Number of children & bearing timepoint	STEM field	Professional title	Leading position
Chair Mendoza	Filipino	2nd	Married	2: 1st child when starting PhD dissertation writing, 2nd child when postdoc started.	Developmental Immunology	Professor	Department chair
Manager Yang	Taiwanese	1.5	Married	2: 1st child in postdoc, 2nd child five years later	Biology	-	Research and program manager
Director Balay	Indian	1st	Married	0	Computer Science	Associate Professor	Co-founder & Co-director of a research studio
Founder Lin	Chinese	1st	Married	0	Chemistry	Professor	Co-founder of a small nano-business
Professor Zhang	Chinese	1st	Married	2: 1st child in postdoc in Japan. 2nd child in the US	Medical Engineering	Professor	-
Professor Chen	Taiwanese-Hongkongese	2nd	Single	0	Biophysics	Professor	Co-Principal Investigator of an awarded research project
Professor Bandi	Indian	1st	Married	0	Computer Science	Associate Professor	-
Dean Gera	Indian	1st	Married	2: 1st child in the first year of faculty appointment	Physics	Professor	Associate Dean & Department Chair
Director Ngo	Vietnamese	1st	In relation-ship	0	Biochemistry	Professor	Director of a research center, Chair of an award foundation
Professor Pradeep	Sri Lankan	1st	Married	1: at start of faculty appointment	Chemistry	Assistant Professor	-

Regarding institutions, six of the ten scholars worked in public universities, of which one is a Hispanic serving institution (HSI) and one is a historically black university (HBCU). These six public institutions had different sizes of student and faculty bodies (ranging from over 5,900

students to over 33,000 students; and from over 900 faculty to over 5,700 faculty members). The diversity in terms of gender and minority students and faculty were also quite varied across these institutions. The other four participants were from private institutions which also of varied size and diversity in student and faculty body. By the Carnegie Classification of Institutions of Higher Education 2020, half of the participants were from the STEM dominant research universities and the other half from comprehensive research universities. Please see Table 5 below for the details of each institution.

Table 5 Features of the Participants' Institutions in 2022

Leading positions/titles and pseudonym of participants	State	Institution Type	STEM dominant research institution	Compre-hensive research institution	Student body (2022)	% female undergrad & grad students	% minority undergrad & grad students	Faculty body (2022)	% female faculty	% minority faculty
Chair Mendoza	CA	Public		x	> 9,000	52 & 46	83 & 74	>900	56	25
Manager Yang	MA	Private		x	>11,000	48 & 38	56 & 21	>1000	25	23
Director Balay	NY	Private	x		>4,600	31 & 48	22 & 45	>750	45	9
Founder Lin	TX	Public (HSI)	x		>6,900	49 & 50	84 & 87	>1,000	50	18
Professor Zhang	NH	Private	x		>6,000	49 & 49	52	>4,000	52	7.9
Professor Chen	PA	Public		x	>33,000	56	36	>5,700	46	28
Professor Bandi	OH	Public	x		>10,700	55	24	>2,600	54	16
Dean Gera	AL	Public (HBCU)		x	>5,900	56 & 42	98	>980	62	87
Director Ngo	CA	Public		x	>26,000	55 & 45	64 & 43	>3,300	53	16
Professor Pradeep	FL	Private	x		>9,300	36	49	>500	31	18

Document Data Sources: Institutional Reports 2022 and Fast Figures and Facts retrieved from institutional websites

6.2 Success Factors and Interventions for AAW's Career Advancement in STEM Fields in Higher Education

The analysis of the document and interview data illuminated that the career success of the ten women in my study were supported by varied factors and interventions at different levels bounded to national and institutional environment, families, communities/social network; and

personal factors regarding mindset and mind tools.

6.2.1 Macro-level: National, Institutional, and Departmental Factors

6.2.1.1 National Factors:

6.2.1.1.1 Funding Sources for Professional Education and Development

The AAW's narratives obtained in the interviews revealed that all ten participants benefited from the U.S. governmental and institutional funding sources. It was either direct or indirect. The stipends they had during their graduate studies and postdoctoral studies in labs supported them at least in living expenses and part of daycare tuition for their little children as in the cases of Chair Mendoza and Manager Yang. Their stories informed the influential role of the research grants from the federal sources such as the National Institute of Health (NIH) and the National Science Foundation (NSF) for both institutions and individual faculty in the STEM fields. The ultimate beneficiaries were actually the younger generation – the students.

Chair Mendoza thankfully shared:

> I was in graduate school I was supported by a fellowship from the National Science Foundation (NSF), the National Institutes of Health. In the Fellowships I had been titled "Minority Graduate Fellowship". So, money was dedicated to underrepresented minorities in science.

Director Balay disclosed that while her institution gave her very limited funding for her research project, the funding from NSF was a huge drive for her retention and advancement in her later career at the same institution. Noticeably, her narrative informed that she and her husband were in the same STEM field and hired in the same department for the same lab project. They were

colleagues of each other. This is a special case of my study:

> We decided to pull together whatever resources we were given and really
> tried actively to get our own funding. We applied to the National Science
> Foundation for an infrastructure grant. And we were lucky. In two years
> after we started here, we were lucky enough to be awarded a 750k grant to
> set up. So, we used that money to set up that lab. It was a lot of work - my
> husband and I we would come in in the summer we would be building
> everything. (Interview transcript)

6.2.1.1.2 National Environment – Wide Opportunities for Job and Promotion

The story of Founder Lin's pipeline implied that the US as a nation in general and its higher education in particular provided her with a wide choice and good opportunity to start and retain in STEM for her career in the academy. After completing her undergraduate and graduate studies in chemistry in her home country, she applied for and got acceptance to a postdoctoral research position at a Canadian university for three and a half years. But she struggled in finding a professoriate position there because "they do not have even lots of different universities". But when she "moved down to the US for another postdoc then [she] was hired to an assistant professor position" with a tenure track. Since then, she could continue moving up in her professional ladder. At the interview timepoint, she has been promoted to a full professor.

My data analysis provided that job and promotion opportunities were the two key impact factors to pull the participants in my study to the US as the destination of their career:

> I had the choice of either going back to [the participant's original country]
> or going to the US. And I felt like the better choice was to come to the US,

because there were more options for success. (Interview transcript with

Director Balay)

Similarly, Dr. Pradeep in the chemistry field noted:

In terms of the country, I guess, I might be wrong, but based on my

experience, based on the people that I met at conferences, my collaborators

from other countries and other stuff, I believe there is no other country than

this for you. If you want to study, or if you want to explore the opportunities.

This is the country anyone should be experiencing (Interview transcript)

This finding reminds me of the same evidence I obtained in another independent study, which was published in a journal (Nguyen, 2020), also as a pilot study for this dissertation. One of my participants in physics field shared her view on the US value and norm which strongly persuaded her to choose this country for her career. When we talked, she had 35 years of living, studying, and working in academia in the US. She insisted that her academic and professional journey to the U.S. was an inspiring and rewarding exploration. She highly appreciated the American institutional cultures of merit-based reward and opportunity equality for those who worked hard for their passion. Her story also informed that American academia and society were open chance for scientists like her to greatly contribute to areas beyond her institutional boundary. She enjoyed devoting her expertise to national and international policies related to areas beyond her narrow profession in physics. She felt the breadth and depth of her perspectives in cross-disciplinary issues were respected and thus contributing.

6.2.1.2 Institutional and School/Departmental Agents and Interventions

From my study, I could evidently confirm that while certain institutional agents obstructed the AAW participants the most, the others facilitated them the best. In this section, I will present these facilitators.

6.2.1.2.1 Advisors and Faculty in Professional Education of AAW in STEM Fields

Analyses of all the ten narratives of the women in my study illuminated that there was an intersection of gender (female and male), race (white and non-white), ethnicity (American and Japanese), and hierarchy (student and supervisor/faculty) in the supporting agents within departments and institutions.

Chair Mendoza affirmed that her white female advisor played the most crucial role in supporting her to choose an undergraduate major best for her interest and strength. Her advisor was open-minded to listen to her intention to change her major from medicine to biology field. She introduced her to work in a biology lab during summer. Thanks to this opportunity, she could have a clearer vision and could finalize her major choice of biology rather medicine for her future long-term future job. In her post-doctoral study, she was again fortunate to have a female mentor who also had small children to take care of. This was a big encouragement for her to have such an understanding from her postdoc supervisor on how hard it was to fulfill dual responsibilities as a new young mother and a researcher.

While Manager Yang was struggling to find a lab to work as a requirement of her academic program, a female faculty offered her an opportunity to work in her department lab, then made her co-author in a publication. These offers were a springboard to lift her up to the professional achievement:

> I went door to door, "Can you use someone to?" There was a woman,

86

"Yeah, I think I have a project for you". She was great, I am still in touch with her, and she really helped me a lot and gave me a project. It was a very good project, very simple. I was able to complete it in the year, and I was actually co-author on that paper. She probably worked, and it was really nice to get a co-authorship on our great work. It was really nice of her, and she made me senior author, because I got a grant to support that project from [name of her undergraduate college]. (Interview transcript)

The narrative of Dr. Zhang about her postdoctoral time provided that not only female supervisors and faculty supported the women in my study, but also male professors facilitated and gave a lot of understanding for mothering women at work. Dr. Zhang shared she felt warm and motivated when one of her male supervisors said:

Because you need to take care of your children. You can continue this job. You should put your family first. Then you can do your job later. It's okay. We didn't have any instruction or group to push you at all!. (Interview transcript)

In her story, she also mentioned about another male professor who tremendously supported her in successfully preparing the first grant proposal for her first independent research project. Without his support, she could not be "continually working in medical engineering field" (Interview transcript)

She was also fortunate to have a male Japanese professor who helped develop her professional capacity well by giving her challenges, encouragement, and support at appropriate times. This professor brought her out of the inferior feeling as a woman in STEM fields

predominated by males, and gave her enough challenge to strive for development and enough support to confidently go ahead in her professional pathway:

> My Japanese professor - he was a very old-styled Japanese. He was very strict. He always said to me, "Please do not think you are a woman, and you were a foreign student. I would not lower down my requirement for you. I always ask you to do the same things as much as high level as I did for other students". So, I remember I spent like two hours just trying to finish a presentation, or my research, because my supervisor thought I did not reach to the level. So, he just asked me to stand there like one by one that helped. At that time, I was really crying, but I did that. Thanks to that, two years made me really improved in my scale – presentation scale, language scale, and also my auto-electronics as the major scale. (Interview transcript)

6.2.1.2.2 Teaching and Leadership Training Programs as Interventions for Pre-tenured and Tenured Faculty

The story of Chair Mendoza could be considered as a typical example of good-impact - interventions the higher education institutions offered to minority women. During her post-doctoral program at a liberal arts college, she had an opportunity to attend a special training program for minority faculty. She "got training in pedagogy" and "got to interact with female undergraduate students". She felt the training program "really framed how [she] saw [her] future lab, and how [she could] interact as a faculty member". It was even more interesting that with this first training program, she found it also gave her a lot of leadership skills she could apply later for her department chairing.

Then when she was hired and promoted in another university, she was given another

intervention, which truly prepared and developed her leadership skills in higher education. It trained her in mindset (understanding higher education governance and operations, thinking deeply and holistically for multiple roles and sides of a problem), and mind tools to be an effective leader in higher education context. The long quote below from her narrative could inform how helpful the training was for her leading position at her institution. It did transform her thinking and doing!

> There was one opportunity called "preparation of HERS" - HERS. It stands for "Higher Education Resource Services". It was the group, but it focused on women.. This was my first leadership training. It was like a you had to dedicate two weeks, two full weeks in the summer, residential. We went to and they had us learned from all of the different positions in the university, from professor to the chancellor, to the finance to every day somebody comes in, all women coming, and they were telling us what they do, and how their position works in the bigger system of the university, and how they got there, and their challenges. And then, at the same time we were doing our own reflection. We took personality tests like kind of to see "what kind of leadership style, what kind of leader are you?"...It was really interesting, you would do Myers Briggs, like all kinds of things about ourselves, and how we interact with people, how we approach a problem, how do we interact with others to be more effective leaders, and I was like amazed with how much I learned through the training. I think that it helped me become more effective, because now, when I am faced with a problem, I'm thinking about it. Not just like there's an immediate action that we have

to take. So, like, "Wait! Let's pause a little bit". I think if it's not something we have to decide right now. Okay, some time to think through it carefully, and talk more. So, I do a lot more consensus building than before.. Whatever now I'm like, "Okay, wait. Well, what do you think we should do and like hold on! Let me think about like, "Who else do we need to consult", "Oh, we're going to need money for that, but we don't have that money. So, Who? Whose money" is that supposed to be?" and like "really kind of come up with more of a plan"…Because you want to make for higher-ed. So, there's the challenges always built on resources, and good relationships between the different units. And so, kind of showing like, if we make this change here, because if you make a mistake, it can be for years, it can impact for years, and then the people who come next are like the ones that are solving the problem you started and I'm trying not to create any new problems in my leadership. So, the training was great! (Interview transcript)

Although only one participant in my study shared about training programs as interventions the institutions gave her during her postdoctoral and department chairing appointments, it meant a lot. It recommends higher education institutions paying more attention to providing their junior faculty, particularly female and minority faculty, with teaching and leading training programs. For individual AAW in higher education, Chair Mendoza's story could suggest them making full use of all training opportunities to prepare themselves for teaching and leading roles.

6.2.1.2.3 Study, Work, and Living Environments

Despite big challenges in highly demanding study and work, the participants could move forward in their professional education and career advancement pipelines thanks to the empathy

and caring from their peers, colleagues, and supervisors. It was both women and men (gender mainstreaming) helping women! I categorized these individual factors into macro-level in my data analysis because the peers, colleagues, and supervisors all together built a supportive and amicable environment within their department and institution as a whole to facilitate graduate students and junior faculty to retain in and develop their profession.

Professor Zhang felt lonely in her engineering lab because she was the only one female in the lab, and her female body was not strong enough to move heavy lab devices and equipment. But such a feeling was gone then thanks to her helpful male peers and students. They even made jokes with her as they did for their male folks. They – white and non-white males - never discriminated her:

> Actually, the couple of things that I felt – I was lonely because the
> instrumentation was sometimes really heavy. So, I tried to move it. Then
> most of students would help me to move. But a couple of the Japanese
> they said, "Oh, if you can't do that then you should suppose not to learn
> engineering!". They had jokes! I did not feel a lot because most of the
> students were like boy students helped me. They joked that they didn't
> treat me as a female. They said they didn't treat me as a female, and so,
> they even they had like a bad joke. I didn't feel like a really bad in that
> way...I didn't feel like I was lonely or something because they all my
> classmates that they were really like me and we were so good conditions
> like every time, like a way I went together to the lunch and something that
> they would really take care of me. (Interview transcript)

Multiple mentors within department – the smallest professional unit of faculty in higher

education - played a crucial supporting source for my participants in their career pipeline. Without this source, they could not have had enough mental strength to move forward in their career. Regarding this multiple mentorship source, Chair Mendoza thankfully shared:

> There were not a lot of women in the lab, and in our department when I was pregnant there were a few other women who had children, had babies. They were giving me the information, "Oh, if you works in the lactation room and here's the key" ...My mentor - my post-doc mentor was older than me. She had children. Their children were the same age as my children's. So, kind of understanding! And I was working in a lab. Actually, the lab I worked in was mostly women. I think, and our floor I mean all of us were at that age where we were starting to start our families, and so it was a little bit more supportive in the lab in that way. (Interview transcript)

Professor Chen in my study also emphasized the important role of respectful and supportive collegial environment created by senior faculty. The collegial environment of her department did motivate and retain her in biophysics field at the same institution:

> Work environment and the place to live are very important to me. So, the Chemistry Department at the [institution name] did have a reputation for being a very collegial department where I were interviewed and visited. That's what my impression was. I felt very good about that - not only senior faculty that I thought I could look up to that were good role models, but also that it seemed that they treated assistant faculty members with respect that they really wanted you to succeed (Interview transcript)

In addition, her sharing implied that *living environment* was closely connected to working environment. The living environment in her story included friendly and helpful people, living convenience (cost of living, cost of housing, social benefits and others), and natural condition. The narrative of Director Balay provided the same things on living environment where her institution was located:

> My spouse and I we chose to stay here in [name of a city] because the cost of living is quite affordable. We bought our house. You know right when we came here, we bought our house and paid it off pretty quickly in a few years, but as you know, right now, the economic conditions in the country are quite unsustainable and for myself and my spouse, we are very financially conscious, we want to have a safe retirement. And the cost of living, the cost of housing here is much lower than in the cities…We like to be in a place where the population is [small]. And you know it's quite nice here, in that sense, because it's up north. The summers are not as intense as in the south. It does snow a lot here, but we're used to it. (Interview transcript)

The work and study environment are closely connected to my finding on role of female academic advisors and faculty in professional education of AAW in STEM. However, I integrate it into this part to underline their collective role embedded in the institution. All together built-up gender, race, and hierarchy mainstreaming and supportive climate to motivate and retain young people in the STEM fields.

6.2.2 Meso-level: Family, Community, and Social and Professional Networks

6.2.2.1 Family Factors

6.2.2.1.1 Parents

The narratives from the participants in my study show gender mainstreaming in which both father and mother played equally important role in their education and career choice. Besides that, many cases also highlighted role model of their mothers.

All the women in my study shared the same point about their parents, who put education of their children in the top priority in their daily life. No matter how much they earned and no matter what work fields they were in, they always strived to give their children best condition to learn:

> It was very important for them [parents] that their children focused on their education. I have a younger brother as well, and so you know they tried to create an environment where I was sheltered from outside influences. For example, they went so far as to making furniture that allowed us to feel comfortable. You know, a nice stable, a nice chair to study. They helped us organize a timetable, even after school where it wasn't just you know, I was, I always had a schedule to work even after school. And I was where you know, I was focusing on different topics, whether it be science or social science depending on what grade I was in. And every day, my father would get math problems from the Internet and give me so that I would be inspired mathematically like always sharpened. So, I would say that there was a lot of emphasis on education. (Transcript of the interview with Director Balay)

The parents even set the career target for their children as in the case of Professor Chen. Both her parents were in STEM fields. Her father was an engineer and her mother was a chemist. They both expected and even "required" them to pursue a PhD in any field, but highly encouraged for medicine or STEM fields – "They really valued the sciences and engineering" (interview transcript).

The case of Director Balay could be a typical illustration of many Asian parents who were not in STEM, but active in navigating good majors for their daughter. The good point in her story that her parents, unlike the other parents, did not put any pressure on her career choice. They just recommended and she chose by herself:

> My parents were recommended by people who do kind of career advice.
> They were recommended that I should go into something with professional
> viability. Computer engineering is what they said I should go into. And so,
> I said okay fine I will do computer engineering. (Interview transcript)

Besides equal role of both parents, the narratives in my study particularly shed a light on mother role in the AAW's choice of their profession and career in STEM fields. Among ten participants, four (Professor Zhang, Professor Bandi, Director Ngo, and Professor Pradeep) have mothers specializing in STEM fields; and three (Director Balay, Founder Lin, and Chair Gera) with mothers not in STEM, but fully supported them to pursue science and technology fields. Apparently, no matter what job fields women are in, they could shape their children's thinking and choice of a career to live independently. The story of Chair Gera was an example:

> From a childhood, when I saw my mom life. Then I realized that financial
> independence is very important for females. Because of that reason I chose

the field, which is a science even though I was not really encouraged in that field. But I decided that I need to get it to a field which will pay me well, and at the time engineering and medicine was very much popular. Since I am not very much comfortable with cutting, blood and all those things. That's why I chose the other field which is engineering. That's how I was motivated, because I know that I will have a better life in science discipline, and that's how I chose STEM, and I was naturally very good enough science and mathematics. I think that made my path easier. (Interview transcript)

The participants' mothers in my study not only set their role model by working in STEM, but also transferred their career dream of their young age to their offspring. Director Ngo shared:

My mother was also a math teacher! And then for my generation, of course, in any [name of home country] family they want you to go to medical school to become a medical doctor, but for me I was always afraid of blood. So, that was why! My mom - she also wanted to become a medical doctor. But then, she got married at the age of 18, and had 5 children. So that dream was gone. So, she transferred that dream to me. (Interview transcript)

For this case, I could argue that the transferring of the dream of this mother was a positive point if it really inspired her daughter (Director Ngo) to pursue a science in general. Otherwise, it would be a bad pressure on the girl.

