



DIVERSIFYING THE PIPELINE TO AVIATION MAINTENANCE EDUCATION AND CAREER PATHWAYS

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SECTION I

OVERVIEW

The Office of Community College Research and Leadership (OCCRL), in partnership with the Corporation for a Skilled Workforce (CSW) and leading provider of aviation services for governmental and commercial aviation markets, AAR Corp., through funding from the Lumina Foundation explored current practices for broadening participation in aviation fields. In particular, we assessed the landscape in aviation maintenance and technician programs of study toward understanding efforts to advance diversity in the field through pathways to aviation education. The following report highlights trends in diversity, equity, and inclusion (DEI) efforts relative to best practices in recruitment, teaching, learning, retention, and completion for a more diverse group of students in community college/CTE programs. Hence, we sought to identify any lessons and/or gaps in the research as it pertains to aviation and skilled trades-related programs. Beyond the literature through fieldwork, we interviewed faculty and staff at four institutions, seeking to understand the successes/challenges in recruiting and retaining more diverse students via current aviation program marketing materials and select curriculum through an equity lens to identify current activities, promising practices, and recommendations for advancing equitable pathways.

Background/Landscape

The field of aviation is expected to grow significantly over the following decades to come. Boeing (2016) predicts the demand of over 600,000 pilots, 650,000 technicians, and 800,000 cabin crew members through 2035. Despite the growing demand for aviation workers,

there is a lack of diversity of women and racially underrepresented (i.e., Black, Hispanic, Asian, and Native American) persons across the United States (U.S.) aviation fields (Gorlin & Bridges, 2021; Ison et al., 2016). In comparison, White males have historically participated across aviation fields (National Research Council, 1997, there is a nearly “nonexistent” representation of women and racial minorities within these fields (Ison et al., 2016, p. 26).

It is crucial to identify strategies for aviation programs to improve the retention and success of these underrepresented groups’ pursuit of aviation careers. This summary report is presented in three sections. The first part offers a review of literature highlighting the landscape of common practices in recruitment, teaching, learning, retention and completion of underrepresented groups. In addition, section one outlines recent concerns acknowledged in the extant literature regarding aviation pathways. The section that follows offers valuable strategies for various stakeholders to promote better outcomes for underrepresented students.

Recruitment Practices in Aviation Education

There are two points of entry into aviation careers for underrepresented groups: civilian (i.e., 157 nonprofit or for-profit postsecondary institutions) and military programs (Kowarski, 2020; Young et al., 2021), and there are benefits and limits to each option. Though one may receive government-sponsored training for an aviation career via the military, there are significant physical and mental demands to overcome during training as well as military service requirements that one must complete after training. To become a pilot, students would

have to complete a bachelor's degree before entry; however, to become an aviation mechanic or air traffic controller, students would have to complete a high school diploma or its GED equivalent (U.S. Air Force, n.d.-a, n.d.-b, n.d.-c).

Of the civilian programs, students have the option of enrolling in aviation programs across two- and four-year postsecondary institutions, including those available at historically Black colleges and universities (HBCUs), though it remains unclear if these same opportunities are available for students attending other minority-serving institutions (MSIs). After bachelor's degree completion for becoming pilot, prospective pilot students also must obtain licenses and ratings from the FAA (Federal Aviation Administration) and complete thousands of flight-training hours to become competitive pilot applicants; whereas, for aviation mechanics, prospective students must complete academic training or on-the-job training to obtain their aviation mechanic certificate (Federal Aviation

Administration, 2021). In becoming an air traffic controller, prospective students must undergo a screening and selection process, including an assessment of personality, attitude, motivations, and expertise. They also must be willing to move to a FAA facility and obtain several years of work experience, a bachelor's degree, or a combination of postsecondary education and work experience equal to three years. Despite the array of civilian-entry opportunities, it remains unclear how long is required to complete degree programs, how much debt individuals incur from their studies, and how likely one will obtain a high-earning salary after graduation (Kowarski, 2020; Seligson, 2019).

Aviation stakeholders implement recruitment approaches (aviation outreach programs and industry-university partnerships) to broaden participation in these aviation careers. The U.S. has long struggled with adequately preparing K-12 students in science, technology, engineering, and mathematics (STEM) areas





(U.S. Department of Transportation & Federal Aviation Administration, 2018). This lack of sufficient STEM preparation has troubled interest, access, and achievement along STEM pipelines, including the aviation pipeline. Recognizing this, the FAA established the Aviation and Space Education (AVSED) Program in 1961, providing hands-on STEM enrichment and engagement, specific to aviation fields, to over 24,000 K-12 youth across the U.S. through 2018. Since 2014, AVSED has housed over 1,000 events encouraging young people to explore long-term aviation careers. Several studies support the impact of STEM outreach programs on prospective STEM students' STEM academic achievement, interests, career plans, majors, STEM retention, undergraduate

psychosocial goals, and undergraduate internships and engagement (Burack et al., 2019; Crutchfield et al., 2011; Findley-Van Nostrand & Pollenz, 2017; Kitchen et al., 2018; Winkleby et al., 2009; Yelamarthi & Mawasha, 2008; Zhe et al., 2010). Altogether, intentional, well-designed outreach programs may improve the interests and pursuits of underrepresented groups in aviation careers. Outreach programs are a viable option for aviation stakeholders to consider.

With the extraordinary demands of the aviation industry, postsecondary institutions have partnered with industry partners to subsidize education costs. Thus, alleviating the financial burdens on prospective students provide

an industry-based internship opportunity for training experience, and offer post-graduate employment opportunities contingent on academic and internship performance (Hubbard & Lopp, 2015). These partnerships provide students with opportunities to connect professionally with aviation experts as well as develop technical skills and expertise through real-world, hands-on opportunities. In a case study, an industry partner noted benefitting up to \$5 million through integrating and implementing industry-university partnerships. Additionally, industry partners expressed interest in continuing education and furthering skills innovation and creativity. Today, strategic industry-university partnerships with aviation programs at two- and four-year HBCUs and MSIs advance the participation of underrepresented groups in aviation careers. Aviation stakeholders may want to evaluate existing industry-university partnerships for promoting and satisfying the long-term diversification, equity, and access needs of aviation fields.

Prospective aviation students have known military and civilian opportunities for pursuing aviation careers. However, these same students pursuing civilian options have unclear and sometimes difficult journeys in affording their degree program, completing

their degree program promptly, and obtaining a high-earning salary after earning an aviation degree. Considering this, aviation outreach programs and industry-university partnerships prove to be vital channels for broadening participation in aviation careers. It is important to evaluate existing aviation program offerings and marketing materials to streamline aviation education delivery, assess the financial burdens students incur through their pursuit of an aviation credential, and determine additional partnerships and recruitment strategies (National Research Council, 1997). Targeted efforts such as these will continue to spark interest and clarify successful ways to navigate aviation careers.

Mentorship

Many studies have also captured the importance of mentoring in STEM education (Mayhew et al., 2016). Mentoring can lead students toward academic success, and interactions from these relationships can lead to increased critical thinking skills, positive regard, and higher self-confidence toward learning (Allen & Eby, 2010; Mayhew et al., 2016). These outcomes have led many postsecondary institutions to implement mentoring opportunities for undergraduate students (Allen & Eby, 2010). Like peer-to-peer experiences, mentoring experiences

IN A CASE STUDY, AN INDUSTRY PARTNER NOTED BENEFITTING UP TO **\$5 MILLION** THROUGH INTEGRATING AND IMPLEMENTING INDUSTRY-UNIVERSITY PARTNERSHIPS.

can be in other STEM-learning opportunities (e.g., postsecondary institution, STEM PCP, STEM-specific comprehensive program, etc.) (Institute of Medicine, 2011). Since students may interact with others who can serve as their mentor along their STEM path (e.g., STEM advisors and professors and industry-partner internship managers, etc.), it remains unclear which students go without a mentor and what the quality is of the mentor-mentee relationship. Like the other approaches, this can prove to be a lengthy and costly program unless postsecondary educators consider an existing infrastructure to do this (e.g., opt-in mentorship program, mentorship expectations and guidelines, etc.).

Academic, Curricular, and Social Supports

Intentional opportunities for underrepresented students can promote students' academic and social integration (Institute of Medicine, 2011). Wang (2020) discusses various strategies to improve STEM student momentum, from redesigning advising practices to better meet varying and individual demands of students to embracing ongoing proactive advising practices and improving how advisors work with postsecondary faculty. Redesigning advising across postsecondary institutions to be more flexible in advising delivery can better support students with varying work schedules and role demands, and it can create additional social and structural networks to show that postsecondary institutions care about student progression in coursework and their personal goals.

Beyond academic support, postsecondary schools can also design undergraduate experiences that ensure students obtain the necessary skills and experiences to thrive in STEM. Today's undergraduate students have many different opportunities to engage in research during their postsecondary experiences, either as course-based undergraduate research, independent study (e.g., Gilmore et al., 2015), a summer research internship, or a living-learning community providing a research-based experience (Laursen et al., 2010). Via STEM-specific living-learning communities, study groups, or other social integration activities, students, when their identities intersect, can share the unique set of problems they face, coping strategies, opportunities, and resources with one another (Wang, 2020). Rather than managing their STEM journeys alone, students can thrive from the collective knowledge and awareness of navigating STEM pipelines at their respective schools. These peer-to-mentor and peer-to-peer experiences can be embedded in many postsecondary learning settings (Institute of Medicine, 2011). The absence of these integrated activities can further hinder students' STEM identities and limit real-world experiences that enhance student knowledge and interests in STEM fields.

A woman wearing a yellow hard hat and a high-visibility safety vest is looking upwards and to the right. She is holding a clipboard and a pen. The image has a blue overlay.

SECTION II

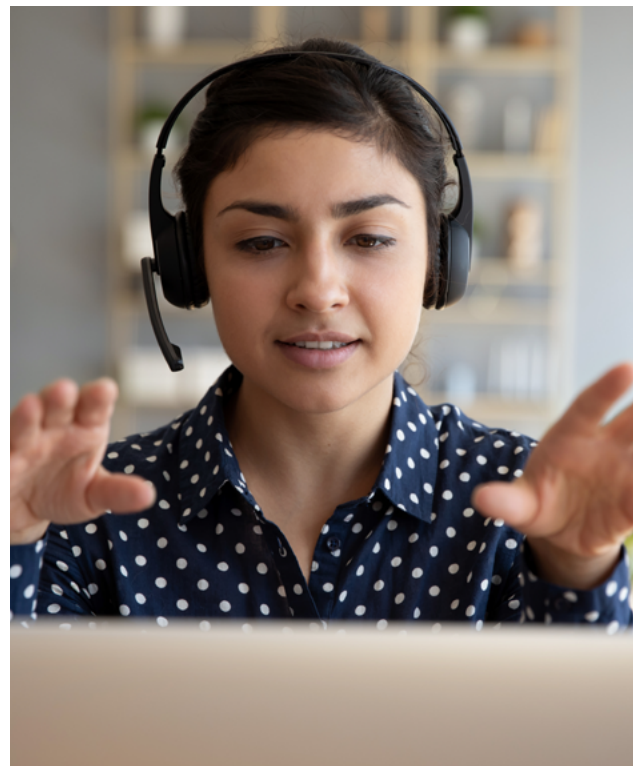
FIELD STUDY

This exploratory field study aims to identify opportunities and challenges associated with advancing diversity and equity in aviation maintenance programs. This project is informed by established best practices in recruitment, teaching, learning, retention, and completion that advance support for diverse groups of students in skilled trades within career and technical education (CTE) pathways. This summary report of findings identifies how the practices and outcomes of the aviation maintenance programs at the selected sites align with the larger research on best practices toward establishing equitable outcomes for underrepresented populations in the field of aviation maintenance, including individuals that identify as Black, Latinx, female, and/or veteran. According to the U.S. Bureau of Labor Statistics (2021), the number of projected jobs for aircraft and avionics equipment mechanics and technicians in 2020 was a little over 151,000, with the job outlook expected to rise by 11% in the next decade. Moreover, the 2020 median wage for this occupation is over \$66,000 annually (U. S. Bureau of Labor Statistics, 2021). This creates a prime opportunity for education providers to diversify the pipeline of workers toward creating educational and economic opportunities for historically marginalized populations.

METHODS

The following is one component of a larger field study in collaboration with the Corporation for a Skilled Workforce and AAR Corp., funded by the Lumina Foundation. The data-collection methods for this field research were varied and included a mix of secondary data, surveys, and case study. In tandem, we engaged in document

analysis of aviation program marketing materials and curriculum, in addition to the facilitation of individual semi-structured interviews, focus groups, and pre-interview questionnaire responses were collected with interested faculty, staff, and administration, from three out of four program sites identified in conjunction with CSW and AAR. The recruitment began with an introductory meeting with program coordinators and administrators from each site. Next, OCCRL worked with the primary contact at each location to satisfy institutional research requirements and disseminate a recruitment message to eligible participants. Prior to taking part in interviews, participants completed a questionnaire to gauge perceptions of diversity, equity, and inclusion initiatives (see Appendix A). Interviews and focus groups were guided by the interview protocol developed by OCCRL (see Appendix B) to further explore perceptions and experiences. Also of note: Sample course



materials (course syllabi and class lecture presentation slides) were shared specifically relative to sheet metal curriculum as one core class to assess the extent to which aviation education programming seeks to create an equitable learning environment (see Appendix C).

Each interview was facilitated virtually by at least two research team members via the Zoom platform. Interviews ranged from a half hour to over an hour. All individual and focus group interviews were transcribed for analysis purposes. OCCRL used pseudonyms to protect the identity of participants. Thus, the findings will include the position of the respondents, but no particular name, location, or demographic descriptors will be used. The analysis began with open coding by our research team toward the identification of emergent themes that aligned with the evaluation questions guiding the project. Through our open coding, emergent themes included recruitment, barriers, and promising practices. The triangulation of multiple data sources across sites, application of thick description to present the findings, and peer debriefing among the OCCRL research team, as well as the larger partnering organizations, were utilized to establish study validity and reliability by the detailed review of transcripts and ongoing debriefing sessions among the OCCRL research team throughout the processes of data collection and analysis, in order to establish intercoder agreement (Creswell, 2014).