Three participants in my study did not have parents working in STEM fields. Their parents did not know anything about graduate studies, faculty, and leading career in HE in the US. However, the parents valued education and fully supported them to pursue high level of education.

They were free to choose their majors and career by their own passion without pressure from their parents:

> They didn't understand what I was, what my career goal was until I got my faculty position until I could show them my title – faculty. They didn't understand what a PhD program is, what a postdoc is like. And then what is it meaning when you're a faculty position. They were like "Oh, you're teaching", "Yes, I'm teaching. But I'm also doing research, and then understand what research was"…They did not force me to go one direction or another. (Transcript of interview with Chair Mendoza)

Manager Yang had the same encouraging parents as Chair Mendoza did:

> I was a first generation of college student. My parents did not go to college, they both finished high school, but neither of them went to college…For me, going to college was something that my parents, of course, really encouraged. (Interview transcript)

6.2.2.1.2 Husband

Besides parents, the AAW in my study also had big support of their husbands during their doctoral and post - doctoral phases. Their husbands were willing to arrange their time to share them in childcaring at home, and in day-care tuition as the cases of Chair Mendoza, Manager Yang, and Professor Zhang:

> My husband was supporting, especially after we came to US, because the US usually didn't have an after-work service. He helped a lot to take care.

And the flexible time in the research also helped me. So, I could balance

my busy work in the lab. I could focus on the lab. (Transcript of interview

with Professor Zhang)

In a couple of cases – Director Balay and Professor Bandi, the husbands were good colleagues in their fields:

We [Director Balay and her husband]...were both passionate about

research. We created this lab together. We are both collaborators in

the process. We both work together, we neither of us can work on

our own. So, being in an environment where we could foster new

ideas, you know, by using the one plus one is more than 2 was

important. (Interview transcript)

I got married at the beginning of my doctoral program. My husband

has continued to be a guiding force in my career …My spouse is

also a faculty in STEM. We support each other…We are lucky that

we are both able to teach and maintain a flourishing research

program. That said, if we were not dual career, we probably would

not be working in this institution (Transcript of interview with

Professor Bandi)

6.2.2.2 Community and Social and Professional Network Factors:

The analysis of cross cases provided that there was an intersection of gender (women help

women) and race (the same ethnic group) in the factors of community and social and professional

networks supporting the AAW in their life outside the academy.

The sense of belonging, being accompanied, and being supported by a community of the same race and ethnicity are essential for the individual confidence in their life and work. Chair Mendoza shared her excitement when she moved from New York to California for her graduate study. In California, she had a big community of her race and ethnicity in which female neighbor was very helpful:

> We had a lot more [Filipino] families in California that came to stay with us to help us as we were starting out…We created community with other Filipinos – actually with the woman that took care of my daughter for two days a week when I went to work. She was the mother of another Filipino, a technician who I had met in graduate school, and they live around the corner. When she said, "Oh, maybe my mom can help you. It was this thing like, "Oh, my gosh, it's the Filipino connection that really helped us". So, you know, that was another thing. Where I was like "Oh, Gosh, you know there's no there's no like organization's help" at least for a mother Filipino postdoc. (Interview transcript)

The narrative of Professor Zhang gave another example of the support from the same gendered friend who was willing to care of her little daughter in order that she could continue her job in the lab:

> I at that time [postdoc research] I was thinking like a to stay home again. But I had a good friend. She came from Taiwan, and she had a son of a half year older than my daughter. So, I was lucky. She said, "Okay. So, I can try caring both of them". Oh, that's good! Yeah! "So, it if it works, then you

can continue your job. If it does not, then you have to stay home, and you

quit". So, my daughter was really happy in that family. So, I continued the

job. (Interview transcript)

While Chair Gera was lonely and isolated when she first lived away from her own village and family for her undergraduate study, a female friend was a big comfort and support for her:

I think the best support I received was from one of my friends at

undergraduate institution. I was from a village. And one of my friends was

emotional for me. She supported me a lot. I think that really helped me in

the social aspect since I was living away from home. Whenever we had any

festivals on our special day. She used to take me to her house. I had special

food and they [her family] used to take care of me for that day, and then,

dropped me back in my hostel. I think those kinds of things in a small, kind

gestures really made me feel warm away from home. (Interview transcript)

Regarding professional network, Director Ngo told a story in which she worked closely with her female colleagues across countries to establish a network providing a platform for professional exchanges and supports. Her quote below describes in detail the procedure and progress of building this helpful network:

It will be great to have female support, a senior female colleague or the

network of women supporting group. I think it is very important, because

you feel more comfortable to talk to a female colleague than a male

colleague. So right now, we have a group of about 25 faculty around the

world, and we have the group text via WhatsApp, when there is a certain

issue arrived such as how to deal with rejected papers, or to deal with male

100

colleague or the department, we text, and people share their opinions or give advice. My colleague and I started this female group in 2020 to deal with the pandemic, and we keep adding more members. A few years ago, I wanted to do this but via a mentoring website. But now it's good that we started with the seed first. My idea is to have a website with female faculty and scientists to mentor females, and nurture young people and it is free to everybody, and people can become a member and free to sign up for that. We have faculty who is willing to be a mentor in STEM. We list them on the website and when people need help, they could be able to search and to contact a faculty mentor directly. (Interview transcript)

Manager Yang shared the benefits she could gain when joining an association for women in science as a member and then as a chair of its advisory committee:

[Name of the association] has allowed me to grow as a leader. As a first-generation college and graduate student, I didn't have any family guidance so I joined the [names of the affiliated chapters]. I gained leadership and executive skills by co-chairing committees and becoming an officer on the Board… Holding leadership positions in [name of the association] has allowed me to transfer these executive and communication skills to my career. Finding friends and mentors through my involvement with [name of the association] has allowed me to get through the difficult times in my career. (Website document)

The stories of the ten AAW revealed that at meso-level they had a lot of support

and encouragement from their parents, especially their mothers, their husband, their folks

in the community, and their colleagues in professional networks. These facilitators implied

an intersectionality of gender, race, and ethnicity in which the role of females of the same

race and ethnicity as the participants' ones were the most significant.

6.2.3 Micro-level: Personal Factors

The personal factors including self-awareness of own strengths and weakness, self-efficacy,

clear vision for major choice and future career, competences, personalities were big contributions

to the AAW's advancement in STEM fields. The personal factors together with other factors in

macro-and meso-levels interplayed to build up the AAW's mindset and mind tools for their career

choice and success.

6.2.3.1 Mindset (Way of Thinking)

All the participants in my study were consistent in their strength of self- awareness, self-

efficacy, clear vision for their choices of undergraduate and graduate majors, future career, and

also for their institutions. In a couple of such cases as Chair Mendoza and Professor Zhang, self-

awareness and self-efficacy enabled the participants to successfully adjust their original choice of

profession and research interests.

On the halfway of undergraduate study in medicine, Chair Mendoza realized that she was

no longer interested in this study field. She wanted to anchor herself in the field which could make

her able figure out fundamental causes and then find good solutions to problems, rather than solely

applied existing knowledge. She preferred biology to medicine. From this clear self-awareness of

her own preference for study field of biology, she reached out to her advisor to seek an opportunity

to make a change to her current medicine major. And she succeeded in persuading her advisor to introduce her to work in a biology lab during summer to confirm if she was really interested and strong in this field.

Moreover, Chair Mendoza showed her good vision for leadership since her graduate study, "I feel like since I was introduced to the possibility of graduate school as an undergrad, that the opportunity to lead, or the opportunity to blaze a path for others was something that attracted me". Then in the role of the department chair after being hired in a tenure-track faculty appointment, she well understood positions and role of her leading and her department for the whole institution:

> Sometimes I ask myself, "why do I want to do this?". The leadership
> positions - they're very challenging because in one's individual lab, it's
> really just my group. I am overseeing the success of the students and the
> people in my lab. For the department chair position, it extends out to the
> entire department. There are other faculty who are like me, who are trying
> to run their own research labs, also teach, and their success is important.
> But the success of the department feeds into the success of the school and
> the university. (Interview transcript)

Later, as a program director of diversity, equity, and inclusion while still chairing her department at the same institution, she was straightforward in her point about excellence and diversity, "Oh, we're going to be excellent in our field, and we do diversity work. It's like an extra, but it's not yet. It shouldn't just be an extra it should be integrated. That's my opinion". And she added:

> We need to have a diversity in our sciences, going forward to really solve

the world's big problems in creative ways. And so, that's another reason

that drives me to lead and let's see other support along the way – actually

professional leadership training. (Interview transcript)

Like Chair Mendoza, Manager Yang also had a clear self-perception of her strong and weak

points in academics

I did not want to do chemistry; I sucked at chemistry. I didn't want to be a

biochemistry major because I didn't want to take physical chemistry

(required) because I thought it would be really hard. I also wasn't really

good at writing. I didn't think about going to any of the social sciences or

languages, or anything. So, I just did biology because that was something I

knew that I was good at. (Interview transcript)

For the case of Director Balay, she identified that she had a special passion for

teaching, sharing, and learning at her young age. When getting older, she developed a special

interest in doing research in computer science. She "wanted to do new things" to "be able to

contribute new things to society". For the future career, she affirmed her preference to

become a professor rather than other occupation.

I realized that I would have more freedom if I were to become a professor

because I could do research in whatever area I wanted…The other thing was

that it was encouraging for me to work with young people. I like that idea.

Where I'm simultaneously sharing knowledge with them, while at the same

time training them on how to contribute to society… that's why I chose to

become a professor. So that's what has brought me into the tenure track.

That's what made me say that I want to go on tenure track because I wanted

to do research…I've always been passionate about research for much of the

time that I got into it. (P03)

The data in my study also revealed exceptional characters in the AAW, who had not been

born and grown up in the US, but decided to migrate to the US for their career in STEM fields.

They felt they were adventurous, brave, and inquiring women about the world outside their own

countries. I could say these characters made them different from many other Asian women, who

normally feared to live far away from their family and closely knitted community in their

homeland:

I think the decision [to take a postdoctoral appointment outside the home

country] was maybe driven by adventure. And I had bravery. The world is

so big, I wanted to go out to see. That's what I wanted. After I graduated in

[name of her home country in Asia] from [name of a university], I could be

landed in a very good position to get into the professorship, maybe five

years earlier than here. This may save me from five to ten years. Let me

change, let me see was the differences between [name of her home country

in Asia] and [name of another country in Northern America]... I wanted to

explore the new world. And I did the postdoc after for three and a half years.

And then I was informed by different professors, "You have potential to be

a professor". So, I should try..I moved down to the US for another postdoc.

And then I had opportunity to apply for an assistant professor [in the US].

(Transcript of interview with Founder Lin)

6.2.3.2 Mind Tools (Way of Doing)

The AAW's stories in my study showed that their competences and personalities helped them overcome oppressions to advance in their professional education and career. These mind tools are typical for female characters as many existing studies points out.

The participants' narratives proved they were of good leadership. They had progressive and adaptive competences and personalities. They were good listeners, perseverant, resilient, and bi-culturally competent women in leadership in STEM fields.

Chair Mendoza, Manager Yang, and Professor Zhang became mothers while they were in doctoral and post-doctoral programs. They were thus under double pressure in their responsibilities as graduate students/researcher and as mothers while their husbands were also busy with their own studies and jobs. However, they never had any ideas of giving up or delay. The double pressure in their responsibilities itself trained them time management skill. Their mindset of never giving up built up their mind tool of time management and multiple-task-handling-and-balance:

> If the pregnancy was going to affect my productivity and my career. I was like, "well, I don't think so" because I feel like I can't leave it. This is what I want to do…Sometimes I had to go because nobody else was going to take care of these things for me in my lab. And I think I wasn't doing that when I was in that situation. I was just like I'm just going to do it and show everybody like "It's not going to be hard". (Transcript of interview with Chair Mendoza)

> I would take her to the lab after I picked her up from daycare, and then I would do stuff in the lunchroom. She played with me when she was an infant, I mean at the time you're not supposed to do that. But I had her in

106

the lab sometimes with me in her little carrier. She just slept, or whatever.

My husband supported my career in the sense that I worked weekend when

I was a graduate student and even now it's like I sometimes I work for 10

hours a day. And I came home. I cooked dinner, and then I worked at night

sometimes. (Transcript of interview with Manager Yang)

Perseverance was the most significant personality of the AAW in my study. They never

gave up the way they chose for their career. I categorized "perseverance" into a mind tool theme

because it is closely connected to the actions based on specific abilities (such as fulfillment of

multiple tasks in a limited time, keeping physical and mental health stably good for long hours of

working) to help people keep on what they are striving for.

The story of Director Balay was an example. Although she faced a lot of challenges and

conflicts caused by her colleague in her department, weak commitment of the leaders above her,

and limited resources for her research project, she as the lab director persistently affirmed that her

students was the top priority. To deal with the constraint of financial resource in her institution,

she submitted her research proposal to whatever funding sources are available. Her professional

competence, perseverance, and reliance brought her success in getting fund for her lab-building

project serving students:

My focus now [as a faculty and lab director] is to make sure that my students

succeed at their research. And I think that's where we are seeing very strong

success right now. This week we got featured in a news segment on TV. So,

that was good for my students…We [she and her husband] decided to pull

together whatever resources we were given, and really tried actively to get

our own funding. We applied to the National Science Foundation for an end. Infrastructure Grant. And we were lucky. In 2 years after we started here, we were lucky enough to be awarded the 750k grant to set up the lab as shown in the image that you're seeing behind me. That's our lab, and as you can see back then we have like nearly 200 cameras in there, so we use that money to set up the lab. It was a results of lots of work of my husband and I - We came in in the summer. We were building everything. (Interview transcript)

Their mind tool of perseverance was also displayed in their patience in improving their weaknesses (language barrier for instance). The case of Founder Lin was the best example. She faced a big barrier in her English language. It created a lot of difficulties for her in teaching and communicating with her colleagues. She determined to consistently spend two hours every night after work to practice speaking English by herself via listening and repeating after the Voice of American Slow English Radio program for solid six months. It was funny that her loud and repetitive speaking to herself in the office made her professor thought she had a problem in mental health:

> There has a good program, Voice of American Slow English. I followed that program and repeated sentence by sentence. And I listened every day from 8 to 10pm. Everybody went back home, I stayed in the office, listening to the Voice of America - slow English - every day for two hours, no matter what nonstop for six months. I would like to share a funny story of myself. One night, Dr. [name], [her postdoc supervisor] knocked on my door to see whether I was fine. I informed his, "Sure, I am doing well". After he left, I

108

started over to repeat the slow English program, meaning I followed the
voice from my computer and read loudly. Dr. [name] came back and looked
around my office, saying "Are you sure you are fine" and pointing at his
head. Finally, I understood his concern was about my mental health. I
showed him my program and my trajectory to improve my speaking and
listening comprehension of English. He happily left my office and went
back home. (Interview transcript)

The analysis of interview data also disclosed that the AAW in my research possessed bi-
cultural competence (mainstream and minority culture) in working with different groups of people
originally from different social and cultural structures. Like most of AAW, they were not
confronting people, but they knew how to negotiate and interrupt others politely when necessary:

I did the negotiations, I said, "I want a flexible schedule. I have to leave
early to attend my kids program at school or whatever, because that's
important to them. He [the work supervisor replied], "Okay!" You should
negotiate that before you start a job to make sure it's clear that you get what
you want, and you know sometimes it did help an Asian woman do that.
Other times I think being Asian is a detriment, because then we're very
polite, not interrupting people. I interrupt people all the time which people
don't like, but that's considered, you know. some people don't like it. They
don't like when people interrupt them, and the reason I do it I don't want to
be mean is because I have a thought, and I'm afraid that if I don't say my
thought [would go]. (Transcript of interview with Manager Yang)

I'm not a very confrontational person. So, when I talk to people, I don't go

aggressive on them. Some professors have that, and we get away with it.

I'm not like that. Well, maybe in email form, I will use "stores" language.

(Transcript of interview with Director Balay)

The AAWs had positive thinking and attitude no matter how tough the situations they confronted. They paid attention to long-term goal of their career rather than to a short run. In my data analysis, I themed "positive thinking and attitude" as a mind tools rather than mindset because they adhere to action of thinking for good (not state of thinking) – skill of good thinking and attitude toward a bad incident or phenomenon - after having self-awareness and self-efficacy of strengths and weaknesses.

The narrative of Chair Gera was a vivid instance. When facing with a lot of unjust evaluation from her colleagues on her promotion, she remained a positive way of thinking:

I realized, "Yes, it [biased justification from her colleague] is just a very common thing that people just do it, because they can't, they just say things". I learned that, and I learned to take it with a smile. I proved it every chance every time I've given that an assignment is given. I make sure that I give my 100% the best I could make sure that the decision, whatever the main thing is, the right decision, giving me the tasks to do it. And I do well, that's the kind of thing. My research should talk about my abilities rather than some people judge on. That was the motive I took, and I think that puts me in a position where I am right now. (Interview transcript)

Director Ngo also had an amazingly optimistic attitude and reaction toward oppressions on

her. And more meaningfully, she has transferred her sanguine to her students. How positive her thinking, attitude, and behavior were good hands-on to the next generation of STEM scholars and practitioners

> One thing I've learned in life is that 1) I always appreciate thing that happened to me, and 2) I always try to think positively about everything happening in [my] life, even though they are really bad things. The more people push me down, the harder I try. I don't get angry. I use it as motivation to try harder. And again, even when all the bad thing happened, I talked to myself, "Well, these gave me experience and I know how to deal with the situation in the future, or how to help other people to avoid such situation.". So right now, what I try to do is to help my students a lot, train them, not only research, but in terms of the mental health, mental exercise, and try to think positively about everything happening around them. (Interview transcript)

In summary, in order to successfully retain and advance in STEM fields, the AAW in my study had a lot of supports by varied agents at different levels in society. At macro-level, the national policy, values, and norms made them choose the US to settle down their career in the academy. Within their institution and school/department, academic advisors, mentors, faculty, and colleagues at different stages of their pathways to career advancement were indispensable agents contributing to their success in STEM fields. Training programs were also a helpful preparation for their tenure-tracked faculty and leadership in their profession. At meso-level, the mothers took an important role in their choice of pursuing higher education level, STEM fields for their

profession and career. Community and social and professional networks as other environments very much supported and encouraged their daily life and work. At micro-level, the AAW in my study stood out in their fields thanks to their exceptionally high curiosity about the world outside their countries/territories, their adventure and bravery to challenge themselves in new environment. These factors were big stimuli for their decision to anchor their career in the US – a country in the other side of the global sphere from their home countries.

My study also informed that they were able to retain and develop in their fields thanks to their good self-awareness of their strengths and weaknesses, then their clear vision for career, passion for learning, teaching, and doing research in STEM, and positive thinking even in the worst situations. Their narratives proved that their perseverance, resilience, time and conflict management, work-family balance, and bi-cultural competences tremendously contributed to their success in the STEM fields in HE.

6.3 Key Obstructions Challenging the AAW in Their Career Pathways in STEM Fields in Higher Education

The interview data analysis revealed that AAW in my study had to confronted all kinds of obstacles at three levels of society – macro-, meso-, and micro-levels.

6.3.1 In Macro-level (Internal and External Factors of Institution, and School/Department)

In my study, over half (seven) of my participants – Manager Yang, Director Balay, Professor Zhang, Professor Chen, Chair Gera, Director Ngo, and Professor Pradeep - disclosed

their most painful stories at macro-level regarding internal factors in their career pathways. At macro-level, the challenges were from internal factors regarding organizational structure and hierarchy in higher education (institution and school/department) and also from external factors (partners outside the academy). All the obstructing factors implied an intersectionality of gender, racial, and hierarchical impacts.

6.3.1.1 Internal Factors (Institution and School/Department): Gave the Most Barriers

6.3.1.1.1 Limitations in Research and Work Facility, and Injustice in Resource Allocation Rooted from the Intersectionality of Gender-based, Racial, and Hierarchical Biases

The first obstacle the AAW in my study faced in their STEM career at early-stage of career/pre-tenure as junior faculty) was the limited physical resources (research lab and office space). This condition negatively impacted their professional development in STEM. Director Balay shared:

> We had very limited resources to push up the lab….When I started at [name of institution] I could see that I would have limited opportunities, or I would maybe have to fight for being able to do my research. And when I started negotiating, that's part of the intake process…So, when I negotiated with these things, they gave me very little resources. (Interview transcript)

Director Ngo even did not have a research lab to work in her first year of faculty at her institution:

> The challenge that I had here was that in the first year I didn't have my

113

lab. They gave me a lab space, but it was occupied by the Marine Sciences. And at the time they were waiting for their building to finish, and there was a delay in the building construction. Basically, I had no lab for over a year. (Interview transcript)

Manager Yang and Professor Zhang also faced the same problem - limited, even no physical facility to work and do research - as Director Balay and Director Ngo, but with the office space for their work hours. Through this difficulty, some nuance regarding intersectionality of *gendered, political or hierarchical and racial bias*es was implicit in the resource allocation between faculty of different races and hierarchical ranks:

When I was a postdoc, a senior postdoc, I asked to have an office, so that I could have some quiet time [for work and professional appointment]. There were offices around and they were mainly given to a lot of the physician scientists, MD/PhDs. But there was an office open, and I talked to my boss, and he was like, "Oh, yeah, yeah, you can do it". And he went on "You need to talk to this person because she is in charge of the administrative stuff ". So, I went to talk to her. She told me that I did not deserve an office. You know what I mean that I couldn't have this office by myself. Now, if I wanted to share this office, like all the other postdocs on the floor, that was fine. But that was the point and so I was like "Okay". So, I went back to my PI, and he was like, "Oh, my God! That's a bitch!" And I was like, "Oh! [laugh]"..So, I did end up sharing the office with somebody, but it was kind of awkward because we both didn't want to be in the office at the same time.

It was a small office, so I thought I ended up just using it just a little bit, and

then that was that. But the one thing that he did tell me which was true in

academia. He said, "If you get money, you can get whatever you want. You

bring a large amount of money in, do whatever you want- so that's

politics!". (Transcript of interview with Manager Yang)

The above sharing of Manager Yang disclosed at least two hierarchical problems in her

department. The first problem was that the voice of the administrative staff was louder than that

of the professor who was mainly in charge of the academic progress of his advisee. The second

problem was that the money spoke louder than the professional voice – "If you bring a large

amount of money in, do whatever you want". Although Manager Yang named it "politics", I

themed it as "hierarchical power gap"

The narrative of Professor Zhang implied for a challenge regarding racial oppression in

which the predominant group of people – the whites – encroached on the minority group:

I hope that other people not like me, don't have this. I had an office with

another. She was actually a technician; she was a white woman. Probably

in her forties, or fifties, a technician. It was my office actually. She came

for another project. We didn't have the more like office space. So, my boss

said, "Okay, can you let her in?". And then I allowed her in. But she started

to kick me out! (Interview transcript)

And Manager Yang also straightly pointed out the obstacle she confronted in her early

stage of her career was mainly rooted from gender and racial bias in which predominant white

males have decisive power over non-white females. Moreover, from her narrative – she repeatedly

mentioned the term "politics", I interpreted it to be "hierarchical bias":

> I felt like I had always hit many difficulties in my career…At the time I would feel really upset because I wanted to join a lab. They didn't want me to join the lab. It was a political situation. I thought about this in another lab, and then there was a political situation. All my labs, it was just like always politics happening. That was something I did learn a lot of politics, very early on…It was still a very white male dominated field! (Interview transcript)

Briefly, the narratives on limitation and unjust allocation of research and work facilities informed an intersectionality of the obstructive roots – gender, racial, and hierarchical biases.

6.3.1.1.2 Unfairness in Evaluation, Nomination, and Promotion

Some of the AAW in my study commented that the current criteria in evaluation, tenure review, and promotion at their institutions were irrational and unfair. For example, in the interview Professor Chen mentioned some discouraging factors, which are related to gender and racial biases in evaluation for promotion and publishing:

> I think in terms of what is valued in science, in terms of evaluating some quality of somebody's achievements for things like promotion. I feel that that still need to be improved. I think there's definitely greater awareness these days about how certain criteria of evaluation are outdated and actually problematic in terms of anyone who's not in the white male majority. (Interview transcript)

Although she did not articulated straightly and concretely, I could infer that non-white females in science still had to face unjust evaluation for promotion. The contemporary evaluation system in science favored white males. Moreover, in review of manuscripts for publication, scholars from minority groups confronted bias:

> There have been some systematic studies that show that women and minorities are cited less in papers than their male colleagues. That's a place that could be improved. It's a publish or perish kind of position. But yet in the publications people are not held accountable for being inclusive. (Interview transcript)

Not only Professor Chen, but also Director Ngo struggled with unfair evaluation for salary raise:

> In my third year, I asked for a salary increase. And the department voted "No" for my case. Even though at the time I already had 16 publications and had 10 grants. Two weeks later, my colleague, who was hired at the same time as me, who had at the time only 2 papers and one grant. They voted "Yes" for her. (Interview transcript)

At least there was one good point sparkling in her story about the advocative role of senior faculty for junior faculty:

> And then another senior faculty said, "Wait a minute. This is not fair for [name of the participant] because two weeks ago we just voted "No" to her case, and her case is much stronger!". In the end, they revoted my case. I got "Yes" but it was not because they thought I deserved it, but because they

wanted the other colleague to get the promotion. (Interview transcript)

No matter whether academic or non-academic an organization is, merit-based or just evaluation, nomination, and promotion are among key things to enhance motivation of the affiliated. In the academy, they are even more important in visualizing professional credibility of faculty. So, how discouraging it was for the participants in my study when they were evaluated unfairly for nomination and promotion!

6.3.1.1.3 Perfunctory Machinery on Diversity and Inclusion, and Irrelevantly High Requirements for Teaching, Doing Research, and Serving in Committees

The way the institution expected the AAW to join different committees for social justice, diversity, and inclusion put huge burden on their occupational service. Such an institutional expectation would have not been an issue if these committees had played a truly important role in decision-making process in their institutions/schools/departments. Professor Chen shared:

> I have noticed that well-meaning people when they nominate faculty for a university committee, they want to make sure that the committee has an adequate representation of women on the committee, and then there's only so many female faculty to choose from. Then the female faculty get asked a lot to serve on these committees. (Interview transcript)

Director Ngo provided another example of heavy unimportant services she had to take care of:

> Even though I have been at [abbreviation name of the university] for many years, they have never asked me to be part of the important committees. They asked me to serve in a recruitment, admission or graduate student

adviser or diversity, something that is time consuming. For the important committees such as Space Committee or the FTE hiring committee or other important ones, nobody asked me for many years. (Interview transcript)

Director Ngo's straight words implied a problematic operation of diversity structure. In theory, the mission of diversity, inclusion, and equity organization in higher education institutions is generally good. Its operations are to bridge social and achievement gaps between overrepresented and underrepresented groups of people. But in reality, the enforcement and performance of this structure could be varied depending on its operations – effective or not effective. Director Ngo's comment "time-consuming" of this structure could inform that it was not good enough for her to find it worthy to invest her time to serve it.

Furthermore, the narratives in my study disclosed that over-demanding requirements of teaching, doing research, and serving committees overloaded the mothering AAW faculty. In many cases, they were even unjustified and rigid. The story of Professor Pradeep was an instance:

I'm also the secretary of the [name of an organization]. So, it's a little bit of work. And then my research group is pretty big, too big actually. I have four PhDs and then I have four undergraduates. It's eight students. Yeah, it's a lot. Four PhDs itself is a lot to begin, to start as an assistant professor. I mean it's a lot, but we keep managing, I guess I don't know how we keep suggesting these things to the school administration. We don't know whether they understand or what sort of barriers they have. I guess that the

119

biggest concern as of now is that they need to think of revamping their tenure track requirements actually. It's too much! If they let us teach only one class per semester. We could not do most of our stuff like teaching two classes for semester. It is a lot actually! (Interview transcript)

The AAW in my study had obstacles not only from limitation in research and work facility, injustice in evaluation, nomination, and promotion, and superficial machinery of diversity, but also aggressive attitude and behavior from higher-positioned people in their institutions.

6.3.1.1.4 Aggressive and Indifferent Attitude and Behavior from Higher-positioned People in the Hierarchy

Aggressive and indifferent attitude and behavior from the department chair and school dean were another type of challenges the AAWs in my study faced in their institutions and schools/departments. It was in fact a mixture of gendered and racial barriers. For instance, Professor Pradeep had the toughest difficulty in her professional life with her postdoctoral advisor. She struggled with his aggressive attitude and behavior. Her painful story was one of the three longest and toughest cases in my study. She was under physical and mental oppression from him for over two years. The adversity she experienced was stemmed from the mixed gendered and hierarchical bias she had to endure during her postdoc appointment. Knowing that she needed to maintain her H1B visa by working for him under his supervisorship, he forced her to work 60 hours per week. He yelled at her whenever he realized he was wrong, and she was right in their experiments. He even yelled at her without reason. It was even worse that he always looked down her because he always thought female performance was not as good as male one. The pro-longed pain she had in her postdoc still haunted her:

He was of a male dominant character. He thought that only males could

120

perform well…This story was up with me until now. I started my postdoc at [short name of a university]…I felt discriminated from my postdoc advisor at [short name of a university]. It was the worst thing ever happened to me…That was two and a half years. I don't think there was a single day that I didn't cry before I got into the lab…And at the end of thing, which actually kind of irritating me. He always brought his two girls [and his wife], "Oh, I have 3 girls in my house. I know how to". I just [said back to him], "No. Don't bring these three. That's your personal life, it's nothing to do with". That's why I told him at once, "This is sexism. You can't do this. You cannot say girls versus boys. It is sexism! You cannot do this just because I am a girl"…I guess another thing was actually the reason why I could not avoid discrimination here was because of my visa status. He knew that I couldn't really do anything against him. That was I felt the discrimination. Imagine if I had been a [US] citizen, he couldn't have done any of these things. Because I was bound to H1B with the labor certificate and everything he knew that I was already trapped. (Interview transcript)

Director Ngo had the same problem with the way her department chair indifferently and even unjustly treated her. She was about to quit her faculty job for many times!

More than 19 years, my voice have never been heard in the department…I was treated unfairly. It's very hard for you to speak up when you are a young faculty. You don't know who to talk to, and then you don't know what to do. You wouldn't dare to tell anybody. Being a young female Asian foreign

professor, it's scary, because you don't know whom you can trust, who really support you. And so, I was really alone. Many times, I cried and said, "Okay, I quit". And I could go to teaching somewhere like four-year college. (Interview transcript)

Director Ngo also faced another difficulty with the discrimination and injustice from her work supervisor – her department chair - in his decision. His partiality might not be connected to gendered or racial bias. Nonetheless, it was a kind of corrupt use of personal relationship in decision-making:

He [department chair] was not very supportive at all, actually he was horrible. For example, he hired two faculty at the same time. We both are Asian, but my colleague is Korean. She grew up in Germany, the department chair also spent some time in Germany and his wife was German. They were friends and he treated me very differently as compared to my Korean colleague. Many times, I wanted to quit my job. Many times, I cried. I wanted to leave the university in the first couple years of my career. I didn't have a lab for a year, and nobody cared. When I asked, I got yelled at by the department chair. He yelled at me multiple times.

The narrative of this participant was one of the most poignant. She experienced a series of barriers in every stage of her career advancement – pre-tenure, tenure, award nomination, and promotion:

Another example of different treatment was award nominations. Every time I asked the department chair to nominate me for an award, he always

122

nominated my colleague because she was a friend with him and his wife and because of their German connection. They hanged out, and all that. Every time I sent him an email to ask how the department selected a candidate, who was in the award committee, he just ignored my emails. He never answered my emails. Most of the awards that I won are open competitions.

The analysis of interview data also revealed another obstruction the participants experienced during their junior faculty and in lower position. It was *hierarchical biases/barriers* (junior vs. senior faculty, lower position vs. higher position). The cases of Director Balay, Professor Chen, and Chair Gera showed this kind of bias clearly.

Director Balay joined her department accommodating three professors of theoretical computer science. Then one female professor – a senior faculty- came. She was assigned to be a mentor of Director Balay – a junior faculty at that time. This senior faculty was not interested in doing research studies and was not successful in getting grants, either while Director Balay was. The painful story happened to the latter from this professional gap. As this participant won a big grant to build her own lab, by her request the university gave her a big space to set up the lab. This space was originally for a student organization and it was the only place on campus big enough for her lab. The envy and complex turned the senior faculty/mentor to be aggressive against Director Balay. This mentor distorted the truth to make the other faculty and students in the department think she was against the students by taking their space:

> She [the senior faculty/mentor] ended up creating a really big really difficult
>
> situation I would say in the department for my spouse and me, whereby she

positioned us as the kind of like the villains to the students. This is very demoralizing, and the rest of the faculty members in the department didn't stand up for either myself or my spouse… She ended up, being more and more aggressive against me, against him. (Interview transcript)

This participant had to struggle by herself to retain in her career. It was worse that she unfortunately did not have any support from the leaders above her:

The chair at that time never did anything to intervene or to fix the issues. The current chair has adopted a very negligent style on every issue of importance. He does not respond to student issues or faculty issues on time, which is making it very difficult to make progress… [None] of our department chair, none of the faculty in our department are doing research. And so, they have no idea about the progress of research. (Interview transcript)

As a result of such aggressive and indifferent attitude and behavior from the senior faculty/mentor and the department chair, Director Balay had to make efforts by herself alone. Fortunately, she had her husband as her colleague at that time. They worked together during the summer to build the lab to serve teaching, learning, and research. Their students were the top beneficiaries of their lab work. And her endeavor was featured by a media channel.

Regarding hierarchical barriers, another participant in my study – Professor Chen - also mentioned her loneliness in attending professional conference when she was a junior faculty:

When I first became a faculty member, things were especially challenging. When I went to conferences when I first started out. I tended to look on the

younger side as a lot of Asian women do. And so, what I found was that people often would be mistaken that I was a student, and so for better or worse. Other professors that I wanted to talk to would not talk to me...I think it's a mix of things. In some cases, it was pretty general. I noticed some professors just don't interact with students. They're very strategic at meetings. They're just interacting with the highly visible faculty members that will forward their career. (Interview transcript)

Professor Chen also felt "invisible" or "chilly" (I borrowed this term from my literature review) because of her gender (female) and race (Asian) in her biophysics field which are predominated with white males:

I've felt invisible because I was a woman, maybe an Asian woman. But I found over the years that in the sciences the more the community is geared towards math or physics where it's much more male dominated than biology—chemistry is somewhere in between. I am biophysicist. Even though there's physics in the name, biophysics is not often viewed as a real physics by physicists. (Interview transcript)

The findings presented in this section supported previous studies about aggression and "chilly climate" AAW experienced in the academy. Noticeably, some cases in my study provided that AAW had to face even macro-aggressive attitude and behaviors, not micro-aggression as pointed in existing literature.

In addition to aggression from higher-leveled people in the hierarchy, the AAW had to deal with prejudice from their colleagues.

6.3.1.1.5 Prejudice from Colleagues

The narratives of Professor Chen and Chair Gera informed most about prejudice from their male and female colleagues:

> I remember some male physicists that would just keep shaking their head when I was getting my talk. It was infuriating. Just this superiority about what is a hard science and what is not. And also, I've noticed that sometimes if I mention an idea as a woman, if a man repeats the same idea at the same meeting and he talks longer about it, he gets noticed for that idea, not the woman. (Transcript of interview with Professor Chen)

Professor Chen struggled with prejudice for females, and Chair Gera faced it, too but due to her young age and appearance:

> I've faced many times the self-statement people making that I achieve anything from an assistant professor to associate professor just because of being young and beautiful…That was the highest rude[ness] I saw in my career as a female, being young because all my colleagues are 70 plus. (Interview transcript)

For her, this kind of prejudice "hurt" her a lot. Her best efforts to overcome bundles of difficulties rooted from concurrence of her faculty role and her mothering responsibility were not credited fairly:

> And I think it's usually hurt a lot, because when you work hard to reach what you are, and nobody thinks about me being awake till 2 or 3 in [beyond] the midnight, and nobody thinks about me coming back to campus in the morning right after having a child, coming back to campus within a

week after C section, and doing a teacher as a normal person as if nobody could consider those. But they always see if opportunity is given to somebody. They think, "Okay, she got it just because of that. That's what I used to hear a lot. (P08)

The interview data informed that the participants of my study confronted many challenges at early stage of their career as postdoctoral researcher and junior faculty/pre-tenured. The agents at each layer of the hierarchy were roots of the challenges. In higher layer, they were AAW's dean, department chair, supervisor, assigned mentor, and senior faculty. In equal layer, they were AAW's colleagues. In lower layer, they are students.

6.3.1.1.6 Resistance from Students

Professor Chen emphasized the situation in which AAW faculty faced with their students' evaluation:

I think on the teaching front there have been some challenges in terms of biases among students as well. I think it's gotten a lot better. I mean every semester a professor is evaluated by the students. You get these student evaluations of teaching. They're often biased. They can be biased comments. (Interview transcript)

In order to provide further explanation for the "biased comments" or evaluation from students as Professor Chen noted above, I make use of a quote I collected from my study in Spring 2017:

As existed as a fact that there are biases and it grows up. The more you advance in your career, the more you feel the struggle basically…There is

apparently a statistical data that women get like 0.3, so we are rated out of 5.0 total and women faculty - students rate women faculty 0.3 point lower than men. So that's the statistics.....This is a fact of life that women faculty get 0.3 points lower than male and non-English speaking faculty someone like me basically non-English speaking faculty whether male or female would get 0.3 lower than English speaking faculty. (Transcript of an interview with a female faculty of chemistry in a research university)

My finding in this dissertation and in the study in Spring 2017 supports the claim of Hune (2011b) on biased evaluation of students on AAW teacher:

Course evaluations also contain student remarks that are inappropriate because they address personal aspects of the instructor unrelated to their teaching and expertise.. Ming-Yeh Lee was racialized and gendered by Women's Studies students in such remarks as: ''Ming-yeh did not smile enough,'' ''was not pleasant but was talkative,'' and was ''not like other Asians'''. (p. 320)

In my study, most of my participants had difficulties from internal factors in their departments and institutions regarding facilities and people at all layers of higher education hierarchy. In addition to the internal factor, external factors regarding partners outside their institution also disrupted their professional work. This kind of obstructing factors are of intersectionality of gender and race.

6.3.1.2 External Agents (Outside the HE Institution)

Outside the academy, Professor Zhang confronted *gender, racial and hierarchical biases* with her work partners. Although she was a principal investigator (PI) of a research project as her colleague (a white male), many partners outside the academy thought she was a "researcher at a lower level". This case informed that the partners had gender and racial bias against her:

> When I was working on the biomedical engineering, we had lots of cooperators actually coming from medical field like medical doctors, clinical coordinators, and some administrative people in hospital…I don't say that they had the discrimination, [but] their attitude. For example, I was a PI of a project. So, I should have had the right to discuss with them, like a fair right, the same level with position. But when I went to talk to certain doctors, they always thought I was just like a researcher in a lower level. They said, "I should ask…", like my supervisor, "I should ask…" – someone, somewhere. (Interview transcript)

Professor Zhang also faced another bias from a female head of a hospital, who did not respect her and even argued against and requested her to change the on-going direction whose protocol had been mutually agreed. But when her male co-PI came to discuss, this hospital head quickly changed her way of talking, without asking for any change:

> We had an IRB passed [research], but they had new research. The head of a hospital, a woman, said, "No, you had to submit a new protocol". "Our project was almost done, almost finished!", [said Professor Zhang]. She said, "I didn't want to talk to you!". I said, "Why? I am a PI!". She said,

"So, yeah, I didn't want to talk to you!". I said, "Why you not!". And then

she said, "I need to talk to other people like more understanding the standard

issue". I said, "I have been here as a PI for more than 10 years. These were

protocols I wrote". [Later] I asked my supervisor [her co-PI of the on-going

research project] to go with me to talk to her. And then when my supervisor

came, she completely changed her face. Yeah. She made me like really

angry. (Interview transcript)

In my study, although only one participant (Professor Zhang) was biased by her partners

outside the academy, it was worth including in this section to point out all kinds of obstacles the

AAW had in their pipeline to career advancement in STEM.

6.3.2 Challenges at Meso-level:

The analysis of interview data revealed that parental pressure on college major choice, lack

of parental care during young age, and no preparation for independent college life were the three

challenges at meso-level facing the AAW in my study.