Sites

The initial four sites were identified in conjunction with AAR and CSW, given their potential to inform the study, and included Olive

Harvey College, an institution within the City Colleges of Chicago system in Chicago, Illinois; Aviation Institute of Maintenance (AIM) in Norfolk, Virginia; Vincennes University Aviation Technology Center in Indianapolis, Indiana; and Rock Valley College in Rockford, Illinois. Despite receiving institutional approval and multiple recruitment attempts, including a virtual meeting with campus representatives, there were no respondents from Rock Valley College. Therefore, this report only includes data and descriptions from the three sites with study participants.

Aviation Institute of Maintenance (AIM)- Norfolk, Virginia

The Aviation Institute of Maintenance (AIM) in Norfolk, Virginia, is a private, for-profit, two-year institution (National Center for Education Statistics, 2022a). AIM has 13 aviation maintenance schools (Aviation Institute of Maintenance, 2021a). The Norfolk location has an enrollment of 230 students, with just over 60% of them attending full time (National Center for Education Statistics, 2022a). Demographically, the student body is identified as 87% male and 13% female, with the largest racial/ethnic groups being white (38%) and Black/African American (36%) students (National Center for Education Statistics, 2022a). This location is in close proximity to multiple military installations, including the world's largest naval base (Aviation Institute of Maintenance, 2021b).

Olive Harvey College, City Colleges of Chicago-Chicago, Illinois

Olive Harvey College, part of the City Colleges of Chicago system, is a two-year public community college designated as a predominantly Black

institution, with an enrollment of 1,955 students. Over 60% of students attend part time (Center for MSIs, 2020; National Center for Education Statistics, 2022b). The student body is 71% female and 29% male, with 69% of students identifying as Black/African American and 24% identifying as Hispanic/Latino (National Center for Education Statistics, 2022b). The Aviation Futures Training Center opened in 2019 as an extension of Olive-Harvey College's Transportation, Distribution and Logistics (TDL) Center (AAR, 2018).

Vincennes University Aviation Technology Center - Indianapolis, Indiana

The Indianapolis Aviation Technology Center is affiliated with Vincennes University, a public four-year institution that primarily awards associate's degrees located in Vincennes, Indiana (National Center for Education Statistics, 2022c; Vincennes University, 2022). The university enrolls 16,048 students overall, with just over 70% attending on a part-time basis. Student demographics are split nearly evenly by gender, and the two largest racial/ethnic groups are identified as white (58%) and Hispanic/Latino (24%) (National Center for Education Statistics, 2022c).

Participants

Across the sites, 17 participants completed the pre-interview questionnaire. Interviews were facilitated individually with five participants and via focus groups with the remaining 12 participants. Eight respondents identified as faculty, eight as administrator/staff, and only one as a current student. Eleven participants identified as male and six identified as female. The survey allowed for open-ended responses

for race/ethnicity with participants naming the following: Black or African American (eight), white or Caucasian (seven), Black/Hispanic (one), and human (one). Eight participants also identified as having served in the U.S. Armed Forces. Given the small number of participants and the size of the programs, information on participants by site is not provided to protect anonymity. However, it should be noted that program faculty were more likely to be white and male while those in administrative or support staff roles were more likely to be female and/or from a racially minoritized group.

FINDINGS

Outreach and Recruitment

Broad recruitment efforts

Across each of the sites, the faculty, staff, and students discussed a plethora of recruitment methods currently being practiced—from visiting schools within the community, to having students travel on the site to tour the facility, to televised or social media marketing. The overall goal of the institution's recruitment was to raise awareness of the vast opportunities present within the aviation industry. Participants at one site emphasized their school's presence in the community through offering summer camps to prospective future students at their local public schools, as well as representation at local air shows, which was highlighted by other institutions as a form of community engagement. Faculty were active in providing tours of the facility for various community groups or utilizing portable props such as engines when engaging audiences in other locations. A faculty member from another site also explained how they provide experimental aircraft demonstrations in the community. However, most faculty and

staff shared that much of the marketing and recruitment responsibilities are designated to a specific marketing department or person. In discussing marketing and recruitment outreach, a staff member commented, “We teach a little bit about aviation and try to get them excited and show them that there is a career path here available for them, you know, instead of going to college or, or whatever else.”

Bolstering Partnerships

Participants also emphasized the role of dual credit programs and industry partnerships to stimulate recruitment efforts. One faculty member stated that the university is “Offering a dual credit program to high schools in the area to teach them the general maintenance portion of an AMP certification.” Meanwhile, a staff member at another institution stated, “In the fall, we’ll start a dual enrollment aviation program.” These programs are essential in creating access to the aviation field. One site also discussed the importance of industry funding to support student attendance, particularly for underrepresented populations, and a partnership with a local organization dedicated to alleviating poverty through pathway programs. Another site discussed its affiliation with AAR to create an AMP pipeline for adult learners. Lastly, faculty discussed being somewhat unsure of the details, though an awareness that their program may be in partnerships with four-year institutions for students to continue to matriculate into various pathways.

Lack of race-conscious targeted recruitment

Institutions were lacking in their recruitment methods targeting underrepresented communities, specifically those identified as

women, Black, and/or Latinx. A staff member shared information about their “Women in Aviation” initiative that provides a program to expose young women to aviation careers. Another site discussed an initiative called the “Starfish Initiative” to broaden participation for young women in various STEM-based fields. While these programs existed specific to advancing opportunities for women, there was an overall lack of intentionality about advancing opportunities for racially minoritized students. While it was pointed out that recruiting veterans inherently led to racial and ethnic diversity, there were no specific efforts to target recruitment of Black or Latinx veteran populations as shared by participants. The existence of veterans’ benefits advertised by one site was utilized to stimulate recruitment generally for this subpopulation. For instance, one participant explained that he first came into contact with the program through a televised commercial and then contacted the veteran’s representative.

“They advertised on television and I saw it. And then I went to their website and took a test and passed that and then I met with the veteran’s representative, and she told me about the program and how I can enroll and get started.” - *Student*

An overarching problem that was present within each site was the lack of race consciousness when viewing the current academic environment, as well as recruiting potential students. Although participants readily discussed their programs’ role in diversifying by gender and supporting veterans, there were minimal discussions centered around race or ethnicity. Treating each student as “the same” is problematic

when addressing and understanding that each student has specific needs based off the societal structures and barriers present within our society historically and contemporarily. “So, I will say for the recruitment side of things, it’s everyone.” “For us here at [participating program], we’re just reaching for everybody.” – Staff member

As previously stated, although there were some efforts present to recruit underrepresented communities, targeted recruitment was lacking, and many participants reached these same conclusions throughout their interviews. A faculty member at another site expressed that the institutions lack the recognition to consider how race and racism impact students of color. They believe:

It seems like forces in society have already been well established and provide signals that steer them [students of color] away from performing well in school. These conditions are not taken into consideration when marketing to young girls and students of color.

Consequently, such frustrations with the lack of targeted recruitment efforts led to the participant feeling that more could be done.

I don’t really feel like we have special marketing to specific groups . . . I think that specifically toward students of color and female students, I think that we probably need to do more of that. I don’t think we really do enough of it.

Faculty perceptions of marketing

While the aviation industry has desired greater

TREATING EACH STUDENT AS “THE SAME” IS PROBLEMATIC WHEN ADDRESSING AND UNDERSTANDING THAT EACH STUDENT HAS SPECIFIC NEEDS BASED OFF THE SOCIETAL STRUCTURES AND BARRIERS PRESENT WITHIN OUR SOCIETY HISTORICALLY AND CONTEMPORARILY.

diversity, marketing and recruitment strategies fall short and are commonly misleading as student bodies of many colleges and universities do not reflect the cultural pluralism of the college-age population or society at large (Friedmann, 2018; Pippert, Essenburg, & Matchett, 2013). The limited outreach, recruitment, and marketing for a diverse talent pool are particularly acute when contrasting prospective students with the representation of those actually enrolled in high-skill, high-demand, high-wage postsecondary CTE and STEM areas such aviation maintenance by race, ethnicity, and gender (Çelik & Watson, 2021; Foster, 2016). Case in point, a faculty member from another location was asked, “Can the school do better to attract more females and African-American students and Latinos?” They responded, “I think they could do a lot better marketing.”



Despite data emphasizing the lack of underrepresented students present in the aviation industry, 87.5% of participants believed their program enrolls a diverse group of students and 75% believing that marketing materials depict diverse groups of students. These perceptions demonstrate the importance of challenging the assumption that institutions are doing all they can to diversify the field. Some participants provided insights and personal recommendations on how recruitment efforts could be more intentional to address current disparities. The majority of these recommendations were spurred from reaching students of underrepresented communities at younger ages and educating them about the career opportunities within aviation maintenance. One faculty member emphasized marketing at the grade school level will improve equitable access, and that allowing prospective students to see themselves in various positions is essential.

Since it is a male-dominated arena, as far as aviation, we need to project to women that it is a welcoming and inviting field. If we want to attract the underprivileged or the minorities, I think we need to go out to schools. It starts in the high school level ... even at the lower grade levels that it's okay to be a mechanic." – *Faculty member*

I personally think that if the students will see more people that look like them in this field, that would really help a lot. And also vice versa and the same with women. – *Staff member*



The websites of each site followed similar trends in the recruitment culture. Although there were opportunities listed to attract students to join the program, targeted recruitment aspects were lacking. As we progressed through interviews concluding that there is a culture of race avoidance within the industry, the statistic of 75% of respondents answering that they have not participated in implementing change within their program to close equity gaps based on data analysis became slightly more understandable. If faculty and staff are being told they are succeeding in their equity efforts, why would they feel the need to make a change?

Challenges Students Encountered

Financial Barriers

A challenge acknowledged across all institutions was the recognition that many students tended to be working while attending the

aviation program. Employment while also trying to attend school created various factors that were identified as impacting students' academic success. Participants highlighted the consequences of financial hardship resulting in students having to work. One faculty stated, "There is a high percentage of our students that also work and go to school . . . they are with us for 30 hours a week. So that's basically just short of a full-time job." Through this comment, the interviewee shines a light on how just being in school can be considered a full-time job; at the same time, many students have financial obligations requiring paid work while attending school.

In recognition of the challenges students face in completing the aviation program, faculty members provided some examples of the lived experiences of their students. The following are three such reflections:

So, if they get off work at midnight or 10:00 pm . . . some students that's their schedule. So, that's where I see them having that as a challenge too . . . I think that they don't have the ability to fully focus because they have economic issues, they've got to actually work to live—then they're going to struggle.

[Students] have jobs. Either that job is a paying job where they are an employee, or they have a job as a family member. So, this course itself that is set out by the FAA requires a huge sacrifice on the part of the individual as well as family members. So, we have people who are working from three in the afternoon until midnight, and then they gotta come in the next day and be ready



for class at 7:00 a.m. We have some folks who are shift workers, there are people who would get off at three o'clock in the morning, and then they go home, get an hour and a half sleep and then come to school. So, I think those are the challenges.

We have a lot of students here that I totally get that they're working a job and they're trying to go through the class and work at the same time. I work with those students too, okay. We work together on it . . . there's those challenges like that.

These statements reflect how critical capturing in how faculty explicitly identify the financial constraints of students are a challenge to students navigating aviation education. To further emphasize the financial challenge students of color face, one faculty member remarked:

Statistically, students of color are going to have more difficulties being able to economically be able to just focus on schooling. They're going to have to go to work as well. So, they're already kind of starting at a deficit in that kind of way as well.

Unfortunately, we were not able to interview students to help inform this challenge.

Nevertheless, it is vital to hear how faculty interpret the theme of financial obligation and students having to work. This theme is further explored in the following section, which focuses on supports offered and utilized by students.

While the obligation of working was identified by faculty as a challenge for students completing the program, there was also the issue of students who did not work but were struggling financially. Through staff interviews, financial issues related to needing money to live, child care, and transportation were raised as challenges students face. When reflecting on their frequent interactions with students who drop out, they state, "We hear from students all the time when they drop out, 'I want to keep you in this. But I have to work. I need to work.' They need the money." The staff continued discussing how the financial hardship faced by students "is the reason they [students] can't afford the transportation . . . a lot of the issues we see are barriers to success. We can always tie back to the money and the lack of resources to overcome those challenges." Several other staff members nodded their heads in agreement with the comment about the financial challenge for students to complete the program.

The majority staff interviewed shared that financial hardship as it relates to childcare affected male students, but disproportionately had adversely impacted female students at a higher rate. For example, one staff member shared women in their aviation maintenance program more often must overcome the lack of child care and saw it as a significant barrier.

Many of our female students do have children and . . . childcare is a recurrent issue. And we hear that from our male students also, but I would say at a much higher rate from our female population . . . I would say she would say childcare over and over.

Staff members brought to light how financial challenges based on the external factors experienced by students directly impact the opportunities for students to succeed academically. The need for financial support while enrolled in aviation maintenance programs was frequently cited as the root cause of non-academic barriers (as discussed in the challenge section). While students with military benefits tended to fare better in this regard, overall financial need impeded success as students tried to balance enrollment with work. The financial hardship presented by expenses such as child care, transportation, and housing were identified as primary reasons students left their programs:

“We hear from students all the time when they drop out, ‘I want to keep doing this, but I have to work’... the barriers to success we can always tie back to the money and the lack of resources to put them to work on those challenges.” Staff Member

Although there was a lack of direct comments to addressing students of color, there was recognition of the disproportionate impact of larger systems of racial inequity on the financial challenges associated with pursuing education and training. Also expressly mentioned was a lack of funding at higher levels for postsecondary education that make it difficult to support students in general, let alone targeting specific underrepresented populations for further education that leads to an aviation credential of value.