6.3.2.1 Pressure from Parents on College Major Choice

My data analysis informed two sides of familial factors impacting the AAW's choice of

their profession, research focus, and career. In one side, it was positive in shaping their choice of

STEM in their career as presented in the section of success factors above.. But in the other side,

the parents levied a big pressure on the AAW if their occupational interests were different from

their parents. The cases of Professor Zhang and Founder Lin provided this type of pressure. At her

young age, Professor Zhang wanted to become a journalist. But her parents opposed strongly and suggested engineering instead for her. Given that she was also good in both language and STEM, she followed her parents' recommendation:

> My parents said "No, in [name of her home country], the journalist job was of a danger, has the risk like a politician. It is risky!". So, they thought, "The engineering was the best, no matter when, the society, the country [always] need the engineers". So, I actually had the same scores in STEM and the language, you know the other like literature. So, I say, "Okay!". Then I went there the college for engineering, and so, it was not too difficult for me to learn there. (Interview transcript)

Founder Lin was under the same pressure from her parents as Professor Zhang was. She preferred information technology. But her parents wanted her to major in chemistry. Her father even transferred her current application for information technology to chemistry. She had no way to pursue her preferred study field. She was forced to major in chemistry. She was stressful, "In the first six months, I was very mad at my father. I just didn't like chemistry. I just didn't like it" (Interview transcript). The problem was that neither her father nor her mother worked in STEM, but they pushed her to pursue undergraduate study in chemistry just because of its job market with high and stable income.

> My father was a police officer with a high-rank. He has three stars in high rank. My mom is manager at [name of a place] Bureau of Commerce, equivalent to the Chamber of Commerce. She was a manager. None of them were related to chemistry, but they believe mathematics, physics, chemistry – these three majors. My father said that if you are good at any of them, you

won't worry about your breakfast in the future, meaning you can find a job. That was a generation. Yeah, I became a chemist, actually a chemist and also chemical engineer. (Interview transcript)

The women in my dissertation struggled not only in their major choice at the threshold of college, but also in their young age without parental care.

6.3.2.2 Lack of Parental Caring at Young Age

There was one case - Professor Zhang - in which her mother's over-immersion in teaching and research left a sad memory in her mind. The experience of lacking her mother's care, especially when she was terribly sick, made her no interest in pursuit of PhD. She talked to herself that she needed to avoid her mother's ignorance for her. She thought she should balance between her family and work.

> I was not really care of PhD at that time. Some reason that I can tell you, because my mom didn't take care of me very carefully as the other mothers like in [name of the participant's home country] as my friends'. So, I actually as a woman – my goal was that I would put the family in the first instead of my mom. I didn't want to be like my mom - putting her job, her teaching, her research first…When I was really sick. My father was busy. He was like at that time he was already at the graduate school of a very famous [country] university. So, he was actually very busy. But my mom said, "Oh, I had to answer the questions for my students". So, I was sick of diarrhea for many days. That was thing what could not wait and the university entrance exam was two weeks later. But she said, "No, I had to

went to the students. I had to do my work". So, she even refused bringing

me to the hospital. (Interview transcript)

Beside insufficiency of parental care at young age, the women in my study also lack a preparation for independent life at college.

6.3.2.3 Lack of Preparation for Independent Life at College

The interview data disclosed that the AAW's parents put high expectation for their children to be successful in a bigger country of advanced higher education. However, they did not provide enough preparation for their children to adapt to new environment. The case of Director Balay was an example. During her high school, her parents asked her to intensively focus on learning to be "book smart" rather than "street smart". Immediately after high school, her parents sent her to the US for her undergraduate study without advance preparing her for life skills such as how to manage money by her own, how to open a banking account, how to use a credit card, how to communicate with people from different backgrounds. Without those preparations, she was shocked. What she shared during the interview is worthy for other parents to learn about what they should help their children prepare to be "street smart" besides "book smart":

> I will admit that there are some flaws in that they [parents] did not prepare
>
> us to be...How they say "book smart" but not "street smart" didn't really
>
> incorporate much world wisdom education for us. So, I would say that was
>
> a big challenge with the way that [country] parents bring up their children.
>
> And that was a mistake, I think that my parents made. They didn't prepare
>
> me for that aspect. "Now you're going to the US. You have to live by

yourself. Be careful with money". I won't say that I was not careful with money. It was just that I didn't even know what a credit card was…How hard it was for me to get that financial awareness and knowledge, because they did not provide it. I have to say this because I think it's an important component of education. There was very much in my house, it was like "you have to focus on your studies, no boyfriends, no nothing of that". I didn't want to have a boyfriend, but I think that it was important for me to have less of NO and more of OKAY. When you go to a different country, and when you encounter different people from different cultures, some of them are more forward thinking, some of them are more conservative. So, how would you interact with people? So, I would get a culture shock…I had a hard time making friends with people who are not from the same ethnic background as me. (Interview transcript)

6.3.3 Challenges at Micro-level

The interviews with the ten women informed that only mothering and first-generation AAW in the US faced the most difficulties regarding their gendered role, language barrier, and immigration status. In fact, seven of them (Chair Mendoza, Manager Yang, Founder Lin, Professor Zhang, Chair Gera, Director Ngo, and Professor Pradeep) had to deal with these types of challenges.

6.3.3.1 Gender-based Barrier

At micro-level or at personal side, the first gendered barrier facing the AAWs in the early stage of their professional education pipeline in the US was their *female role in family and at work.* There were five mothering women (Chair Mendoza, Manager Yang, Professor Zhang, Chair Gera, and Professor Pradeep) in my study. They struggled to balance their time and energy between multi-responsibilities inside and outside their family as a wife, a mother (childbearing and childcaring), as graduate student/faculty, and as an expected agent for diversity and inclusiveness at their institution. For responsibilities in the family, the situation was even tougher if their small children had health issues and if their family and husband lived far away from them. The overwhelming female role pushed them to the edge of quitting their job in STEM field.

For example, Professor Zhang experienced a lot of difficulties in dealing with time for work and for childcare when she had the first and second child. She had to stop working for a long while. Her struggling story also informed of irrational policy/administrative mechanism in maternal leave for mothering women at that time:

> I got pregnant for the first - my son and then when I pregnant, I still worked, but I was pretty tired. I still worked down [until close to delivery to the first son]. Then I stopped working for about a half a year. I took care of him and then I found it so lonely. It was boring!

When having the second child, Professor Zhang experienced even much tougher situation. She could not take a maternal leave. If she did, she were not eligible for continuing her work for the research project:

[With the second child] I said, "I want to take that [maternal leave]". That time, the leader, the professor said, "Okay!". But the administrative leader said, "No, we can't do that because this was the project base. So, if you take that, the project would be delayed… If you had two kids, I didn't think you could work fully for the research. So, you should go back home". He refused to allow me to take that maternal leave. He said, "If you like to a leave, then you would forever leave". That was a tough situation. I was shocked! (P05)

Her sharing about her maternal leave showed a gap in the professional and administrative power over the professional activity. The supervising professor said "Okay", but the administrator gave opposite word – "No". This is the second case in my study in which the obstacle facing the participant implied for a hierarchical gap between the professional and administrative voice on conditions for the participants' research works. The first case was of Manager Yang with difficulty in requesting for an office to work. Her professor said she could have it, but the department administrator said she "did not deserve an office".

Back to maternal leave issue, Chair Gera also had a big challenge in getting a leave after a C-section delivery:

The thing in the academy we do not have anything called maternal leave. My child was born on the 7th of August, and I was back to my campus for teaching on the 17th of August. I had C section and though my daughter was in the NICU for 36 days. Still, I did not get any maternity leave or anything for that. In the holidays time I had my daughter, and then, on the first day of college open, I was there as attended at the Faculty Staff Conference, and

136

I taught my first class also. There wasn't anything called maternity leave at least in this institution. We don't have anything, maternity, or anything on that leave. We just have to use our sick leaves. If not, then we just have to come back to work. Yeah, because they would not give a semester long off, and if you are assigned to teach a class, you have to teach it. There is no other person who will be covering it, or class or something that, there is nothing. So, there is no changes at least in our institution. It does not work… We don't have any. And yes, with my maybe being 6 weeks I had to use the childcare which I had to use from for 6 weeks.

In addition, Chair Gera had to cope with the age-restricted and expensive but low-quality day-care at her institution:

[Child-care service] was very expensive. Yeah, at the time the service were too low, and yes, almost more than one-fourth of my salary was going to my childcare…Actually, there is a childcare center here. But it was for a certain age group, which was for two years. They have an age restriction. That was why my daughter could not fit that criterion of the age. She had to be in a different day care. But then because she was used to that daycare, I did not switch her, even when she was more mature when she was meeting that age criteria. (Interview transcript)

In my study both Chair Mendoza and Chair Gera had to deal with the tension between her low post-doctoral salary and high day-care expense for their small child:

The challenges there were in STEM fields when you're doing post-doctoral

training, the salary is not very high. We were living in Berkeley. So, the daycare costs were very high. It was just like basically my salary went straight to the daycare. But you need the daycare in order to continue in your field. (Transcript of interview with Chair Mendoza)

The mothering women in my dissertation fell into depression when their small children were sick. They were pushed to the edge of getting rid of her research job. Among the tough stories, that of Profession Zhang could be the most pressing:

The difficulty I was thinking of was as always on how to balance the family, the children, and the job. I worked and tended to my daughter because her ear infection happened, and then she had another infection. She had a very high fever and got really bad. At that time, I said, "Okay, I probably I felt really bad because she was sick. So, I had to stay home for a week or 10 days. I felt bad, for I was a full-time worker – a researcher. I was staying home with my daughter so long. I got really stressed, and then I went to my group leader – a professor, I said, "I probably need to either change my status as a part- time, or I had to quit". (Interview transcript)

I themed the obstructions the mothering participants shared during the interviews as noted above in this section to be "gendered barrier". I could say all working women having small children face it! Men do, too, but not directly as women. Professor Zhang's comment about gendered barrier could draw a big attention:

They are men basically putting a day with 120% of effort only at the work. They don't care of family. They don't care of anything else, it could just

138

work for the job, So, of course they can have more achievements in this point of view. Like my professors in Japan, they all even today, they don't buy socks for themselves. Their wives do everything for them. (Interview transcript)

Chair Gera agreed with Professor Zhang in the point that married women, especially mothering ones, worked much harder than men because of their gendered role – bearing and rearing children no matter how much their husband and family might share with them. Their time and energy are squeezed between work/study and family responsibilities:

I think, [women] do much more than the men in terms of that they have their family, and both of the "clock" start at the same time. Because women have a body [feature]. You need to have kids. You have a family and at the same time, same period with the beginning of your getting what you have to do good that way. You have to go to stage by stage up. I think …since it's been females being more in demand, such as an at home and profession does not have anything to do with what they have to do at home. (Interview transcript)

Professor Pradeep was the fifth case in my study living with such a squeeze between mothering, researching, teaching, and serving roles:

Here I struggle with the time management. But I guess partly this because of my little one because he is still three years old. So, I come back, I cannot do anything at home with him because he won't let me to do any work. And

139

my job is not a 9am to 5pm job. We can't stop working... I also a secretary

of the [name of an organization]. And then my research group is pretty big,

too actually. I have four PhD [students] and then I have four undergraduates.

It's 8 students. Yeah, it's a lot! It is a lot actually! (Interview transcript)

At micro-level, the married and mothering AAW in my study shared the same pressure from their concurrent multiple responsibilities. Gendered role of bearing and caring children was an incremental element of their overwhelming loads. They faced the toughness because the other roles was not lessened during their mothering. They had to teach, do research, and serve committees with the same load as their non-mothering colleagues.

The second barrier my participants had in their career pipeline was language..

6.3.3.2 Language Barrier

Half of the AAW (Founder Lin, Professor Zhang, Chair Gera, Director Ngo, and Professor Pradeep) in my study had a lot of difficulties with their limited English language competence. This type of barrier influenced them not only in their study but also in their job competition. They had to work extremely hard to overcome it.

In undergraduate study in STEM field, Chair Gera struggled with the English as a main instruction medium:

When I got into my undergraduate, it was all English. There wasn't anything

I could study in my own language. That was very difficult for me. That

transition was very difficult for me to understand completely in a different

language, understand terms, and everything. These were the ones very much

difficult. (Interview transcript)

140

The language barrier even impacted their choice of discipline. The case of Director Ngo was an example. She originally like literature and history, "not interested in science". Once she migrated to the US with her family, due to her limitation in English command, she had to switch her interest to science – "taking science courses such as math, chemistry, and biology". In fact, as the STEM were not her original preference, she did change her major three times in her undergraduate study – first geography, next biology, and then chemistry. And for PhD program, she first applied for environment science program, then "ended up with studying physical chemistry". (Interview transcript)

The language barrier also challenged the AAW in getting hired as in the case of Founder Lin and Professor Zhang. The job application of the former was not reviewed because of her English language limitation:

> There was an obstacle when applied, my colleagues later, they told me,
> "[First name of the participant], they didn't even evaluate your CV.
> They received it and threw it to the trash can.". They reviewed all
> applications. However, those who can communicate properly already
> found their job. Those who have no job offers could not understand
> English nor speak English properly. (Interview transcript)

The latter applied for a teaching position at an engineering school and received a decline dure to her weakness in English language:

> They were reasoning that I was not good at English. And I should not have
> the ability to communicate with the other faculty. So, they thought I could

141

do research by myself, but I could not do the communication. (Interview

transcript)

In fact, language barrier was the initial obstacle, even a shock facing these AAW when they first migrated to the other countries (the US, Canada, and Japan). What Founder Lin shared was a typical example. This barrier did take her a lot of time to improve as presented in the section of success factors at micro-level:

On July 19, 2001, I immigrated to Canada. After I immigrated to the nation

of Canada, I realized one thing – "I don't speak English at all!" ..I listened

to the news, evening news reported by Peter Mansbridge, who is on the

same level as Anderson Cooper or something like that. The anchor is Peter

Mansbridge, a very famous anchor in Canada. After 30 minutes, you know

that the news was 30 minutes. They reported a news, beautiful speech,

beautiful report, but I didn't understand anything. I understood two words

by guessing–good night. My goodness! I didn't understand anything but the

last two words, I believe, is "good night". I do not have the time difference

or jetlag, but I did not sleep that night…When I talked to Dr. [last name]

during my first interview. Originally, she thought we were going to have

communication professionally. She had her notebooks and prepared to start

writing down our discussion. It turns out that she asked me "I'm sorry I beg

your pardon. Can you repeat?". Throughout the whole conversation, she

kindly asked me to repeat, indicating that she didn't understand what I said.

When I wrote down what I wanted to do, she got the points, but when I

spoke, she didn't know what I said. She suggested me to improve my

English first and then contacted her again. She didn't give me the position

after that conversation. (Interview transcript)

For Founder Lin, English language incompetence obstructed her not only in communicating with her post-doctoral position, but also in applying for a tenured position as presented above. Thanks to straightforward recommendation of her supervisor, she was persistent to practice every night in the office by herself with an English program for solid six months. Eventually, she were able to co-teach with her professor and successfully applied for a tenured position. At the interview timepoint, she has been a full professor of chemistry at a STEM dominant research university in the US:

Dr. [last name of another professor] asked me what my future plan was after

the talk in his class. I informed him that I want to become a tenured

professor. He replied, "At this moment, you will not have compatibility for

this position. Your academic preparation is excellent, but your

pronunciation and intonation need to be improved." From that time (March

2002), I started to work on my English improvement. (Interview transcript)

The narratives of the participants disclosed language barriers in their early stage of the pipeline. No matter how big or small this type of obstacle was, they could overcome it by themselves. So, I could label it "controllable barrier". The interview data analysis brought out another obstruction, which was uncontrollable. It was their immigration status at their early stage of the pipeline.

6.3.3.3 Immigration Status

In my study, the narrative of Professor Pradeep was an illustration for the obstacle migrating AAW faced. As presented in the section of obstructions at macro-level caused by the agents in institutional and departmental level, she had to endure the oppression from her post-doctoral appointment supervisor. Knowing that she needed to maintain her H1B visa by working for him in the lab, he forced her to work 60 hours per week. He yelled at her whenever he realized he was wrong, and she was right in their experiments. He even yelled at her without reason:

> I guess another thing was actually the reason why I could not avoid discrimination here was because of my visa status. He knew that I couldn't really do anything against him. That was I felt the discrimination. Imagine if I had been a [US] citizen, he couldn't have done any of these things. Because I was bound to H1B with the labor certificate and everything he knew that I was already trapped. (Interview transcript)

The case of Chair Gera gave a different nuance of immigration barrier. Her difficulty in immigration status pulled her back to the academy rather than involved in industry after she completed her master's degree in the electronic engineering field. At the interview, she was delighted to share that thanks to this barrier, she tended upwards a PhD program. And after that program, she could anchor her professional life in the academy:

> In my case it was a little bit different again, which was that I pursued my master's in the electrical engineering, and then I wanted to get into a job. But at the time, my visa status was an issue - you have to get a job within 60 days, otherwise you would be out of the States. At that time in a year, before you switch, that was 60-day period. Because I could not secure a job

144

within that 60-day period. I got into this PhD program. And that was how I

got into my PhD. And at the time I was very much interested in calling

myself as an engineer rather than an educator. I guess it was just my destiny.

(Interview transcript)

In summary, at each phase of the career pipeline the AAW in my study faced different

barriers primarily rooted from the intersectionality of gender, racial, and hierarchical biases against

them. At macro-level, they mainly confronted limitations in research and work facilities, and

injustice in resource allocation. Moreover, the unfair evaluation, nomination, and promotion

discouraged them a lot in their career pipeline, especially at their early stage of faculty

appointment. In addition, they was swamped by heavy workload of teaching, research, and service.

It was worse that the committees they were expected to join were perfunctory and thus time and

energy-consuming. In the interaction with the people at higher level in the organizational

hierarchy, and with the colleagues and students, they had pain with some key people's biased and

indifferent attitude, assessment/evaluation, and behavior. They also had difficulties in working

with the partners outside their institutions.

At meso-level, some of the participants were under pressure of their parents who forced

them to choose a STEM field. Furthermore, the gap between their parents' high expectation and

no preparation of necessary life skills for independent college life outside their home country

caused a big shock for a couple of AAW in my study.

At micro-level, the AAW were challenged by their gendered role in family (as a wife and

a mother) and at work (as an educator, a researcher/faculty, and a committees servant). Their

weakness in English command and immigration status if they were migrated to the US for their

professional education and faculty also obstructed them to the career advancement.

145

On the other hand, my study informed that after successfully coping with those barriers,

they became stronger, mature, and more competent in their social and professional life.

7.0 Discussions and Contributions

This section discusses what and how my dissertation contributes to the established scholarship of AAW in STEM fields in higher education, research methodology and method, and praxis related to STEM fields in higher education in the US.

7.1 Discussions and Contributions to Established Scholarship of AAW in STEM Fields in Higher Education

The findings of my study first contribute to the existing knowledge base on AAW in STEM fields in HE in the way in which they support, enrich, and challenge the current scholarship. The analytical results also highlights the impacts of the cultures of academy on AAW development in STEM in HE. In addition, my study illuminates personal factors regarding social cognition, mindset, mind tool, capitals, and leadership power the AAW possessed to enable them stand firmly in adversities.

7.1.1 Consolidating Established Knowledge on AAW in STEM Fields in HE and also in AAW in HE in General

The AAW STEM leaders' narratives add valuable nuance to existing research literature on the persistent underrepresentation status of AAW in higher level of leadership in HE in general

and in STEM fields in particular. The impossibility of my recruiting AAW in such higher levels as dean, provost, vice president, president, in my study is rigorous evidence.

The findings of my study supports those of Chen and Hune (2011) about leaks in the pipeline of Asian American Pacific Islander's moving from doctoral studies to advanced positions in academia like full professoriate rank and campus presidents.

The rigorous answers to the first research question - *What factors and interventions empowered the AAW to overcome the barriers and advance in their career in STEM fields in HE in the U.S?* – provide a shared formulas for AAW's success in academic career. First, they need to go through all the stages of the professional education and faculty pipeline in HE with good performance. The first stage was building their own academic credibility by earning advanced graduate degrees (doctoral and postdoctoral levels). The second stage when being hired as tenure-tracked faculty was to cumulate documented accomplishments through their teaching, research, and services. This stage enabled them to enhance their visibility and leadership capacities in dealing with institutional politics and complexities at work (Lee et al., 2018; Torne, 2013). In leadership trajectories, they needed to continue to learn how to negotiate and cope with stereotypes, discrimination, and injustice related to their multiple identities (Kawahara et al., 2013; Torne, 2013). In other words, their human capital was gained through their first stage and continued building up in the second stage. While cumulating their own human capital, they strived to formulate their social and cultural capitals manifested by their established social networks and their bi-cultural competence in their teaching, research, and service practices. Without these capitals they could not have conquered obstructions to move up in their career ladder.