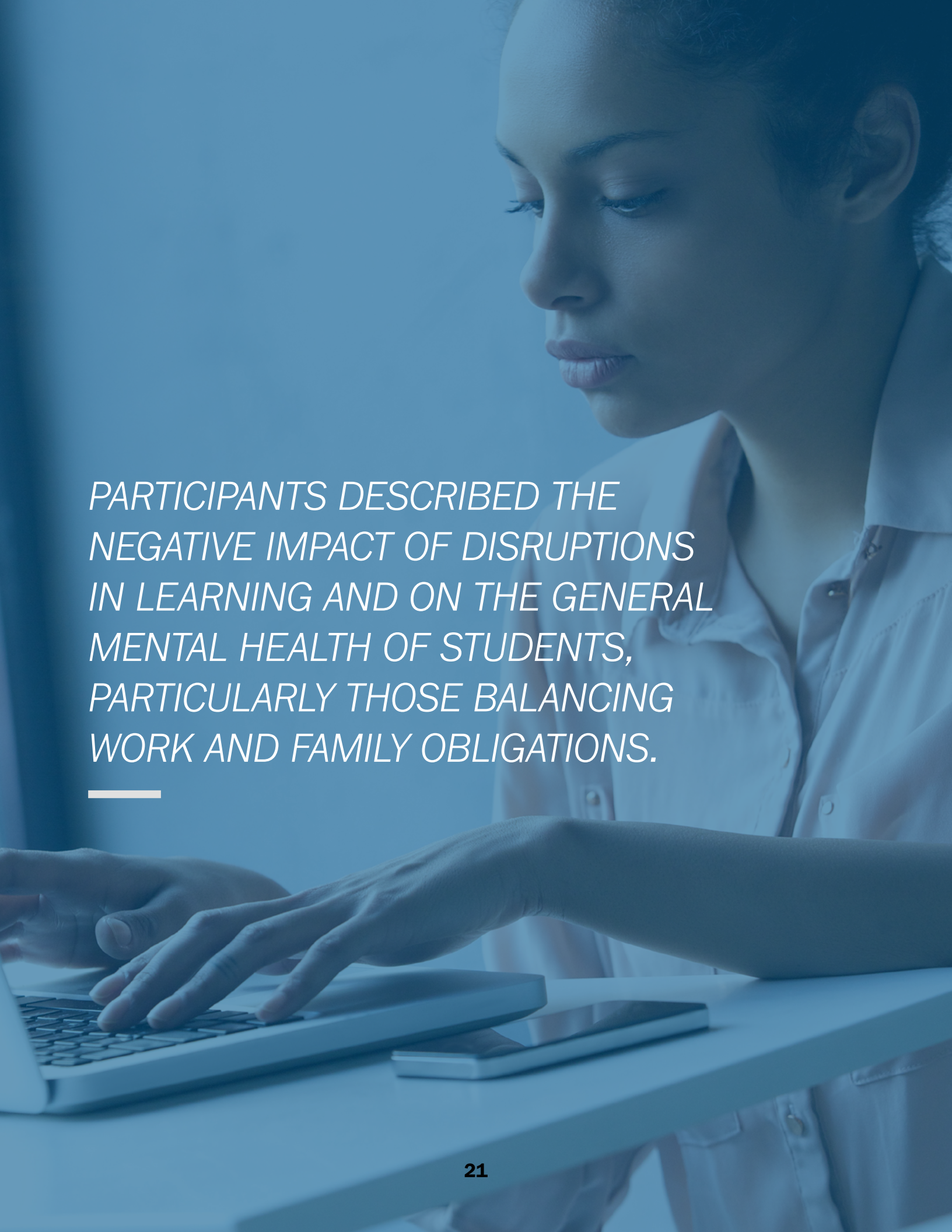
One solution that emerged as a promising practice to address the issue of financial support at one site was an employer-paid partnership cohort in which students are paid

in full. While there was no targeted recruiting for the cohort of eight students, two were women and six identified as a member of a racially minoritized group. While the initial cohort was comprised largely of students under the age of 24, the employer indicated a desire to provide opportunities beyond recent high school graduates. According to a staff member, it was important to this employer that the partnership create opportunities for people who wouldn't otherwise be able to access the program by alleviating financial barriers for interested individuals. Despite not having targeted recruitment efforts, this cohort was particularly beneficial for populations that are currently underrepresented in the field. Even beyond this site, participants noted that industry investment and support is critical to advancing diversity in the field.

Impact of COVID-19 Pandemic

Each location responded somewhat differently to the COVID-19 pandemic. Two institutions utilized virtual learning platforms to deliver lectures and worked to create opportunities for students to engage in applied work in smaller groups while masked and socially distanced. Additionally, at one site, there was general agreement that a lack of child care was a specific barrier for female students who were observed to bear primary responsibility for providing and/or securing care for children, especially during the pandemic.

A faculty member recalled getting together with colleagues to rewrite curriculum and have it approved by the local FAA office. One institution completely stopped instruction for a short

A woman with dark hair pulled back, wearing a white button-down shirt, is shown in profile from the chest up. She is looking down at a laptop keyboard. Her hands are on the keyboard. A smartphone is lying on the desk next to the laptop. The entire image has a blue color overlay.

*PARTICIPANTS DESCRIBED THE
NEGATIVE IMPACT OF DISRUPTIONS
IN LEARNING AND ON THE GENERAL
MENTAL HEALTH OF STUDENTS,
PARTICULARLY THOSE BALANCING
WORK AND FAMILY OBLIGATIONS.*

period of time due to the challenges of moving an applied curriculum to an online delivery format. Regardless of the approach, participants described the negative impact of disruptions in learning and on the general mental health of students, particularly those balancing work and family obligations. An additional effect was identified for students' motivation to continue in the program as the aviation industry job outlook was impacted and students began to consider other career fields:

“I know when they come to me considering withdrawing, they're thinking about these other fields other than aviation because of the hit that we had.” - *Staff Member*

Faculty Availability

We would like to highlight two additional challenges that can impede student success in the program that the interviewers did not directly identify, but that we felt are critical to highlight: faculty availability and a culture of race-consciousness. Through the narratives shared by faculty, we were able to picture the dedication and commitment many aviation mechanic instructors take in ensuring students are successful in the program. It seems that faculty tended to be the first line of support for students in the program. With this in mind, it was informative how often we heard faculty describe their workload. Some of the roles included instruction, grading, providing tours, tutoring, and academic advisors. One faculty member provided the following detail of the structure of an aviation mechanic instruction:

A typical day for me and for my colleagues includes teaching from 7:30 a.m. to 1:50

p.m. Monday through Friday. We are expected to be available for students for at least one hour each day. We are our own lab instructors. We are our own lab instructors. That means when it is time to do grading, we must grade classroom quizzes and tests as well as the lab projects. Additionally, the aviation maintenance faculty are the individuals who give tours to prospective new students. Tours are given several times weekly and typically are 60 to 90 minutes long. The maintenance faculty also serves as the academic advisors with the student body.

As the above case reveals, faculty demands are complex and extensive; providing for struggling students may be difficult for faculty.

Across the sites, faculty shared the following familiar lived experiences: “Most of the time I have class; my time is pretty much taken up; students come in by noon, and I leave at about 8 p.m.” Other thought included, “My plate is pretty full as it is with advising because all the instructors, we do full advising for all our students . . . it's a plateful.” It is important to note that the respondents shared their time and commitments not to complain but more to highlight the challenge for them, to better support students who may need additional support. The challenge then becomes how faculty can find the time to help students who may be falling behind in the course.

Soft Skills

Another challenge identified across faculty and staff participants was the lack of certain skill sets among students, or what may be

identified as “soft skills.” The U.S. Department of Labor (n.d.) recognizes a shortlist of soft skills: communication, enthusiasm and attitude, teamwork, networking, and professionalism. However, the interviews highlighted the importance of these soft skills to realize either academic or career success. The challenges included, but were not limited to, the following conditions: (a) check email; (b) being on time and prepared for class; (c) maintain reference to review the syllabus; (d) use and maintain a calendar; (e) develop and sustain good study habits; (f) manage their time; and (g) job interview skills. Many of these practices build off of each other.

The response in reference to this challenge was that soft skills are necessary to be successful in the program and to obtain subsequent job placement. The respondents felt that some student struggles were related to understanding practices that successful students perform, such as not being late, studying, and bringing textbooks to class. Some faculty highlighted

students needing to develop study skills to prepare for class. A faculty member referenced the preparation students need to follow: “Since I start [class] at 7:30 [a.m.], [I] try and get here at seven o’clock . . . and kind of get yourself situated and review your notes.” Another faculty member talked about students doing “the reading and being prepared for class.” A third faculty member who discussed this theme pointed out that some students could get more help from the college to develop study skills because “when they come in, they don’t have very good study skills . . . as far as what to expect at least have some study skills and study habits.” Embedded within the idea of study habits was the belief that students needed to manage their time more effectively.

Staff also mentioned time management and juggling participation in the program with other primary responsibilities as concerning. The following is what one staff member shared regarding help with time management, stating, “That’s just because some of them, they really need some extra instruction on how to manage



their time because they're here a lot, all week. So, while they're here using their time effectively and then when they're away from here, using their time effectively." These challenges centered around the idea that the lack of soft skills among students negatively impacted their ability to maintain good study practices or understand how to manage their time effectively while enrolled.

In particular, for high school students attending the aviation program, being prepared for class means understanding a holiday or break from high school does not mean there is a break from their aviation class; therefore, being informed and making sure they check the syllabus is an important task. Faculty believe a challenge for some students is creating and using practices that can help them succeed academically. One faculty member called some of these soft skills "tips for success" and the vocation of school. When asked to explain, the faculty member offered:

I've got a list of tips for success . . . Are you going to check your email every day? Just to make sure that the school didn't send you something for your financial aid or [that you] got a quiz tomorrow Check your email once in the morning, middle of the day before you get ready to leave school—just to make sure there's nothing you need to know about.

In the above response, crucial to student academic success is understanding that the main line of communication in the program is via email. If a student has not been accustomed to practicing this action, it can impact how he or she accesses information. Meanwhile, the

theme of soft skills as a challenge was also raised as an issue once students completed the aviation program. The point behind this challenge was that staff believed that not simply having academic success through the completion of the program was enough for students of color. They thought that more students needed to see actual results of their labor in the program—evident through having achieved a job placement. The lack of interviewing skills can become a problem if students are unaware of the unspoken rules of entering the professional workforce. A staff member shared how she work on "a lot of the soft skills that they [students] haven't had the opportunity to need." Overall, the soft skills discussed involved helping students prepare for job interviews to improve their chances of entering the workforce.

Wrap Around Supports

Academic

An important theme in the types of support students need is opportunities to advance academic and study skills, particularly with mathematics. Across all three sites, faculty and staff members described students as largely underprepared as it relates to both study and technical skill sets. In fact, an emerging theme from the data was the belief that students needed supports in building self-confidence to see themselves successfully completing the program. The need to support-building student confidence emerges from when they enter the program. The support for academic skills is particularly problematic as the student interviewee described the aptitude tests required for entry into the program that centered on these skills. A staff member states, "The day of testing, they're going to be nervous.

So, we always try to provide some form of encouragement to them, to calm them down.” Also, staff share that “A lot of our students, they’ll tell us it’s been a long time since they’ve been in school . . . they’re nervous about being in a classroom environment.”

Overwhelmingly, faculty demonstrated a willingness and commitment to providing individualized tutoring to students; however, this was a challenge as it was primarily done informally, and rigorous demands on both student and faculty scheduling left little open time. Faculty perspectives around students’ experiences, or even perception that they were ill-prepared, was noted as important to building student confidence:

I happen to teach students when they first come to school so they’re brand new and many of those students have zero confidence. They don’t know that I’m going into math and I really hated math. And they have to overcome those shortcomings that they believe they have, but they don’t really.

- *Faculty Member*

In the classroom, faculty described their efforts to build confidence by supporting students in mastering a specific skill and facilitating opportunities to lead in peer groups:

What I see in my classes, it’s transformational . . . my whole point of the class is to get them comfortable with tools and being able to do the work and trusting in themselves. -

Faculty Member

As the above faculty reflection demonstrates, some students in the aviation program need

help in building their capacity. More telling was the recognition of the impact for students of color. Two faculty members shared their views on working with some students of color who need confidence building:

“When you’re talking about underrepresented students in the program, I think the thing is how do you get them ramped up to believe that they can actually be part of that, give them the exposure and also help them to understand that they can do it. . . . So, how do you make sure that they get the kinds of, let’s call it educational nourishment. You know, the vitamins that get their mind believing that they can participate in and be part of something.”

“I talked to an adult student at one point that he said he kept being told he couldn’t do something. I looked him straight in the eye and I said, ‘Listen do not let anybody tell you, you can’t do something because you can and you will, if you’re given the opportunity.’”

To formalize and structure support for building academic skills beyond the efforts of individual faculty, one site introduced tutoring and general exam prep every Friday. A lack of student self-confidence was cited as a contributor to anxiety about the testing required to obtain the certificate necessary for employment following completion of the program. In response to this, the same site moved from providing optional general exam prep to requiring a capstone course for completion of the program. This decision was made as faculty reviewed data exemplifying much higher certification rates for participating students. At the conclusion of the 21 months, students must sit for capstone

over five-weeks with offerings scheduled during daytime and evening hours. According to the faculty, the value of the capstone program has been especially critical as students navigated disruptions throughout the COVID-19 pandemic, with faculty indicating that in their current capstone course, they were not just reviewing material but often reteaching it to students in a way they had not previously done.

In addition to the capstone course, this site created a culture of celebration for students upon successful completion of their certification exam that served as a source of encouragement for current students. According to one staff member, “We make a big production of that ... memorialize the moment.” The celebration involves the newly certified mechanic blowing an air horn, signing an aircraft wing, and having his name added to a visible display. At the sound of the air horn, faculty, students, and staff stop what they are doing to join in the celebration. Faculty identify the certification as a major milestone for the individual and a motivating force for those who are currently in training:

I’ll be teaching in my class and the air horn will go off in the shop. And my students will say, ‘Somebody’s got their certificate’... so they know about it and they get just as excited about it as we do. - *Faculty Member*

Instructors bring their classes down there, shake that person’s hand or at least say hi or something, celebrate with that person. It gives our students a reason to keep going, if he can do it, or she can do it, you can do it. - *Faculty Member*

Mentoring

Mentorship throughout the program, as well as during the transition into employment, was identified as critical to student success. Faculty routinely described themselves as mentors to students both inside and outside of the classroom, as students balanced external pressures presented by work and family obligations. Beyond faculty, peer mentorship was identified as important but underutilized as an intentional, or formalized, practice. However, it was noted that this can sometimes organically happen for student veteran populations, especially when there are specific support persons and/or spaces available for them to facilitate connections with each other.

As mentors, faculty and staff found themselves supporting students in developing soft skills, especially as they prepared to enter the workforce. For students transitioning into this career from the military, one staff member pointed out that they have often had no experience with the interview process. While formalized support and resources for career services varied across sites, this is an area where students frequently needed guidance and mentorship.