While seeking the factors contributing to their career success, my study deeply explored universal and contextualized barriers and challenges facing the AAW in their trajectories to career advancement.

My empirical answers to my second research question – *In the journeys to success in STEM fields in HE, what were the biggest obstructions the AAW had to face?* - support the previous studies on visible and invisible barriers challenging AAW's pathways (at each stage) to career advancement in the academy. My study also pointed out the intersectionality of gender, racial, and hierarchy biases against the AAW in the pipeline of their career in STEM fields in higher education.

7.1.2 Enriching and Challenging Existing Knowledge on AAW in STEM Fields in HE

7.1.2.1 Enriching

Compared to the previous studies on AAW in STEM fields in HE (Camacho, 2013; Castro & Collins, 2020; Espinosa, 2011; Johnson et al., 2011; Ko et al., 2014; NSF, 2013, 2015; Ong, 2002; Ong, 2005; Ong, 2011; Ong et al., 2016; Ong et al., 2011a; Sosnowski, 2002; Tate & Linn, 2005; Varma, 2002; Varma et al., 2006; Williams et al., 2016), my study emphasized more the national and institutional factors which enabled them to decide, retain, and develop in STEM fields, given that barriers obstructed their pipeline to career advancement.

Regarding national factors, my study shed light on the role of their home Asian countries and the receiving country (the US) in aspects of social values and professional development opportunities in the AAW's success in career in STEM fields. The parents, school, and society in their home countries had a special interest and support for high level of education and for STEM fields. These characteristics helped build a strong STEM initial knowledge and interest for AAW

and train them to intensively focus on their study rather than other things outside classroom. The higher education in the receiving countries, especially in the US made them build up the capacities of dealing with tensions and pressures, even oppressions rooted from the intersectionality of gendered, racial, and hierarchical biases. Their stories implied that in the US, the support sources from different levels and ample opportunities for jobs in STEM and for promotion together are bigger than or at least equal to challenge and competitiveness. I could conceptualize this implication into the mathematic formula below:

Sum (support sources from varied levels + opportunities (job & promotion) $\geq$ Sum (competitiveness + challenges)

My study is among a few research works with insights into the AAW's perspectives on what national factors supported them to anchor their career in the US while they might have more benefits and saved a lot of time to move up in career if they returned to their home countries or to other countries to anchor their career.

My study also informed that the work environment in STEM fields seemed more struggling than in social sciences and humanities fields because of its more acute competition in winning grants for lab research projects. By nature, STEM fields require huge funding sources for experimental equipment and materials. Lab facility is like a backbone of STEM body. And lab work opportunity is like blood to raise STEM profession and make STEM body healthy and strong. The interviews with the AAW participants provided that without labs, the STEM programs could not exist and evolve for both undergraduate and graduate students as well as for faculty's professional development. This finding of my study added a crucial point to the knowledge base on the success of students and faculty in STEM fields. That was the institutional/departmental side for the lab facilities. For individual AAW, in order to retain and develop in STEM, they needed to have high productivity in the research publications and win research grants. Lacking either of these pivot factors, they hardly built up their professional prestige to move ahead in their career in STEM

in HE.

Moreover, at micro level, my study featured more personal factors contributing to success of AAW in STEM, particularly those as of the first-generation-immigrants of their families in the US. The exceptionally high curiosity of the AAW about the world outside their home countries, good sense of adventure, and good risk-taking skill with perseverance and resilience plus bi-cultural competence were essential characteristics to empower them to overcome obstacles and advance in their STEM career.

Furthermore, my study was one of few studies examining the AAW's success from the point of leadership power base introduced by Thomas and Thomas (2003). Generally, the AAW in my study used their *Personal Power Base* (consisting of Information, Expertise and Goodwill) more than their *Position Power Base* provided by their organization (Authority, Reward, and Discipline) in leading their roles at work.

Regarding differences of lived experiences of AAW in academic and non-academic leading position, my study implied that the AAW in an academic leading position faced more pressure of required research, teaching, and services than those in non-academic posts. Tension in relationship with some of their colleagues and administrators in the higher education hierarchy was also more acute. On the other hand, the AAW in non-academic position had to deal with more diverse people of varied roles, races, gender, and hierarchical ranks in their administrative structures, which required them to more flexible in handling their daily work issues. They need to learn the skill of "a juggler" (fast responsiveness and adequate flexibility) – a metaphor used by the Manager Yang in the interview.

In linguistics, my study enriched the existing pool of metaphors used by the scholars in their studies. The stories of the AAW in my study provided some more interesting metaphors -

"*juggler*" (emphasizing good flexibility in handling complexities and uncertainties), "*deeply rooted blooming tree*" (denoting role of fundamental factors in empowering individuals to develop and then to support others), "*track*" (implying each career has its own way to go and choosing a right track to pursue plays a pivot role), and "*sluggish shovel*" (referring to passive leaders without action to advocate their competent subordinates). These three new metaphors were used to describe the participants' role in their management and teaching, strategy to make them firm and do forward in shaking situation, and barrier they faced in their STEM career pathway. In addition, the three metaphors of "glass ceiling", "walking a tight rope" between family and my career, and "uncharted waters amidst opposing waves" originally noted in the previous studies were repeatedly used by the AAW in my study.

7.1.2.2 Challenging

The findings of my study challenged the contemporary knowledge base on AAW in the academy and in STEM fields in two points.

The first one calls for a *revisit of parents' and family's role in the young's choice of college major*. The expectation and intervention of parents in many cases created pressure over their children's choice of career orientation. This badly influenced self-efficacy and self-motivation for study and pursue career paths of the young. The narratives of the participants in my study also disclosed that the parents did not offer enough preparation of life and social skills for their children. There was a gap between parents' expectation and children's prepared capacities.

While my and the previous studies highlighted the role model of mothers in family, my study also provided a couple of cases in which the mother's over-immersion in work left a bad feeling for their children and in which the mother could not have a job in STEM field of her dream, then she passed her dream to her daughter.

152

The second point refers to questions about *the operations and performance of recently emerging diversity and inclusion machinery in higher education*. No one can deny diversity and inclusion are key factors to improve the status of minority and disadvantageous people in organizations. However, most of the stories shared by the participants in my study implied that the way their institutions organized structure for social justice, diversity, and inclusion was not truly effective. The established structure seemed not yet to empower and validate the important role of diversity and inclusion as talked about. In my study, this kind of structure AAW reported was not strong enough to protect them from painful experiences in the academy and to advocate for them. That was why the AAW in my study still faced a lot of adversities although their professional performance could be competitive with their predominant colleagues. They still felt serving this type of machinery for social justice, diversity, and inclusion wasted a lot of their time and energy.

Moreover, when comparing the analysis of document data related to diversity and inclusion (as shown in Table 5) and the interview data, I could not find any close positive association between institutional diversity and inclusion denoted by proportion of female and minority student and faculty bodies and the painful and favorable stories the participants shared. The case of Professor Pradeep was a typical example. She was from a private STEM dominant university with 36% of female students, 49% minority students, 31% of female faculty, and 18% of minority faculty. All these indicators were generally lower than those of the other institutions in my study. But she very much enjoyed the collegial culture of her institution. Her colleagues were friendly, supportive, and collaborative. They were not hostile in professional competition:

> The moment that I landed here, "My goodness, everything was very
>
> different. People are so, so, so, great! During the faculty meetings we never
>
> fight. We never! ..We don't compete each other. It is just so good! We as a

group, we have issues with the administrative levels. I think that's common for everywhere with a challenge because they see problems in a different angle than we do…My peers, my colleagues are very friendly. [They together create a] very housewarming environment. I love it! (Interview transcript)

In reverse, when she did her postdoctoral study at a much bigger comprehensive research institution with higher level of diversity and inclusion (56%, 36%, 46%, and 28% respectively), she had the most haunted painful experience among tough stories in my study.

7.2 Discussions and Contributions to Praxis of STEM Fields in Higher Education

My study provides a series of suggestions for stakeholders at three levels of society. At macro-levels, both national/federal and institutional agents need to continue and promote supportive resources and interventions, and established values to protect and facilitate more AAW to advance in their career. At meso-level, my study gives Asian parents some recommendations to help their children prepare better for their STEM pursuit journey. And at micro-level, bundle of advice are offered by the participants in my study.

7.2.1 Suggestions for Policy and Decision Makers (Macro-level)

7.2.1.1 In National/Federal Agencies

At national and federal level, my study recommends that it is necessary to maintain and promote funding sources to support research projects of varied sizes. Special attention should be paid to scholars and faculty at their early stage of career in STEM fields. My study provided that contemporary funding supports have positively impacted both faculty and student development for a long-term future. Their research projects would help enhance the competitiveness of the country at present and in the future.

The immigration policy and regulations should be more contextualized. For example, giving some exceptional consideration for individuals of excellent performance in their research projects in order that they could prevent themselves from exploitation of the employers/work supervisors as the case of Professor Pradeep shared in my study. Recently, the policy of STEM visa has been a remarkable improvement. And this should be promoted for longer-term work visa toward permanent residence permit for STEM and non-STEM scholars who want to contribute to the US for a long-run.

7.2.1.2 In Higher Education Institutions and Departments

7.2.1.2.1 Consolidating Established Values of the US Higher Education

The findings of my dissertation also agree with the proposals offered by the scholars of the existing research literature. They advocated that structural factors should be strengthened and improved. My rigorous answers to both of my research questions confirmed that while institutional factors gave the most and the best supports for the career advancement of the AAW women in

STEM fields, they pressed the AAW with the most barriers rooted from the intersectionality of gendered, racial, and hierarchical biases.

In order to protect other AAW in STEM from being possibly challenged by the same barrier intersectionality as the AAW in my study were, the proposal of Chin (2012) still works well. She drew from her own experience and proposed that higher education institutions (HEIs) should sustain the established principles *of academic freedom* and *shared governance* as "big equalizers" (p. 155). The painful stories shared by the AAW in my study once again call for continued pursuit of social justice in higher education, especially in the current context of the US society with degrading value of democracy, social justice, and equity. In reality, the principles of academic freedom and shared governance have shaped the institutional policy, organizational behaviors, and hence build up cultures of the academy (collegial, managerial, developmental, advocacy, virtual, and tangible). My study results imply that the AAW in STEM truly need each academy culture, particularly collegiality, management, development, and advocacy.

7.2.1.2.2 Revisiting Current Machinery for Diversity, Inclusion, and Equity

At institutional level, perception and organizational behavior via structuring machinery for social justice, diversity, and inclusion should be (re)-considered and (re)organized to make the established/establishing machinery work better in terms of validity and effectiveness. I borrow the name instead view to underline a true meaning of diversity for a broader society beyond the institution, "We need to have a diversity in our sciences, going forward to really solve the world's big problems in creative ways. And so that's another reason that drives me to lead and let's see other support along the way – actually professional leadership training."

I also rely on the perspectives of Chen and Hune (2011) and Wu (2015) to suggest that systematic and transformative changes should be made to eliminate discrimination related to

gender, race, and culture. Institutional values of excellence and equity; diversity and inclusivity should be strengthened by placing a right structure for them in order that they could effectively contribute to AAW's success in academia. All HEI stakeholders should be fully aware that while the academy is an agent for social change, it is also as a venue for racism, gender discrimination, xenophobia, and other injustices to persist (Hune, 1997, 1998, 2006, 2011a, 2020a, 2020b). With that understanding, changes in behavior and organizational structure could make their institutions more truly diverse environments by a "culturally pluralistic" atmosphere. Such an atmosphere should be nurtured for all members of the institution to "achieve fully" (Tierney et al., 2004, p. 15). Moreover, the notion of competence and authority of each agent in the institution should be defined based on culture and social constructs (Tierney et al., 2004).

7.2.1.2.3 Supporting and Intervening for Retention and Development of Students in STEM
Fields

As my study examined the whole pipeline of the AAW from their professional education (undergraduate and graduate studies) to faculty and leadership in their profession, for individual students in STEM fields, I agree with Carlone (2007), Joseph (2012), and Ong et al. (2018) to recommend that AAW students and students of color in general should be paid special attention and supported. They are "most vulnerable to opting out of STEM, given that institutional and interpersonal slights and pressures occur at a critical point in time when their decision to persist in STEM education and careers may be affected." (Ong et al., 2018, p. 208)

Students, especially female students of color need academic advisors and professors who know when and how to give most appropriate challenge, encouragement, and support to develop without demotivation or complacency. They also need a peer community to share and help out whenever they get stuck in their academic and social life.

Students need to be continuously inspired in STEM classroom, which is one of the key factors for students to retain and attain across the pipeline. I draw this suggestive point from the narratives of Professor Chen in my study. Her chemistry teacher had inspired her to focus on this subject during her high school learning and helped her decide to major in chemistry as an undergraduate. That teacher taught her "how to think deeply about problems". And at college since junior year, opportunities to work in different labs brainstormed her to think of the exciting side of using computers in biophysics. At that time, she was fortunate to have a supportive professor, who gave her "a real research project that ended up in a publication. So that was really exciting". That was "what convinced" her to apply for biophysics PhD program. (Interview transcript).

The case of Professor Pradeep is another interesting illustration for crucial impact of teachers on student choice of major and career. She proudly told about her "best professor" in her undergraduate study though he was one "the toughest professors" she had ever learnt with . For her, "not everyone can teach like him". He was so capable of instilling knowledge into students' mind that his student did not feel they had to study for his exam. More importantly, his passion for teaching did inspire her dream to become a teacher like him

> He had this passion for teaching. "Oh, my goodness, if I could get into the place where he was!". I still remember when I went to the visa interview. He [the visa official] asked, "Tell me why you apply for [name of a university]?" This was my answer, "I got this amazing professor. So, I always, I was thinking I love teaching. It's in my blood. I think it's just there for me to teach. It's not a problem. When you know how to teach, then you wanted to follow people who are really good at teaching. And then then I was just like, "This guy inspired me". So, I'm just, "Oh, my goodness, he's

amazing!". And that was the reason why I actually did apply for [name of the university]. (Interview transcript)

7.2.1.2.4 Supporting and Intervening for Retention and Advancement of Faculty in STEM Fields

7.2.1.2.4.1 Maternal Leave and Childcare Service Policy

For individual female faculty, the institution should consider some flexible mechanism in their maternal leave in order that female faculty with small children would be less struggling in their balance between childbearing, childcaring, teaching, research, and service. The day care service on campus with less expensive tuition is also essential to support mothering faculty in maintaining their academic performance during motherhood.

7.2.1.2.4.2 Mentoring Program and Network

Drawing from painful stories told during the interviews in my study, what Chair Gera shared could be a good suggestion for the approach to develop a mentoring program for young junior faculty within school/department or institution. She informed a mentoring program for young women newly hired at her academic program had been recently started. Under this mentoring program, the junior female faculty has had an orientation to learn about current institutional policy and procedure to reach out to right administrators for their requests and proposals for improvement.

The Professor Pradeep also gave a suggestion for department chair, dean, and senior faculty to organize informal meetings rather than formal ones for junior female faculty to speak out and share. Assigning right people with right personalities for mentoring is also as important as organizing mentoring structure:

It could have been great if I had a good department chair that was going to listen, to keep an eye on "How your lab is going?", "How your lab is set up?", or "Do you need help?" I think for example, even though to be the chair, you don't need to have formal meetings. For example, one per quarter, can meet for 30 min for coffee, or for lunch with the young faculty. Because sometimes you meet one on one and in the office you can feel intimidating…So, make it really informal, casual and you can talk because when you get to office, sometimes people feel very tense…Not only the department chair, but perhaps also, the Dean, or senior faculty can reach out.

Professor Pradeep offered this implication from her own experience with the mentor assigned to her. She accepted that having an assigned mentor was good, but an assigned mentor with personalities easily approachable, shareable, and helpful was more important:

The department did assign a mentor to me. But I felt there was a barrier. I wouldn't dare to tell all the things that happened to me to the senior faculty. And also, you have to select the mentor with the right personality. Some people can be very approachable but some of them, you are terrified. You wouldn't be able to open up. I think it is important at least to have a few people to keep an eye out there, to reach out to support the young faculty. (Interview transcript)

The findings of my study together with the previous studies emphasize the importance of *multiple mentorships* for AAW in different stages of their development from professional

160

education to pre-tenure, then tenure, and leadership stages (in executive and academic posts). Multiple mentors include their peers, senior colleagues, supervisors, social agents, and family members. Given that STEM fields are male-dominant, the AAW and other women of color desperately need mentors who are willing to advocate, empower, and validate the efforts of the AAW and women of color. They also need mentors for their familial life and social networks. Professor Brandi gave concrete suggestions regarding multiple mentorships. For junior faculty, there should be at least three mentors – teaching mentor, research mentor, and life mentor:

> I will say informal mentors are always important for any faculty member, especially for an early career faculty. I also suggest having multiple faculty mentors for different facets of your life. I mistakenly believed I should find a mentor that can cover all the criteria I had, and be willing to spend their time mentoring me. News flash: that ideal candidate does NOT exist. What does exist are talented individuals who have a specific trait you admire. Find them. Find a teaching mentor. Find a research mentor. Also, find a lifestyle mentor. The last one is so important. If you are struggling a family while maintaining an academic career, what sort of life-work balance do you envisage? Will you hire an in-home nanny? How much of your work are you able/ willing to delegate? Will you breastfeed/ pump or will you use formula? Difficult questions, tough choices. It helps to associate with others who have done this successfully. (Interview transcript)

7.2.1.2.4.3 Consistency, Transparency, and Integrity in Understanding and Operations of Criteria for Resource Allocation and Evaluation for Tenure, Nomination, and Promotion

The institution should ensure a regular conversation between administrative and academic agents to share their points. This would help bridge the gap between their understanding and operating the criteria for resource allocation and evaluation for tenure, nomination, and promotion. Besides the narratives shared by AAW in my study in the section of key obstructions at macro-level, the story of current tenure review policy at Professor Pradeep's institution provides a further approach for tenure evaluation. It should not be rigid in the way that the requirements of teaching and doing research for assistant, associate, and full professorship are irrelevantly similar:

> In terms of the institution, I think that it's a little complicated because we are scientists, right? And then the administrative people are mostly engineers. So, the way that they actually evaluate certain things are very different than how a scientist would do. So, we see that issue all the time. It's not just me facing it. And then another thing is going to be because they've implemented a tenure track system recently. They didn't have a tenure track for a long time. So, I was actually the very first chemist hired that they did as a tenure track. But then what they did was actually they evaluated everyone else for the tenure track. They didn't really hire anyone. Me as a tenure track – assistant professor. So, they are now evaluating all professors to their tenure track. But personally, I believe the school supporting system or supporting system as a tenure track…But what they

162

expect from us is actually what a typical our [name of her former school] expects from a tenure track for professors. But I was just, "That's not right!". That's not because in [name of her former school] you don't have teach two classes every semester. Here we have to teach 2 classes per semester. It is a lot actually. So, in [name of her former school] for a tenure tracked assistant professor, you teach only one class per semester, and then you do the research. But here I have to actually teach 2 classes every semester, publish paper(s) per year, and then I have to submit 4 to 5 grants. I am just, "No, no, that's not the way it works! In [name of her former school] they don't expect you to submit 4 to 5 grants, because that's impossible, they would expect you to put one good grant per year, and they can have publications as much as possible, and then teach one class. (Interview transcript)

The institutions should also improve their criteria and procedure of tenure review and yearly evaluation. It should not be rigid, and should be more transparent and inclusive by including the participation of junior faculty, and more counting disadvantages of underrepresented faculty.

7.2.2 Suggestions for Family and Community (Meso-level)

From the stories shared by the participants, I would suggest Asian families, particularly parents, and community members should not push their children to a specific STEM field of good demand and high salary in the job market. Having a practical choice of major responding to the

job market is a good point. However, they should understand the job market does not stand still. It is moving all the time. Each occupational journey has its own challenges. Their children need a true passion and capacities of their own to overcome obstacles by themselves. The parents are not able to deal with academic and social difficulties for their children. Parents should thus respect professional interests and be aware of strengths and weaknesses of their children.

In addition to emphasis on schooling of their children, the parents should pay more attention to giving their children better preparation of social and life skills for their independent living before they enroll in their professional education at college.