Within the realm of mentorship, some participants acknowledged the importance of students having mentors who shared their identities and experiences. A lack of women and racially minoritized individuals in the industry and faculty was noted as a barrier to diversifying the field. However, one participant identified possibilities associated with peer mentorship:



We've tossed around the idea quite a bit about student mentorships, taking a more seasoned student and maybe someone who looks like and has a similar background to some of our newer students who might struggle to get adjusted in the program.” - *Staff Member*

Delimitations/Limitations

With respect to the scope of this exploratory investigation, the study was delimited to four institutions. However, one limitation beyond the choices and boundaries set by AAR Corp., CSW, and OCCRL as collaborating parties were limitations our respective team had no degree of control over. Notwithstanding, one of the project goals was to study four higher education institutions offering aviation maintenance programming to better understand the successes and challenges they encountered in recruiting and retaining more diverse students. Despite correspondence with all four institutions, participants only represented three of the four institutions. Thus, the emergent findings of this report do not reflect one of the initially agreeable sites.

Context matters and the three institutions informing our fieldwork are located in two geographical regions in the United States: the Midwest and the Mid-Atlantic. Although generalization is not the goal or appropriate from this exploratory, qualitative component of the project, it is important to note that some of the findings may be informed by the geographic location of each institution. For that reason, what was gleaned from this project may not be readily applicable to other institutions, though the findings could have transferability.

Nevertheless, the emergent findings offer support for the overall diversification of aviation maintenance pathways and programs.

Another limitation was the lack of diverse perspectives of students and administrators. While we were able to interview faculty members from all three institutions, there were limitations in the range of participants across sites. Our organization strongly supports the value of capturing student voices in order as it has been shown to be effective for ensuring student engagement, success, and agency of their academic and career development. Notwithstanding, there is value in having student voice as it is part and parcel to data informed decision making. Subsequently, student voice would enlighten the findings of this field study as well as the recommendations generated to improve aviation education pathways. Unfortunately, we only had one student participant within this study. Limited also what the representation of administrative support professionals as those participating came forward from one out the three sites. As a result, the findings of this report are largely composed of the voices of the teaching faculty across each of the institutions.

Conclusion and Recommendations

There is a suite of things to consider when improving the retention and completion of students who are navigating aviation majors and careers. Though these apply to CTE and STEM programs broadly, below we have identified several points to consider for aviation programs.

Navigating Icy Environments

Studies have noted chilly climate effects as

loneliness, micro/ macro -aggression, other negative messaging or interaction from peers and educators either furthered or harmed postsecondary students' interest and progress, cultural identity, and feelings of belonging for some underrepresented groups in CTE and STEM fields broadly (Jackson, 2013; Jorstad et al., 2017; National Academies of Sciences, Engineering, and Medicine, 2018; Reyes, 2011; Wang, 2020). This chilly climate may also impact the experiences of persons navigating aviation fields.

A primary recommendation centers on advancing equity consciousness, racial and cultural proficiency among faculty, staff, and administrators in aviation maintenance programs. The research team encountered significant hesitation among eligible participants when it came to both participating in the study and talking about race. Routinely participants would discuss gender, veteran status, and age but avoid discussions of race. Furthermore, when questions were asked specifically referencing support for Black or Latinx students, responses were framed from a deficit perspective. Racially minoritized students were assumed to be lacking in resources and knowledge with their underrepresentation in the field attributed to a lack of awareness versus historical and systemic exclusionary practices.

Explicit Engaging with Race/Ethnicity in DEI Efforts

The responses to the questionnaire reflected that participants do not routinely engage in activities or discussions to analyze disaggregated data by gender, race/ethnicity, or the intersectional identities across underrepresented groups. Only

three participants indicated any experience with implementing change to close equity gaps based on data analysis and did not do so by subgroupings of special populations. However, the majority of participants indicated they had participated in diversity, equity, and/or inclusion training. The following participant noted the limitations of these trainings and lack of awareness:

“I’d like to see awareness of the decision makers, more information about the disparity. I feel like diversity and inclusion, they’re buzz words and we all want them and we all use them but we don’t really know what that means ... I think access to what’s existing and what could be for the decision makers as it relates to increasing diversity... maybe this study will get them talking about it, making a plan for it.” - *Staff Member*

Participants routinely described themselves as not seeing race and treating all students the same. At the same time, the research team observed the tokenization of colleagues and students throughout conversations. Despite occupational demographics, there were descriptions of the field as already being diverse. This leads to deeper questions regarding how institutional actors conceptualize diversity and equity that could serve to create barriers to advancing equitable outcomes.

Paramount to advancing racial/ethnic and gender diversity in aviation maintenance is the alleviation of financial barriers to reduce the need for students to work while enrolled. The most effective strategy identified to address this barrier was the creation of programs that not only pay student cost of attendance but

pay students direct wages while enrolled. This is critical to closing opportunity gaps to enter aviation pathways, given historical and systemic racial income inequities. In addition, it is recommended that as part of professional development toward becoming race-conscious, faculty and staff understand the racialized impact of financial barriers and intersectionality as it relates to race/ethnicity and gender.

Lastly, as participants readily discussed age and identified financial challenges for adult students matriculating into programs, it is advised that the field at large explore opportunities to reduce time to completion for those students entering with relevant skill sets gained either from military service or employment experience. This could include credit for prior learning based on relevant assessments of skill sets. While it is understood that the curriculum is highly regulated, an opportunity exists for all stakeholders to explore innovative practices, particularly if there is a sincere commitment to advancing racial and gender equity. Based on the qualitative findings and document analysis of our field work, advancing college and career readiness skills prior to student matriculation into aviation maintenance programs is a significant concern. Given the need for prerequisite mathematics skills, this is a specific area ripe for the implementation of bridge programs and partnerships that could serve to close opportunity gaps and build student confidence and proficiency. What follows are suggested actionable strategies for fostering more explicit efforts to increase awareness and access to aviation education and careers as well as bolster persistence and equitable outcomes.



*I FEEL LIKE DIVERSITY
AND INCLUSION,
THEY'RE BUZZ WORDS
AND WE ALL WANT
THEM AND WE ALL USE
THEM BUT WE DON'T
REALLY KNOW WHAT
THAT MEANS ...*

- STAFF MEMBER

Aviation Outreach and Recruitment Practices

1. Provide financial support for students to affordability, complete their degree/certificate, and establish accountability means for evaluating the effectiveness of this approach;
2. Using [OCCRL's Comprehensive Local Needs Assessment](#), examine programmatic offerings to provide clear and specific degree completion timelines and costs of aviation curriculum delivery, and establish accountability means for evaluating the effectiveness of this approach;
3. Using the Comprehensive Local Needs Assessment, examine programmatic offerings and recruitment materials to assess for the integration of underrepresented students' backgrounds and experiences (i.e., use web software such as Google Analytics or other similar software to analyze how online users engage with your website and online resources);
4. Establish aviation outreach programs and accountability means for evaluating the effectiveness of this approach;
5. Establish industry-university partnerships and establish accountability means for evaluating the effectiveness of this approach for both parties.

Aviation Retention and Completion Practices

1. Using the Comprehensive Local Needs Assessment, improve the classroom, programmatic, and advising structures, as well as practices and policies to strengthen

- supportive learning environments;
2. Streamline aviation education delivery to improve learning for all students;
 3. Establish programmatic capacity to connect students to one another and industry professionals;
 4. Establish programmatic capacity through informal learning opportunities to deepen students' commitment toward completing their aviation degree and pursuing an aviation career;
 5. Using the Comprehensive Local Needs Assessment, establish accountability means for evaluating the retention and completion efforts.