7.2.3 Suggestions for Individual AAW Interested in or Recently Engaged in STEM Fields in Higher Education (Micro-level)

Regarding personal factors at micro-level, the lived experiences of the AAW in study highlighted salient ways of thinking and ways of doing to help them coping with barriers stemmed from the intersectionality of gendered, racial, and hierarchical biases. These primary factors are consistent with the personal strategies shared by previous studies (Kawahara, 2007; Kawahara et al., 2008; Lee et al., 2018; Paik et al., 2018; Wu, 2015). Besides adaptation of the perception "challenges, struggles and conflicts as part of being a leader" (Kawahara, 2007, p. 27), the AAW in my study also showed they had dominant culture efficacy and bicultural competence. They were able to be pertinently flexible in dealing with complexities in their work practice in STEM fields. In many cases, the AAW in my study had the same personalities as the other women and women of colors in recent decades' studies (Chin, 2020; Irey, 2013; Kawahara, 2007; Kawahara et al., 2008; Kawahara et al., 2013; Lee et al., 2018; Ng, 2017; Paik et al., 2018; Torne, 2013; Wu, 2015). Resiliency and perseverance, self-empowerment by academic and work credibility, determination

164

in struggling against injustices, integrity, and pride and confidence helped AAW overcome visible and invisible barriers are the most significant characters manifested in my and the other's research works. These personalities and capacities are unique of working married females as noted by Northouse (2016a), Northouse (2016b), Eagly and Carli (2007), Hoyt (2016), and House et al. (2004).

Moreover, the AAW in my dissertation also had good skills in work-family balance, professional and social networking for getting and giving mentorship, interpersonal and cross-cultural communication enabled them to handle well their own weaknesses and barriers. These skills had been illuminated in studies before me (Duero & Villegas, 2018; Valverde & Dariotis, 2019).

The evidence regarding individual AAW's personal factors I sought could give me a strong foundation to state that the AAW participants in my study had growth mindset rather than fixed mindset. Their growth mindset was first denoted by the way they could successfully switched their ability from their own interests in non-STEM fields (journalism, literature) to their parents' suggestions for STEM majors. Then they were able to adapt themselves well to new educational and living environments in a new country although they had not been prepared well. And finally, in spite of many barriers, they could move up in their career ladder. Their growth mindset functioned as a prerequisite to build up and strengthen their own mind tools (soft-skills). In return, their obtained mind tools contributed to promote their mindset for their peer and student development.

My study's findings about AAW scholars' mindset and mind tools are helpful for not only AAW but also for women and women of color in STEM fields. Besides those, my data also provided some of practical takeaways for individual students and faculty in STEM. Below are key

lessons for them, drawing from lived experiences of the participants in my study. I intentionally put all the recommendations below in the form of quotes from the participants. My purpose is to make them sound direct conversations between the AAW leaders in STEM and other AAW who are interested in or has been recently in STEM fields and want to advance in their career:

7.2.3.1 Reach Out and Communicate Efficiently with Professors for Your Problems in the STEM Fields – *succinct description, direct and specific question(s), suggestive solutions*

> I learned that professors are busy and that you can't just ask somebody to sit down and look at your data with you for two hours. And I learned to trust myself more and whittled down the question to something very specific that I could write in an email within one or two paragraphs at most. So just a very specific question starting with "Oh, I actually don't know how to solve this. What is the best approach for this problem is?" Well, then, I would look at the different approaches that are available. Try to pick one that I thought was the most promising, and then going with that approach and figure out… What is it about that approach that I don't understand? And if that part of the approach I don't understand. Could I make it? The question was even more specific like, "Is it about some assumption that's being made that I don't understand?" Or "is it about some limitation that I should be aware of?", and so I tried to make as specific a question as I could. And this was back when email was just getting started. I think it wasn't really used that widely. Just keep in mind that maybe at most I would get half an hour

with that professor of time, and that's it. (Transcript of interview with Professor Chen)

7.2.3.2 Build Your Own Professional and Social Networks of the Same Gender and Social Identities – network of females from the same field and social context would be a key to promptly trouble shoot problems in profession and life

I will be great to have female support, a senior female colleague or the network of women supporting group. I think it is very important, because you feel more comfortable to talk to a female colleague than a male colleague. So right now, we have a group of about 25 faculty around the world, and we have the group text via WhatsApp, when there is a certain issue arrived such as how to deal with rejected papers, or to deal with male colleague or the department, we text, and people share their opinions or give advice. My colleague and I started this female group in 2020 to deal with the pandemic, and we keep adding more members. A few years ago, I wanted to do this but via a mentoring website. But now it's good that we started with the seed first. My idea is to have a website with female faculty and scientists to mentor females, and nurture young people and it is free to everybody, and people can become a member and free to sign up for that. We have faculty who is willing to be a mentor in STEM. We list them on the website and when people need help, they could be able to search and to contact a faculty mentor directly. I know a number of senior female scientists, but they don't really support younger people or other females at

all. Because they have this mentality "I struggled and now you should be, why it should be easy for you"? (Transcript of interview with Director Ngo)

7.2.3.3 Be Yourself, Think positively, and Do Not Feel Inferior in Your STEM Field!

"Consider yourself as the change sector. We can be a role model. We can be the leaders. And we can lead the trail of young women into the science and engineering technology."

I think in science there is no field restriction for women. They can do any field very well as long as they have passion or interest in it, and they shouldn't be thinking about the statistics that there are very few women, or there are many men over there. We should not keep those things in the mind at all. Statistics and history teach us a lot, but it doesn't mean it is supposed not to be changed. Just consider yourself as the change sector. You don't have to follow the trend that people choosing some other fields. You have to choose the field because you are good at... I think, I want everybody to be on the top of barriers. We know just to go on with the mission which you want to excel in your life. I mean whichever the field you choose. If it is science, that's much better, because that science is at long life. You will have very good prosperity such as financial, and other than being financially strong, is the best thing one could ask for. I think it will help her being independent, and they'll make her own decisions. I think science fields are the best things for females, and they just should not look at the statistics as that you always feel, "I am the one of the very few". We take pride in it, and go with the model. (Transcript of interview with Chair Gera)

7.2.3.4 Speak Out and Negotiate!

You're going to negotiate before you start a job to make sure it's clear that you get what you want, and you know sometimes it did help being an Asian woman doing that. Other times I think being Asian is a detriment because we're very polite, like not interrupting people. I interrupt people all the time, which people don't like, but that's inconsiderate, you know, some people don't like it. They don't like it when people interrupt them, and the reason I do it, I don't want to be mean, is because I have a thought, and I'm afraid that if I don't say my thought, I will forget it. (Manager Yang)

7.2.3.5 Do the Best to Be Prolific in Research, Publication, and Grant Proposal, Be Balanced between Work and Family, and Be Persevering in Your Career Passion.

All together are pressing, but rewarding!

Yes, it was difficult. But I think it was all for good. Because I've worked on those for two years - the first two years of my marriage, which was also first two years of my career. That helped me a lot, because I was working [till] 2 o'clock or 3 o'clock in the morning, developing new courses and things like this. I think that helped me. Within that first year I got a half of a million grant, and based on that hard work I did, they even in two years I got my first baby also. I think this work was a pressure, and my baby was born 10 weeks in advance. I had to go through more because I was working day and night in the pressure. It was difficult. It was difficult, challenging time. But I think it was worth that my baby was safe, of course. And then a lot of works were paid off, producing at least huge publications. And it

produced a few grants successfully. I was successful at grants. I think that really helped me. I was perfectly able to balance all of them. But even with all the challenges that I did not give up, and I kept going, kept going. (Transcript of interview with Chair Gera)

7.3 Discussions and Contributions to Research Methodology and Method

As presented in the section of Research Methodology and Methods, my study followed phenomenological narrative approach (PNA) with success case study method (SCM).

In higher education research, there have been a modest number of research studies using PNA because of two key reasons: (1) the phenomenological inquiry and narrative inquiry have been widely thought to be apparently disparate qualitative research approaches, and (2) mixed use of them consumes a huge amount of time and energy consumption.

My ambitious research inquiry for deep insights into both unique individualized and shared lived experiences of AAW in STEM in higher education inspired me to adhere to a combined use as "*phenomenological narrative research*" in one study. And the findings and recommendations for agents at three levels of the society presented in Section 6 and 7 affirm the possible use of PNA to understand complex phenomena embedded in AAW's status in STEM fields in HE. Together with previous studies, my research contributes to consolidating the possibility of phenomenological narrative research approach in higher education field. By conducting an empirical study guided by PNA, my dissertation could imply effective ways to promote strengths and control weaknesses of each approach.

Another contribution of my study is attributed to the *Success Case Method* (SCM). It framed my strategy of participant recruitment, data collection, management, and analysis. Thanks to this method with two instruments of documents and interviews, my study could holistically seek structural and personal factors workable for the AAW's career advancement in STEM fields in higher education. Given that there have been a big number of previous studies on challenges and barriers facing AAW in higher education in general and in STEM in particular, my study adds a new way to examine life stories of AAW in the academy – looking for success stories rather than poignant stories. Indeed, SCM has been widely used in such areas as healthcare, rural development, child adoption, social welfare, manufacture, and some others since the last decade of the 20th century. The ten-success case study in my dissertation introduces an example of a little-known method, which could work well in education an higher education research.

8.0 Conclusion

My dissertation contributed to six aspects regarding research, policy, and practice. First, my examination of the whole pipeline of AAW from their professional education to faculty, and further career advancement provided a fuller reflection on their lived experiences in STEM fields. Both structural and personal factors at three levels in society and in HE organizations were studied and highlighted. Second, my study provided practical suggestions for improving/making changes to established national and/or institutional policies to better facilitate AAW, in particular, and women of color in general to pursue, retain, and advance in STEM fields. Third, my study recommended effective strategies for individual AAW on how to deal with barriers to persist and develop themselves in STEM fields. Fourth, my dissertation enriched the limited knowledgebase of AAW in STEM fields in higher education in quantity of research work and quality of research inquiry. Fifthly, regarding research methodology, my dissertation gave one example of the possible use of "two apparently disparate qualitative methodologies of phenomenological narrative research" in one study (Nigar, 2020, p. 10). Together with previous studies, my research contributed to consolidating the new methodological approach of phenomenological narrative research in the higher education field. Last, but not least, my dissertation implied for a possible intersection of multiple disciplines in a research study – higher education (context), psychology (mindset and mind tools), and sociology (three levels of society). This intersection was displayed in my research inquiry, conceptual and theoretical framework, methods, and data analytical approach.

With the phenomenological narrative methodology and methods of document analysis and in-depth interviews, my dissertation synthesized the understanding of lived experiences of Asian

American women (AAW) in STEM fields in higher education (HE) in the US. It informed that in spite of barriers rooted from the intersectionality of gender, racial, and hierarchical biases challenging them in different stages of their career pipeline, they successfully advanced in the STEM fields in HE thanks to varied factors and interventions.

Structurally (macro-level), the national and institutional resources, agents, and interventions greatly supported them to overcome internal and external obstacles and develop themselves in the career trajectories. Caring and scholarly works of their advisors, mentors, faculty; multiple funding sources, leadership training program, and helpful and affective peer environment were key structural factors at macro level contributing to their success.

At meso-level, they had supportive professional and social networks. In family, their parents and husband provided them with encouragement and support in order that they could focus on their professional development. Community with the presence of people of the same race and ethnicity as theirs was also a big facilitator for their life and work.

Individually (micro-level), they stood out in their fields with their significant growth mindset and mind tool. They had exceptionally high inquiries about the professional world outside their home countries, adventure, and bravery, perseverance, resilience, time and conflict management, work/study-family balance, and bi-cultural competences. Their narrative informed that they had strong self-awareness and self-efficacy in envisioning their professional and career choice although many of them were under unavoidable pressure from their parents.

My study provided implications for policy and decision makers at national and organizational levels on how to improve their policies, behaviors, and practices to facilitate more AAWs to advance in STEM fields.

For individual AAWs, my study offered specific strategies to build up and promote their

human, social, and cultural capitals associated with growth mindset and strong mind tools to stand firmly through obstacles and succeed in career advancement in STEM fields in HE.

While confirming and enriching the existing knowledge base of AAW in STEM fields in HE, my study challenged some points in previous studies and current practices regarding roles of Asian parents in their children choice of profession and career pathways; and the on-going structure for social justice, diversity, and inclusion.

With understanding of AAW leaders' lived experiences in STEM fields in higher education and awareness of certain constraints in my study, I would like to provide two major implications for future studies:

First, research subject should be expanded to Asian American men and women from different minority groups in the US in order that suggestions for policy makers and practitioners would be more covering and viable for better impact on making changes toward national, institutional, and personal scales.

Moreover, it is necessary to conduct a further study on the current machinery of diversity, inclusion, and equity among HEIs with its pros and cons. The further study should provide success cases of effective models of how to organize a workable structure for better social justice through better diversity, more inclusiveness without losing established quality of learning, teaching, research, and services of faculty and students.

I conclude my dissertation by quoting what Chair Gera shared in the interview and a statement of a lab institute where Manager Yang worked. Chair Gera featured the overall impacts of gender and environments on AAW's career pathways. In one hand, the barriers challenged these women. On the other hand, the gendered and environmental biases helped them build up their own strategies to cope with, then develop their capacities to survive and thrive in their career in STEM:

I think women are more challenged in terms of their responsibilities, but of

course they excel because they are natural in that way. They're very strong

mentally, and they are very strong when they make the decisions and things

like that. And I think that's they're naturally born…If women are given

more opportunities, considering that they have more challenges in the

family level, because it is more challenging for them to have a family life-

work balance; they may do much better because even with all those

challenges they perform as well as when less challenges. (Interview

transcript)

The best efforts of individual AAW are not enough for their success in careers. The

standpoint and behavior of the organization are needed to bolster its members' endeavors:

[Lab name] values diversity and inclusion and encourages highly talented

and motivated individuals of all ethnic backgrounds, gender identities,

sexual orientations and disabilities to join us in pushing the boundaries in

what we can achieve in cancer research. In partnership with the [institution

name] community, we want to create and maintain a supportive lab

environment to enable both the physical and mental well-being of all lab

members and to allow everyone to reach their full potential. (Statement of

the Lab, employer of Manager Yang)

Appendix A –IRB Approval

University of Pittsburgh
Institutional Review Board
Office of Research Protections

EXEMPT DETERMINATION

Date:	January 21, 2022
IRB:	STUDY21090187
PI:	Dao Nguyen
Title:	Asian American women's success in STEM fields in higher education: A phenomenological narrative research

The Institutional Review Board reviewed and determined the above referenced study meets the regulatory requirements for exempt research under 45 CFR 46.104.

Determination Documentation

Determination Date:	1/21/2022
Exempt Category:	(2)(ii) Tests, surveys, interviews, or observation (low risk)

| Approved Documents: | • Interview Protocol, Category: Data Collection;
• Email Message/Letter to potential participants, Category: Recruitment Materials;
• Introductory Script (revised), Category: Recruitment Materials;
• IRB-DaoNguyen-HRP-721 - WORKSHEET - Exemption_Tests Surveys Public Behavior_Version_0.01.docx, Category: IRB Protocol; |

If you have any questions, please contact the University of Pittsburgh IRB Coordinator, Ali Arak.

Please take a moment to complete our Satisfaction Survey as we appreciate your feedback.

Figure 6 IRB Approval

Dao Nguyen

Introductory Script

Study Title: *Asian American women's success in STEM fields in higher education:*
A phenomenological narrative research

Study number: 21090187

This is a research study to be conducted at the University of Pittsburgh (Pitt). The purpose of my doctoral study is to seek success factors of Asian American women (AAW) in science, technology, engineering, and mathematics (STEM) fields in their whole pipeline from education and profession to leadership in higher education (HE), and to point out factors challenging AAW's advancement in STEM fields in each stage of their pipeline. The ultimate goal of my dissertation is to provide higher education institutions (HEIs), communities, families, and other stakeholders with viable strategies to facilitate AAW's development in STEM fields in higher education. Specific recommendations for individual AAW in STEM fields on how to cope up with barriers is also the same highest goal of my study. To obtain these inquiries, I will interview at least 10 participants of the study who are in academic and non-academic leadership positions (low and high levels) in STEM fields at four-year universities in the United States of America. Each interview will last between 60 to 90 minutes. I will also collect documents regarding institutional histories, visions, missions, strategies, and policies regarding academic freedom, diversity, inclusiveness, recruitment, retention and promotion. Personal documents which have already been available publicly or are voluntarily shared by the participants will be also obtained. All participants must be older than 18 years of age. The questions in each interview will be about the participants' backgrounds related to their demographics, and educational, professional and

leadership milestones. The most important part of the interview is about their narratives about their journeys to the leadership with both facilitators and barriers.

I will audio record each interview. And each interview will be transcribed verbatim. All responses are confidential, and results will be kept under lock and key or in password-protected files.

Because the student will be audiotaping your interview and note-taking of your personal documents on a regular basis, others will likely know that you are participating in the study. There is a small chance that participation in the study could cause minor embarrassment. There is the possibility of a breach of confidentiality of the research data, but the student will take steps to protect your confidentiality. You will not benefit directly from participation, but the information gathered from you will be used to fulfill her doctoral thesis supervised by Dr. Maureen Porter.

The participation of the interviewees is voluntary, and they may stop being interviewed.

In order to ensure the reliability and validity of the study, the student may need to contact back to the participants for further interviews (if needed) and for proof-reading the transcripts. The further interviews will help enrich the data for the study inquiries. And the proof-reading the transcripts will guarantee the accuracy of the data collected from the interviews with the participants.

This study is being conducted by Dao Nguyen, who can be reached at dao.ng@pitt.edu or 412.983.1593, if you have any questions. Her academic adviser is Dr. Maureen Porter, Department of Educational Foundations, Organizations, and Policy (EFOB) , School of Education, University of Pittsburgh (mporter@pitt.edu)

Good morning/afternoon/evening [title] [full name]!

My name is Dao Nguyen, a Ph.D. candidate from the Department of Educational Foundations, Organizations, and Policy, School of Education, University of Pittsburgh (Pitt). I am conducting a research study *"Asian American women's success in STEM fields in higher education: A phenomenological narrative research" as* my doctoral dissertation. My study has been approved by the Institutional Review Board (IRB) of Pitt as attached.

The purpose of my study is to seek success factors of Asian American women (AAW) in science, technology, engineering, and mathematics (STEM) fields in their whole pipeline from education and profession to leadership in higher education (HE), and to point out factors challenging AAW's advancement in STEM fields in each stage of their pipeline. The ultimate goal of my dissertation is to provide higher education institutions (HEIs), communities, families, and other stakeholders with viable strategies to facilitate AAW's development in STEM fields in higher education. Specific recommendations for individual AAW in STEM fields on how to cope up with barriers is also the same highest goal of my study.

To obtain these inquiries, I need to interview at least 10 participants who are in academic and non-academic leadership positions (low and high levels) in STEM fields at four-year universities in the United States of America. Each interview will last between 60 to 90 minutes and will be audio-recorded. The audio recording will be transcribed verbatim. All responses are confidential, and results will be kept under lock and key or in password-protected files. The interview will be conducted in person or via Zoom at your best convenience. Your participation in the interviewees is voluntary, and they may stop being interviewed.

I will also collect documents regarding institutional histories, visions, missions, strategies, and policies regarding academic freedom, diversity, inclusiveness, recruitment, retention and promotion. Personal documents which have already been available publicly or are voluntarily shared by the participants will be also obtained. The questions in each interview will be about your backgrounds related to their demographics, and educational, professional and leadership

milestones. The most important part of the interview is about your journey to the leadership with both facilitators and barriers.

I identified you as a potential participant by your online educational institution profile and success in leadership and in the STEM fields at your institution.

You will not benefit directly from participation, but the information gathered from you will be used to fulfill my doctoral thesis supervised by Dr. Maureen Porter.

In order to ensure the reliability and validity of the study, I may need to contact back to you for a further interview (if needed) and for proof-reading the transcript. The further interview will help enrich the data for my study inquiries. And the proof-reading the transcripts will guarantee the accuracy of the data collected from your interview.

You are invited to participate in my study because of your gender, Asian origin, and your success in the STEM fields at your institution.

I copy this message to my academic advisor and also my dissertation study mentor Dr. Maureen Porter for her information.

I look forward to hearing from your convenient reply.

Thank you for your time and consideration.

Sincerely,

Dao

Dao Nguyen (she/her)
Ph.D. Candidate in Higher Education Management Program
Department of Educational Foundations, Organizations, and Policy
School of Education
University of Pittsburgh
230 South Bouquet Street, Room # 5101 Posvar Hall,
Pittsburgh PA 15260, USA
e: dao.ng@pitt.edu | m: +1-412-983-1593

Asian American women's success in STEM fields in higher education:

A phenomenological narrative research

Interviewee Code: …………………

Date of Oral Interview: ………………..

Good morning/afternoon.

Thank you very much for agreeing to be a part of my study on Asian American women's success in STEM fields in higher education. I highly appreciate your time for the interview today. My name is Dao Nguyen, from the University of Pittsburgh. The interview will take between 60 and 90 minutes. The interview aims to get insights into your lived experiences in your educational, professional, and leadership pipeline [the researcher briefly defines the term "pipeline" if the participant is confused about it. It is also necessary to clarify the definition of the term "success"]. It has two main sections. The first one is to ask about your demographical, educational, professional and leadership backgrounds. The second section will ask deeply about your education, profession, and leadership advancement with both facilitating and challenging factors.

The interview will be recorded and transcribed. Both your identifiers and your school's will be coded. What you have shared with me during the interview will be strictly kept confidential.

Before we start, do you have any questions?

(answer the questions)....................................

Now could we start the interview?

Section one: Demographical, educational, professional and leadership backgrounds of the participant

1. Could you please describe your original race and ethnicity?

2. In your family, which Asian generation[5] do you belong to in the U.S.? the first or first and a half, or second, third or fourth?

3. What was/were your major(s) in undergraduate and graduate studies? Where did you study?

4. How long have you been in this leading position and what are your responsibilities? To whom do you report?

5. Did you have other leadership experiences in this or other institutions? If yes, please share where, when, and what responsibilities?

6. Please briefly describe your current leadership [you will talk about it in details in the next section]

   a. Why did you choose this current leadership position?

   b. What accomplishment(s) are you most proud of in this position?

   c. What did you expect to achieve, but have not been able to do or change for your institution?

Section 2: Facilitating and challenging factors in education, profession, and leadership pipeline

Let's talk about factors supporting and challenging you in your career advancement from education and profession to current leadership. For your convenience to recall, I will ask you from your most recent to the furthest experiences.

1. *Leadership ladder* (at different leading levels if any)

   1.1. What made you want to become a leader as you are now? what and who inspired you the most?

   1.2. What were your original goals for your unit/organization when you were promoted to be a leader?

---

[5] The first generation are those who immigrated to the U.S. as an adult;
       1.5 generation are those who immigrated to the U.S. as a child;
       The second one is those who did with their parents at a young age;
       The third one is those whose grandparents immigrated to the U.S.; and
       The fourth one is those whose great-grandparents did to the U.S.

1.3. What accomplishments have you most proud of since the promotion? [in other words, what goals have you obtained] and what and who facilitated and supported you to achieve them?

1.4. How about other goal(s) that you have still struggled to accomplish? What changes and supports are needed to help you do you need to move forward in your leadership?

1.5. For the coming time, what do you expect for yourself as an Asian American leader and for your organization?

1.6. What institutional and personal strategies are needed to support you to obtain these goals?

2. *Professional pathway* (from being hired as a faculty or staff in higher education to first promotion, and more if any)

   2.1. Why did you decide to pursue your career in the STEM fields in the academy?

   2.2. Could you share what you were most satisfied with in your journey as a faculty in the STEM field?

   2.3. What difficulties did you have to confront in being hired and in pursuing tenure track?

   2.4. How did you overcome them? What and who most facilitated you to go through all these barriers?

3. *Educational journey* (from undergraduate to graduate study in STEM fields)

   3.1. What made you retain and complete the academic degree programs in STEM fields?

   3.2. What were the key achievements besides degree attainment in your undergraduate and graduate studies?

   3.3. How did these achievements prepare you in your professional advancement and current leadership?

   3.4. What were key obstacles in your undergraduate and graduate studies in STEM fields?

   3.5. What and who supported you most to overcome these challenges?

Conclusion

What else would you like to share about your educational, professional, and leadership pipeline and the roles of your family, community, institution, and you yourself in each stage of your whole pipeline.

Thank you for your valuable time devoted to my interview.

All the best to your career and personal life!

Bibliography

AAUW. (2016). *Barriers and bias: The status of women in leadership*. American Association of University Women.

Achyuta, A., Namrata, K., & Anant, N. (2018). The Skills to Pay the Bills: Returns to On-the-job Soft Skills Training. *NBER Working Papers, National Bureau of Economic Research, Inc*, *24313*.

Anderson, E., Vanner, C., Wotipka, C., & Kelly, K. (2021). Participation does not equal voice: Gendered Experiences in an Academic and Professional Society. *Comparative Education Review*, *65*(3). https://doi.org/https://doi.org/10.1086/715115

Arcidiacono, P. (2004). Ability sorting and the returns to college major. *Journal of Econometrics*, *121*(1-2), 343-375

Arthur, M., Khapova, S., & Wilderom, C. (2005). Career Success in a Boundaryless Career World. *Journal of Organizational Behavior*, *26*, 177-202. https://doi.org/http://dx.doi.org/10.1002/job.290

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* WH Freeman/Times Books/ Henry Holt & Co.

Bannerji, H. (2000). *The dark side of the nation: Essays on multiculturalism, nationalism and gender*. Canadian Scholars' Press Inc.

Barton, A. C., & Osborne, M. D. (2001). *Teaching science in diverse settings: Marginalized discourses and classroom practice*. Peter Lang Publisher.

Becker, G. (1993). Nobel Lecture: The economic way of looking at behavior. *Journal of Political Economy*, *101*, 385-409.

Bell, D. (1980). Brown v. Board of Education and the Interest-convergence dilema. *Harvard Law Review*, *93*(3), 518-533.

Bennis, W. (2009). *On becoming a leader*. Basic Book.

Bergquist, W. H., & Pawlak, K. (2008). *Engaging the Six Cultures of the Academy*. Jossey Bass.

Bernstein, C., & Volpe, S. (2016). The implications of sex role identity and psychological capital for organisations: A South African study [Article]. *SA Journal of Industrial Psychology*, *42*(1). https://doi.org/10.4102/sajip.v42i1.1311

Blackstone, A. (2014). *Principles of sociological inquiry qualitative and quantitative methods*. Saylor Foundation. http://poznam.mnz.sigov.si/skmp/images/abook_file/sociology_researchmethods.pdf.

Bourdieu, P. (1986). The forms of capital. In J. G. Richardson (Ed.), *Handbook of theory and research for the sociology of education.* Greendwood Press.

Brinkerhoff, R. O. (2003). *The success case method: Find out quickly what's working and what's not*. Berrett-Koehler Publishers, Inc.

Brizee, A., Tompkins, C., Chernouski, L., & Boyle, L. (August 2015). *Critical Race Theory (1970s-present)* https://owl.english.purdue.edu/owl/resource/722/14/

Brown, S. V. (2000). The preparation of minorities for academic careers in science and engineering: How well are we doing? In R. D. G. Campbell, & C. Morrison (Ed.), *Access denied: Race, ethnicity, and the scientific enterprise*. Oxford University Press.

Camacho, M. M., & Lord, S. M. (2013). *The borderlands of education: Latinas in engineering.* Lexington books.

Canul, K. H. (2003). Latina/o cultural values and the academy: Latinas navigating through the administrative role. In C. J & J. L (Eds.), *The majority in the minority: Expanding the representation of Latina/o faculty, administrators and students in higher education* (pp. 167-175). Stylus Publishing.

Carlone, H. B., & Johnson, A. . (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of research in Science Teaching*, *44*(8), 1011–1245. https://doi.org/https://doi.org/10.1002/tea.20237

Carter, S. M., & Little, M. (2007). Justifying knowledge, justifying method, taking action: Epistemologies, methodologies, and methods in qualitative research. *Qualitative Health Research*, *17*(10), 1316-1328. https://doi.org/https://doi.org/10.1177/1049732307306927

Castro, A. R., & Collins, C. S. (2020). Asian American women in STEM in the lab with "White men named John". *Science Education*, *105*, 33-61.

Chen, E., & Hune, S. (2011). Asian American pacific islander women from Ph.D. to campus president: Gains and leaks in the pipeline [Article]. *Diversity in Higher Education*, *10*, 163-190. https://doi.org/10.1108/S1479-3644(2011)0000010012

Chen, G., & Buell, J. (2018). Of models and myths: Asian(Americans) in STEM and the neoliberal racial project. *Race Ethnicity and Education*, *21*(5), 607-625. https://doi.org/10.1080/13613324.2017.1377170

Chi, M. T. H. (1997). Quantifying qualitative analyses of verbal dat: A practical guide. *Journal of the Learning Sciences*, *6*, 271-315.

Chia, R. (2002). The production of management knowledge: Philosophical underpinnings of research design. In D. Partington (Ed.), *Essential Skills for Management Research* (pp. 1-19). SAGE Publications Ltd. https://doi.org/http://dx.doi.org/10.4135/9781848605305.n1

Chin, J. (2012). *Advancing through the ranks: Challenges and transformations*. Nova Science Publishers, Inc. https://www.scopus.com/inward/record.uri?eid=2-s2.0-84892861679&partnerID=40&md5=63711f6f9480914d538def016771cb47

Chin, J. (2013). Introduction: Special section in Asian American Leadership. *Asian American Journal of Psychology,*, *4*(4), 235-239.

Chin, J. (2020). Successfully Navigating Career Paths [Article]. *Women and Therapy*, *43*(1-2), 182-196. https://doi.org/10.1080/02703149.2019.1684677

Chinn, P. (2002). Asian and Pacific Islander women scientists and engineers: A narrative exploration of model minority, gender, and racial stereotypes. *Journal of research in Science Teaching*, *39*(4), 302-323. https://doi.org/https://doi.org/10.1002/tea.10026

Chung, J. R. (2008). *The Journey: Asian American females in higher education administration* (Doctoral Dissertation). University of Southern California.

Clandinin, D. J. (2006). *Handbook of narrative inquiry: Mapping a methodology*. SAGE.

Coil, A. (2017). Why men don't believe the data on gender bias in science. https://www.wired.com/story/why-men-dont-believe-the-data-on-gender-bias-in-science/

Collins, P. H. (2000). Gender, black feminism, and black political economy. *Annals of the American Academy of Political and Social Science*, *568*, 41–53.

Crenshaw, K. (1989). Demarginalizing the intersectionality of race and sex: A Black Feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics. *The University of Chicago Legal Forum*, *140*, 139-167.

Crenshaw, K. (1991). Mapping the margins: Intersectionality, violence against women of color. *Standford Law Review*, *43*(6), 1241-1299.

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. SAGE.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). SAGE.

Creusere, M., Zhao, H., Bond Huie, S., & Troutman, D. R. (2019). Postsecondary education impact on intergenerational income mobility: Differences by completion status, gender, race/ethnicity, and type of major. *The Journal of Higher Education*, *90*(6), 915-939. https://doi.org/10.1080/00221546.2019.1565882

Crotty, M. (1998). *The Foundation of Social Research: Meaning and Perspectives in the Research Process*. SAGE.

Daniel, J. (2012). Choosing Between Non-probability Sampling and Probability Sampling. In *Sampling Essentials: Practical Guidelines for Making Sampling Choices* (pp. 66-80). SAGE.

Davidson, L. (1993). Story telling and schizophrenia: Using narrative structure in phenomenological research. *The Humanistic Psychologist*, *21*(2), 200-220. https://doi.org/http://dx.doi.org.pitt.idm.oclc.org/10.1080/08873267.1993.9976919

DeBlaere, C. (2020). Defining Myself In: My Early Career Journey [Article]. *Women & Therapy*, *43*(1-2), 144-156. https://doi.org/10.1080/02703149.2019.1684672

Delgado, R., & Stefancic, J. (2001). *Critical race theory: An introduction.* New York University Press.

Derks, B., Ellemers, N., Laar, C., & Groot, K. (2011). Do sexist organizational cultures create the queen bee? *British Journal of Social Psychology*, *50*(3), 519–535.

Dill, B. T., & Zambrana, R. E. (2009). *Emerging Intersections: Race, class, and gender in theory, policy, and practice.* Rutgers University Press.

Duero, D. G., & Villegas, F. J. (2018). Phenomenological-narrative contributions to understand the narrative strategies that shape the autobiographical account throughout different moments of the therapeutic process. *Research in Psychotherapy: Psychopathology, Process and Outcome*, *21*(2). https://doi.org/10.4081/ripppo.2018.309

Dweck, C. S. (2007). *Mindset: The new psychology of success* (Updated ed.). Penguin Random House.

Eagly, A. H., & Carli, L. L. (2007). *Through the labyrinth: The truth about how women become leaders*. Havard Business School Press.

Espinosa, L. L., Turk, J. M., Taylor, M., & Chessman, H. M. (2011). Pipelines and pathways: Women of color in undergraduate STEM majors and the college experiences that contribute to persistence. *Harvard Educational Review*, *81*(2), 209–241. https://doi.org/http://doi.org/10.17763/haer.81.2.92315ww157656k3u

Espinosa, L. L., Turk, J. M., Taylor, M., & Chessman, H. M. . (2019). *Race and Ethnicity in Higher Education: A Status Report.* American Council on Education.

Etherington, K. (2007). Ethical research in reflexive relationship. *Qualitative Inquiry*, *13*(5), 599-616.

Fiske, S. T., Cuddy, A. J., & Xu, J. (1999). (Dis)respecting versus (Dis)liking: Status and interdependence predict ambivalent stereotypes of competence and warmth. *Journal of Social Issues*, *55*(3), 473–489.

Fox, M. F., Sonnert, G., & Nikiforova, I. (2009). Successful programs for undergraduate women in science and engineering: Adapting versus adopting the institutional environment. *Research in Higher Education*, *50*(4), https://doi.org/10.1007/s11162-11009-19120-11164.

Godfrey-Smith, P. (2009). *Theory and reality: An introduction to the philosophy of science*. University of Chicago Press.

Goleman, D. (1995). *Emotional Intelligent*. Bantam Books.

Gorard, S., & Taylor, C. (2004). *Combining methods in educational and social research*. Open University Press.

Gray, D. (2004). *Doing Research in the Real World*. SAGE.

Greenfield, N. (2021, June 12). Why are states lining up to ban critical race theory? *University World News*. https://www.universityworldnews.com/post.php?story=20210612085115831

Guba, E., & Lincoln, Y. (1985). *Naturalistic inquiry*. SAGE.

Harding, S. (1987). Introduction: "Is there a feminist method?". In *Feminism and Methodology*. Indiana University Press.

Harding, S. G. (1993). *The "racial" economy of science: Toward a democratic future*. Indiana University Press.

Harding, S. G. (1998). *Is science multicultural?: Postcolonialisms, feminisms, and epistemologies*. Indiana University Press.

Hess, C., Gault, B., & Yi, Y. (2013). *Accelerating Change for Women Faculty of Color in STEM: Policy, Action, and Collaboration.* Institute for Women's Policy Research.

Hoeffel, E., Rastogi, S., Kim, Myoung, & andShahid, H. (March 2012). *The Asian Population: 2010 Census Briefs*. https://www.census.gov/prod/cen2010/briefs/c2010br-11.pdf

Homma-True, R. (2017). Feminist Psychology and Psychotherapy: A Personal Journey [Article]. *Women and Therapy*, *40*(3-4), 427-441. https://doi.org/10.1080/02703149.2017.1241584

hooks, b. (2003). *Teaching community: A pedagogy of hope*. Routledge.

House, R. J., Hanges, P. J., Javidan, M., Dorfman, P. W., & Gupta, V. (Eds.). (2004). *Culture, leadership, and organizations: The GLOBE study of 62 societies*. SAGE.

Hoyt, C. L. S., S. (2016). Gender and leadership. In P. Northouse (Ed.), *Leadership - Theory and practice* (7th ed., pp. 397-426). SAGE.

Huang, B. (2012). *Navigating power and politics: Women of color senior leaders in academe* (Doctoral dissertation). University of Maryland.

Huang, B. (2013). From revolving doors and chilly climates to creating inclusive environments for pre-tenure Asian American faculty. In S. Museus, Maramba, D., & Teranishi, R. (Ed.), *The misrepresented minority: New insights on Asian Americans and Pacific Islanders and their implications for higher education* (pp. 266-280). Stylus Publishing.

Huang, B., Appel, H., & Ai, A. L. (2011). The effects of discrimination and acculturation to service seeking satisfaction for latina and Asian American women: Implications for mental health professions [Article]. *Social Work in Public Health*, *26*(1), 46-59. https://doi.org/10.1080/10911350903341077

Hune, S. (1997). Higher education as gendered space: Asian American women and everyday inequities. In B. Z. Z. C.R. Ronai, & J.R. Feagin (Ed.), *Everyday sexism in the third millennium* (pp. 182-196). Routledge.

Hune, S. (1998). *Pacific American women in higher education: Claiming visibility & voices.* Association of American Colleges and Universities.

Hune, S. (2002). Demographics and diversity of Asian American college students. In C. M. K. M. K. McEwen, A. N. Alvarez, S. Lee, & C. T. H. Liang (Ed.), *Working with Asian American college students* (pp. II-20). Jossey-Bass.

Hune, S. (2006). Asian Pacific American women and men in higher education: The contested spaces of their participation, persistence, and challenges as students, faculty, and administrator. In G. Li, & G. H. Beckett (Ed.), *"Strangers" of the academy: Asian women scholars in higher education* (pp. 15-35). Stylus Publishing, LLC.

Hune, S. (2009). Reflections on linking the global south and Asian American studies [Review]. *Amerasia Journal*, *35*(3), 35-46. https://www.scopus.com/inward/record.uri?eid=2-s2.0-78649278258&partnerID=40&md5=bc38526fd3225068b008fe95bd9061d3

Hune, S. (2011a). Asian American women faculty and the contested space of the classroom: Navigating student resistance and (re) claiming authority and their rightful place. In *Women of color in higher education: Turbulent past, promising future* (Vol. 9, pp. 307-335). Emerald Group Publishing Limited.

Hune, S. (2011b). Asian American women faculty and the contested space of the classroom: Navigating student resistance and (re)claiming authority and their rightful place. In G. Jean-Marie & B. Lloyd-Jones (Eds.), *Diversity in Higher Education* (Vol. 9, pp. 307-335).

Hune, S. (2020a). Introduction: Our histories. In S. H. G. Nomura (Ed.), *Our voices, our histories* (pp. 8-16). New York University Press.

Hune, S. (2020b). Prologue: Taking action: Asian American faculty against injustices in the academy. In K. L. C. Valverde & W. M. Dariotis (Eds.), *Fight the tower: Asian American women scholars' resistance and renewal in the academy.* (pp. 1-28). Rutgers University Press.

Hymowitz, C., & Schellhardt, T. D. (March 24, 1986). The glass-ceiling; Why women can't seem to break the invisible barrier that blocks them from top jobs. *The Wall Street Journal, 57, D1, D4-5, 57*(D1, D4-5). http://pitt.idm.oclc.org/login?url=https://search-proquest-com.pitt.idm.oclc.org/docview/135185178?accountid=14709

Hyun, J. (2005). *Breaking the bamboo ceiling: Career strategies for Asians.* Harper Collins.

Irey, S. (2013). *How Asian American women perceive and move toward leadership roles in community colleges: A study of insider counter narratives.* (Doctoral dissertation). University of Washington.

Jenkins, F. (2009, February 23). The status of Latinas at the five sisters. *Hispanic Outlook*, *19*(10), 18-24.

Johns, M. L. (2013). Breaking the glass ceiling: structural, cultural, and organizational barriers preventing women from achieving senior and executive positions. *Perspectives in health information management*, *10 (Winter*(1e).

Johnson, A., Brown, J., Carlone, H., & Cuevas, A. K. (2011). Authoring identity amidst the treacherous terrain of science: A multiracial feminist examination of the journeys of three women of color in science. *Journal of research in Science Teaching*, *48*(4), 339–366. https://doi.org/https://doi.org/10.1002/tea.20411

Joseph, J. (2012). From one culture to another: Years one and two of graduate school for black women in the STEM fields. *International Journal of Doctoral Studies*, *7*, 125–142. http://ijds.org/Volume7/IJDSv7p125-142Joseph344.pdf

Kang, C., Jo, H., Han, S. W., & Weis, L. (2021, June 17). Complexifying Asian American Student Pathways to STEM Majors: Differences by EthnicSubgroups and College Selectivity. *Journal of Diversity in Higher Education*. https://doi.org/http://dx.doi.org/10.1037/dhe0000326

Kawahara, D. M. (2007). "Making a difference": Asian American women leaders [Article]. *Women and Therapy*, *30*(3-4), 17-33. https://doi.org/10.1300/J015v30n03_03

Kawahara, D. M., Esnil, E. M., & Hsu, J. (2008). Asian American Women Leaders: The Intersection of Race, Gender, and Leadership. In *Women and Leadership: Transforming Visions and Diverse Voices* (pp. 297-313). Blackwell Publishing Ltd. https://doi.org/10.1002/9780470692332.ch14

Kawahara, D. M., Pal, M. S., & Chin, J. L. (2013). The leadership experiences of Asian Americans [Article]. *Asian American Journal of Psychology*, *4*(4), 240-248. https://doi.org/10.1037/a0035196

Kawahara, D. M., Tsong, Y., & Liu, J. (2020). The Long and Winding Road of Being and Becoming [Article]. *Women and Therapy*, *43*(1-2), 74-90. https://doi.org/10.1080/02703149.2019.1684684

Kim, C., Christina, L., Anderson, T., Elizabeth, L., & William, M. (2010). Aisan and female in the white God's world: A qualitative exploration of discrimination in Christian academia. *Mental Health, Religion, & Culture*, *13*(5), 453-465.

Kitano, M. K. (1997). Gifted Asian American women. *Journal for the Education of the Gifted*, *21*, 3–37. https://doi.org/10.1177/016235329702100102

Ko, L. T., Kachchaf, R. R., Hodari, A. K., & Ong, M. (2014). Agency of women of color in physics and astronomy: Strategies for persistence and success. *Journal of Women and Minorities in Science and Engineering*, *20*(2), 171-195. https://doi.org/https://doi.org/10.1615/JWomenMinorScienEng.2014008198

Labov, W., & Waletzky, J. (1967). *Narrative analysis. Essays on the verbal and visual arts* 1966 Spring Meeting of the Ameican Ethnological Society, Seattle.

Ladson-Billings, G. (1998). Just what is critical race theory and what's it doing in a nice field like education? *Qualitative Studies in Education*, *11*(1), 7-24.

Le, B. P. (2016). Choosing to lead: Success characteristics of Asian American academic library leaders [Article]. *Library Management*, *37*(1-2), 81-90. https://doi.org/10.1108/LM-05-2015-0029

Lee, J., Ramakrishnan, K., & Wong, J. (2018). Accurately Counting Asian Americans Is a Civil Rights Issue. *The ANNALS of the American Academy of Political and Social Science*, *677*(1), 191-202. https://doi.org/10.1177/0002716218765432

Lee, J., & Zhou, M. (2015). *The Asian American Achievement Paradox*. SAGE.

Lee, S. (2018). *Servant leadership: A phenomenological study of Southeast Asian women's career advancement experiences in community colleges*. (Doctoral dissertation). California State University Stanislaus.

Li, G., & Beckett, G. (2006). *"Strangers" of the academy: Asian women scholars in higher education*. Stylus Publishing, LLC.

Li, P. (2014). Recent developments: Hitting the ceiling: An examination of barriers to success for Asian American women. *Berkeley J. Gender L. & Just.*, *29*. http://scholarship.law.berkeley.edu/bglj/vol29/iss1/5

Liang, J., & Peters-Hawkins, A. (2017). "I Am More Than What I Look Alike": Asian American Women in Public School Administration [Article]. *Educational Administration Quarterly*, *53*(1), 40-69. https://doi.org/10.1177/0013161X16652219

Lipsitz, G. (2006). *The possessive investment in whiteness: How white people profit from identity politics*. Temple University Press.

López, G. R., & Parker, L. (Ed.). (2003). *Interrogating racism in qualitative research methodology*. Peter Lang Publishers.

Malcom, L., & Malcom, S. (2011). The double bind: The next generation. *Harvard Educational Review*, *81*(2), 162–172. https://doi.org/http://doi.org/10.17763/haer.81.2.a84201x508406327

McClelland, D. C., & Burnham, D. H. (January-February 1995). Power is the great motivator. *Harvard Business Review*, 126-139.

Melin, J. L., & Correll, S. J. (2022). Preventing soft skill decay among early-career women in STEM during COVID-19: Evidence from a longitudinal intervention. *Proceedings of the National Academy of Sciences*, *119*(32), e2123105119. https://doi.org/doi:10.1073/pnas.2123105119

Merriam, S. B. (1988). *Case Study Research in Education: A Qualitative Approach*. Jossey-Bass Publishers.

Merriam, S. B. (2009). *Qualitative Research- A Guide to Design and Implementation*. Jossey-Bass.

Merton, R. (1988). The Matthew effect in science, II: Cumulative advantage and the symbolism of intellectual property. *ISIS*, *79*, 606-623.

Miles, M., Huberman, M., & Saldana, J. (2020). *Qualitative data analysis – A methods sourcebook*. SAGE.

Milner IV, R. (2007). Race, culture, and researcher positionality: working through dangers seen, unseen, and unforeseen. *Educational Researcher*, *36*(7), 388-400. https://doi.org/10.3102/0013189X07309471

Montas-Hunter, S. S. (2012). Self-Efficacy and Latina Leaders in Higher Education. *Journal of Hispanic Higher Education*, *11*(4), 315-335. https://doi.org/https://doi.org/10.1177/1538192712441709

Monzó, L. D., & Hoo, S. S. (2014). Translating the academy: Learning the racialized languages of academia [Article]. *Journal of Diversity in Higher Education*, *7*(3), 147-165. https://doi.org/10.1037/a0037400

Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences*, *109*(41), 16474–16479.

Mukkamala, S., & Suyemoto, K. L. (2018). Racialized sexism/sexualized racism: A multimethod study of intersectional experiences of discrimination for Asian American women [Article]. *Asian American Journal of Psychology*, *9*(1), 32-46. https://doi.org/10.1037/aap0000104

Nader, L. (1996). Introduction. In L. Nader (Ed.), *Naked science: Anthropological inquiry into boundaries, power, and knowledge* (pp. 1-28). Routledge.

NCES. (2009). *The statistics in brief 2009*. National Center for Education Statistics.

NCES. (February 2019). *Status and Trends in the Education of Racial and Ethnic Groups*. National Center for Education Statistics. (Indicator #26: Stem degrees, Issue). https://nces.ed.gov/programs/raceindicators/indicator_reg.asp

Ng, F. (2017). *Asian American women leaders' strategies for negotiating intersectional discrimination related to racism and sexism* (Publication Number 10637226.) (Doctoral dissertation). University of Massachusetts Boston.

Ngunjiri, F. W., & Hernandez, K.-A. C. (2017). Problematizing Authentic Leadership: A Collaborative Autoethnography of Immigrant Women of Color Leaders in Higher Education. *Advances in Developing Human Resources*, *19*(4), 393-406. https://doi.org/10.1177/1523422317728735

Nguyen, D. (2020). Asian American women in the academy: Multiple success case study of their leadership labyrinths and practices. *American Journal of Qualitative Research*, *4*(3), 14-44. https://doi.org/10.29333/ajqr/8467

Nigar, N. (2020). Hermeneutic Phenomenological Narrative Enquiry: A Qualitative Study Design. *Theory and Practice in Language Studies*, *10*(1), 10-18. https://link.gale.com/apps/doc/A611678846/LitRC?u=upitt_main&sid=bookmark-LitRC&xid=71a32f8e

Northouse, P. (2016a). Culture and leadership. In P. Northouse (Ed.), *Leadership - Theory and practice* (7th ed., pp. 427-466). SAGE.

Northouse, P. (2016b). *Leadership: Theory and practice* (7th ed.). SAGE.

NSF. (2013). *Women, minorities, and persons with disabilities in science and engineering: 2013*. https://www.nsf.gov/statistics/

NSF. (2015). *Women, minorities, and persons with disabilities in science and engineering: 2015*. https://www.nsf.gov/statistics/

O'Malley, B. (2021, June 18). UNESCO calls for more investment, more equity in science. *University World News*. Retrieved 2021, June 24, from https://www.universityworldnews.com/post.php?story=20210618082602135

Oakley, J. G. (2000). Gender-based barriers to senior management positions: Understanding the scarcity of female CEOs. *Journal of Business Ethics*, *27*, 321–334. https://doi.org/doi:10.1023/A:1006226129868

Ong, M. (2002). *Against the current: Women of color succeeding in physics*. (Order No. 3082349). Available from ProQuest Dissertations & Theses Global. (304803810). http://pitt.idm.oclc.org/login?url=https://www.proquest.com/dissertations-theses/against-current-women-color-succeeding-physics/docview/304803810/se-2.

Ong, M. (2005). Body projects of young women of color in physics: Intersections of gender, race, and science. *Social Problems*, *52*(2), 593–617. https://doi.org/https://doi.org/10.1525/sp.2005.52.4.593

Ong, M. (2011). Broadening participation: The status of women of color in computer science. *Communications of the ACM*, *54*(7), 32-34. https://doi.org/https://doi.org/10.1145/1965724.1965737

Ong, M., Ko, L. T., & Hodari, A. K. (2016). Agency of women of color in STEM: Individual and institutional strategies for persistence and success. In E. H. Branch (Ed.), *Pathways, potholes, and the persistence of women in science: Reconsidering the pipeline* (pp. 183-195). Lexington Books.

Ong, M., Smith, J. M., & Ko, L. T. (2018). Counterspaces for women of color in STEM higher education: Marginal and central spaces for persistence and success. *J Res Sci Teach*, *55*, 206-245. https://doi.org/https://doi.org/10.1002/tea.21417

Ong, M., Wright, C., Espinosa, L., & Orfield, G. (2011a). Inside the double bind: A synthesis of empirical research on undergraduate and graduate women of color in science, technology, engineering, and mathematics. *Harvard Educational Review*, *81*, 172-209.

Ong, M., Wright, C., Espinosa, L., & Orfield, G. (2011b). Inside the double bind: A synthesis of empirical research on undergraduate and graduate women of color in science, technology, engineering, and mathematics. *Harvard Educational Review*, *81*(2), 172–208.

Ong, T., & MEC. (1979). *Report on Moral Education 1979*. Singapore National Printers.

Paik, S. J., Choe, S. M. M., Otto, W. J., & Rahman, Z. (2018). Learning About the Lives and Early Experiences of Notable Asian American Women: Productive Giftedness, Childhood Traits, and Supportive Conditions [Article]. *Journal for the Education of the Gifted*, *41*(2), 160-192. https://doi.org/10.1177/0162353218763927

Park, Y., Maramba, D., & Hernandez, X. (2014). *Asian Americans in higher education: Charting new realities* (Vol. 40). John Wiley & Sons, Inc.

Patterson, C. (2018). Constructing narrative and phenomenological meaning within one study. *Qualitative Research Journal*, *18*(3), 223-237. https://doi.org/10.1108/QRJ-D-17-00033

Petitjean, P., Jami, C., & Moulin, A. M. (1992). *Science and empires: Historical studies about scientific development and European expansion* (Vol. 136). Kluwer Academic Publishers.

Pittman, C. T. (2010). Race and gender oppression in the classroom: The experiences of women faculty of color with white male students. *Teaching Sociology*, *38*, 183-196.

Porter, M. K., & Fahrenwald, C. (2022). Reframing Constructive Spaces for Women in Educational Leadership: A Transatlantic Study. In V. Showunmi, P. Moorosi, C. Shakeshaft, & I. Oplatka (Eds.), *The Bloomsbury Handbook of Gender and Educational Leadership and Management* (pp. 24–37). Bloomsbury Academic. https://doi.org/http://dx.doi.org/10.5040/9781350173187.0011

PRC. (2012). *The rise of Asian Americans.* Pew Research Center. http://www.pewsocialtrends.org/files/2012/06/SDT-The-Rise-of-Asian-Americans-Full-Report.pdf

PRC. (2018). *Women and men in STEM often at odds over workplace equity*. Pew Research Center.

Principe, L. (2011). *The scientific revolution: A very short introduction* (Vol. 266). Oxford University Press.

Prinster, R. (April 22, 2016). Asians and Pacific Islanders Are Scarce in Higher Ed Leadership, but a Strong Community Is Working to Change That. *Insight into Diversity*. Retrieved Oct 1, 2018, from http://www.insightintodiversity.com/asians-and-pacific-islanders-are-scarce-in-higher-ed-leadership-but-a-strong-community-is-working-to-change-that/

Purdie-Vaughns, V., & Eibach, R. P. (2008). Intersectional invisibility: The distinctive advantages and disadvantages of multiple subordinate-group identities. *Sex Roles: A Journal of Research*, *59*(5-6), 377–391. https://doi.org/https://doi.org/10.1007/s11199-008-9424-4

Rathgeber, E. M. (1990). WID, WAD, GAD: Trends in research and practice. *The Journal of Developing Areas*, 489–502.

Razack, S. (1998). *Looking white people in the eye*. University of Toronto Press.

Reeves, M. (2014). *Leadership journeys of Asian women in US higher education: A narrative research study exploring leadership development experiences through critical reflection* (Doctoral dissertation). Northeastern University.

Richard, J. (n.d). *7 soft skills you need for career success.* https://www.monster.ca/careeradvice/article/soft-skills-in-demand

Riessman, C. K. (2008). *Narrative methods for the human sciences*. SAGE.

Robinson, K. (1996). Of mail-order brides and 'boys own tales': Representations of Asian-Australian marriages. *Feminist Review*, *52*, 53–68. https://doi.org/doi:10.1057/fr.1996.7

Saldana, J. (2016). *The coding manual for qualitative researchers* (4th ed.). SAGE.

Sanchez, P., Hucles, P., Sanchez-Hucles, J., & Mehta, S. (2007). Increasing diverse women leadership in corporate America: Climbing concrete walls and shattering glass ceilings! In B. L. J. L. Chin, J. K. Rice, & J. Sanchez-Hucles (Ed.), *Women and leadership: Transforming vision and diverse voices* (pp. 228-244). Blackwell.

Sanchez-Hucles, J., Dryden, A. E., & Winstead, B. (2012). The Multiple Identities of Feminist Women of Color: Creating a New Feminism? In *Navigating Multiple Identities: Race, Gender, Culture, Nationality, and Roles*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199732074.003.0006

Sanchez-Hucles, J. V., & Davis, D. D. (2010). Women and Women of Color in Leadership: Complexity, Identity, and Intersectionality [Article]. *American Psychologist*, *65*(3), 171-181. https://www.scopus.com/inward/record.uri?eid=2-s2.0-77950366974&doi=10.1037%2fa0017459&partnerID=40&md5=0635a64cbb5b55df687b0b8399a05259

Schultz, T. (1961). Investment in human capital. *American Economic Review*, *51*, 1-17.

Shanahan, M. (2009). Identity in science learning: Exploring the attention given to agency and structure in studies ofidentity. *Studies in Science Education*, *45*(1), 43-64.

Sorensen, B. (1998). *Women and Post-Conflict Reconstruction: Issues and Sources*. UNRISD.

Sosnowski, N. H. (2002). *Women of color staking a claim for cyber domain: Unpacking the racial/ gender gap in science, mathematics, engineering and technology (SMET)*. UMass Amherst.

Stanley, C. (2007). When counter narratives meet master narratives in the journal editorial review process. *Educational Researcher*, *36*(1), 14-21.

Steinbugler, A. C., Press, J. E., & Dias, J. J. (2006). Gender, Race, and Affirmative Action:Operationalizing Intersectionality in Survey Research. *Gender & Society*, *20*(6), 805-825. https://doi.org/10.1177/0891243206293299

Stephens, N., Brannon, T., Markus, H., & Nelson, J. (2015). Feeling at home in college: Fortifying school-relevant selves to reduce social class disparities in higher education. *Social Issues and Policy Review*, *9*(1), 1-24. https://spssi-onlinelibrary-wiley-com.pitt.idm.oclc.org/doi/pdfdirect/10.1111/sipr.12008

Stephens, N., Markus, H., & Fryberg, S. (2012). Social class disparities in health and educa- tion: Reducing inequality by applying a sociocultural self model of behavior. *Psychological Review*, *119*, 723-744.

Sulé, V. T. (2009). Oppositional stances of black female graduate students: Perspectives from social and natural sciences. In M. F. Howard-Hamilton (Ed.), *Standing on the outside looking in: Underrepresented students' experiences in advanced degree programs.* (pp. 147-167). Stylus Publishing.

Takaki, R. (1998). *Strangers from a different shore: A history of Asian Americans*. Little Brown.

Tate, E. D., & Linn, M. (2005). How does identity shape the experiences of women of color engineering students? *Journal of Science Education and Technology*, *14*(5-6), 483–493. https://doi.org/https://doi.org/10.1007/s10956-005-0223-1

Taylor, E., Gillborn, D., & Ladson-Billings, G. (Ed.). (2009). *Foundations of cirtical race theory in education.* Routledge.

Tesch, R. (1994). The contribution of a qualitative method: Phenomenological research. In C. V. M. Langenbach, $ L. Aagaard (Ed.), *An introduction to educational research*. Allyn and Bacon.

Thomas, K., & Thomas, G. (2003). *Power Base Inventory*. CPP.

Tierney, W. G., Campbell, C. D., & Sanchez, G. J. (2004). *The road ahead: Improving diversity in graduate education*. Center for Higher Education Policy Analysis, Rossier School of Education, University of Southern California.

Torne, J. (2013). *Asian American women leaders in the Pacific coast: thier pathway to presidency in two-year institutions.* (Doctoral dissertation). University of San Francisco.

Turner, V. S. C. (2002). Women of color in academe: Living with multiple marginality. *The Journal of Higher Education,*, *73*(1), 74-93.

USCensus. (2010). *US Census 2010.* United States Census Bureau.

USCensus. (2020). *US Census 2020*. United States Census Bureau.

Valenzuela, Y. (2006). *Mi fuerza/my strength: The academic and personal experiences of Chicana/ Latina transfer students in math and science. (Order No. 3243278). Available from ProQuest Dissertations & Theses Global. (304916976). http://pitt.idm.oclc.org/login?url=https://www.proquest.com/dissertations-theses/mi-fuerza-my-strength-academic-personal/docview/304916976/se-2.*

Valverde, K. L. C., & Dariotis, W. M. (2019). *Fight the tower: Asian American women scholars' resistance and renewal in the academy.* (K. L. C. Valverde & W. M. Dariotis, Eds.). Rutgers University Press.

Varma, R. (2002). Women in information technology: A case study of undergraduate students in a minority-serving institution. *Bulletin of Science, Technology, and Society,*, *22*(4), 274–282. https://doi.org/https://doi.org/10.1177/0270467602022004003

Varma, R., Prasad, A., & Kapur, D. (2006). Confronting the "socialization" barrier: Crossethnic differences in undergraduate women's preference for IT education. In W. A. J. M. Cohoon (Ed.), *Women and information technology: Research on underrepresentation* (pp. 301–322). MIT Press.

Vue, R., & Newman, C. (2010). Critical race theory in education research. *International Encyclopedia of Education*, 779-786.

Wellington, S., Kropf, M., & Gerkovich, P. (2003). What's holding women back. *Harvard Business Review*, *81*, 18-19.

West, C. M. (1995). Mammy, Sapphire, and Jezebel: Historical images of Black women and their implications for psychotherapy. *Psychotherapy*, *32*, 458-466.

Williams, J. C., Phillips, K. W., & Hall, E. V. (2016). Tools for change: Boosting the retention of women in the stem pipeline [Article]. *Journal of Research in Gender Studies*, *6*(1), 11-75. https://doi.org/10.22381/JRGS6120161

Williams, M., & Mary, T. (1996). *Introduction to the philosophy of social research*. Routledge.

WOCN. *Term: Women of color*. Women of Color Network. https://wocninc.org/about/

Wu, L., & Jing, W. (2011). Asian Women in STEM Careers: An Invisible Minority in a Double Bind. *Issues in Science and Technology*, *28*(1), 82-87.

Wu, M. L. (2015). Partners for progress and prosperity: A personal and professional journey. In H. N. Cheng, M. L. Wu, & B. D. Miller (Eds.), *ACS Symposium Series* (Vol. 1195, pp. 237-263). Washington D.C: American Chemical Society.

Yazilitas, D., Svensson, J., Vries, G., & Saharso, S. (2013). Gendered study choice: a literature review. A review of theory and research into the unequal representation of male and female students in mathematics, science, and technology. *Educational Research and Evaluation:An International Journal on Theory and Practice,*, *9*(6), 525-545. https://doi.org/DOI: 10.1080/13803611.2013.803931

Zaleznik, A. (1992). Managers and leaders: Are they different? *Harvard Business Review*, *70*(2), 126-135.