Final Thoughts

Our suggested recommendations can disrupt our current practices and aid the plight of future aviation career professionals. Improving retention and outcomes of underrepresented groups in aviation requires an effective, integrated strategy from aviation stakeholders who are dedicated to diversifying the aviation industry for the long term. Though this work is not exhaustive, we explored the standard practices of aviation recruitment, teaching, learning, and completion. This work intentionally avoids identifying any of the common practices as best practices, since there is no one setting that is extraordinarily matriculating underrepresented persons into aviation careers. Therefore, our work offers recommendations based on current literature, research, and enrollments trends that can offer actionable insights and next steps for attracting, retaining, and completing racially minoritized and female students in aviation maintenance. In the end, aviation stakeholders can increase and improve aviation pathways

for underrepresented African American/Black, Hispanic/Latinx, Native American, and Asian Americans, as well as white women using informative research, equity-conscious lenses, and thorough assessment of the aforementioned implemented strategies and approaches.





SECTION III

- A. Participant Questionnaire
- B. Interview Protocol
- C. Aviation Teaching and Learning Through an Equity Lens
- D. References

APPENDIX A: PARTICIPANT QUESTIONNAIRE

Introduction

Thank you for participating in the study. To assist us in preparing to facilitate the interviews, please answer the survey questions. If you don't know the answer or the question is not applicable to you, please indicate that as well. While this research does not require a signature of informed consent, please [click here](#) to review an information sheet that provides research participation details.

1. Name
2. Institutional Affiliation
3. Gender Identity
4. Race/Ethnicity
5. Have you ever served in the United States armed forces?
6. Please provide your e-mail address to receive information on scheduling your interview
7. Which role best describes you?

Administration/Staff and Faculty

8. Professional Title
9. Please describe current methods of student recruitment for your aviation maintenance program including any specific targeted recruitment or partnerships for populations currently underrepresented in aviation (e.g. women, Black students, Latinx students, veterans). To help us gain a complete picture of your school's work, please provide as much detail as possible.

10. For the next section, select the option that best describes the current context of your program

Recruitment	Yes	No	Unsure
<p>materials (print and digital) depict diverse groups of students.</p>			
<p>Informational materials about my program are available in languages other than English</p>			
<p>My program enrolls a diverse group of students</p>			
<p>My program enrolls a homogenous group of students.</p>			
<p>I have access to disaggregated data by gender in enrollment and completion of my program.</p>			
<p>I have access to disaggregated data by race/ethnicity in enrollment and completion of my program.</p>			
<p>I have participated in activities or discussions analyzing disaggregated data by gender to identify equity gaps in my program</p>			

Recruitment	Yes	No	Unsure
<p>I have participated in activities or discussions analyzing disaggregated data by race/ethnicity to identify equity gaps in my program.</p>			
<p>I have participated in implementing change within my program to close equity gaps based on data analysis.</p>			
<p>I have access to post graduate outcomes data on student employment earnings in the workforce</p>			
<p>I have access to disaggregated data on post-graduate outcomes data on student employment and earnings in the workforce</p>			
<p>I have participated in training on diversity, equity, and/or inclusion.</p>			

- 11.** What opportunities do you think exist to advance diversity in the field of aviation maintenance? Please be as detailed as possible.
- 12.** What kind of professional development opportunities exist for you toward supporting diverse groups of students? Please be as detailed as possible.

Students

13. Approximately how many courses have you completed toward your program of study?

14. What is your ultimate goal for completing your current program of study (check all that apply)?

Completing a certificate(s)

Completing an Associate's degree

Transferring into a Bachelor's degree program

Entering the workforce

Other (please specify)

None of the above

APPENDIX B: INTERVIEW PROTOCOL

Sheet Metal and Eagle Pathway Programs

- What is attracting underrepresented students (women, Black, Latinx, veterans) to aviation maintenance education programs?
- What supports and/or other services were offered to students participating in these programs? What supports did aviation maintenance students seem to most use or need (including women, students of color, and veterans)?
- After reviewing the student data, what stands out regarding the enrollment, completion, certification/degree attainment, retention, and employment of these individuals? What are some positive outcomes? What are some opportunities for improvement?
- What challenges do students face in completing their programs or certifications and degrees? What changes can be made to support the improvement of outcomes?
- What are some of the greatest successes in implementing the project? What are some of the challenges in implementing the project?
- To what extent will AAR and education partners sustain policy and practice changes beyond the grant-performance period?
- Will practices within the Lumina-funded project be embedded into broader institutional policy and practice?
- What other longer-term outcomes are anticipated because of this project?

APPENDIX C: AVIATION TEACHING AND LEARNING PRACTICES THROUGH AN EQUITY LENS

Truncated Review of Literature

Aviation standards and requirements developed by the FAA and Aviation Accreditation Board International (AABI) establish a precedent for the aviation industry (Kearns, 2016; Watkins et al., 2016), though there are many iterations of aviation education over the years. From an apprenticeship (1903-1929) to simulation (1929-1979) and safety (1979-present) emphases, today's aviation instructional practices and pedagogical choices are primarily driven by NASA's 1979 conference. Since the military has a specific teaching and learning model tied to military traditional culture and practices, the following section primarily describes students' teaching and learning experiences in postsecondary settings.

At the time of the NASA conference, airline stakeholders discerned and sought strategies to address the high number of "human-error-caused" incidents across the aviation industry (Kearns, 2016, p. 5). This conference led to Crew Resource Management (CRM) training, which ensures the understanding of hardware, software, and liveware to ensure flight safety and effective operational use. Today, some pilots attend mandatory annual CRM training, and portions of CRM are embedded in ground school. With no two programs alike, faculty are primarily responsible for preparing the next generation of aviation leaders. At associate aviation programs, aviation mechanic students complete a certificate, and air traffic controller students complete a degree that has up to 30 credit hours (Kearns, 2016). At baccalaureate aviation programs, aviation students complete instruction for an average of 120 credit hours in the following learning categories: general, core, and aviation-specific coursework (Young et al., 2021). All learning experiences feature "written examinations, on-the-job training, and performance measures" to satisfy the demands of their respective aviation-specific job (Watkins et al., 2016, p. 5).

Teaching has largely shifted as these settings transitioned to virtual learning due to the COVID-19 global pandemic (Jain et al., 2021). Within a short time, faculty members transition their in-person, hands-on offerings to virtual formats. Though this was difficult, they recorded and/or livestreamed themselves so students could view them and work on assignments accordingly. Some schools delayed in-person instruction to a later point in students' careers, but it is unclear when and if these courses will happen due to the rise of the highly contagious delta variant (Anthes, 2021). Some researchers acknowledge that shifts in aviation content delivery follow a naturally occurring new wave of aviation learning, in which there is a greater emphasis on customized, individual training and learning (Kearns, 2016)

Given how current and previous iterations of aviation learning track, sort, and demand learners to conform and comply, Kearns projects that the subsequent paradigmatic emphasis of aviation curriculum will include a mastery-oriented focus. This emphasis allows learners to maximize their performance by choosing to advance their understanding beyond “minimum acceptable level of performance (Kearns, 2016, p. 6; Kearns et al., 2017). Emphasis on mastery-oriented teaching and learning will allow aviation students to excel in their own way without the pressures of completing their program within a specific timeframe. It will also not exclude them from practicing (to develop and improve) their weak areas. Kearns contends that virtual learning could prove beneficial in delivering this customized, individual training for aviation students.

Bundling, Sequencing, and Gatekeeper Courses

Depending on the postsecondary institution in question, STEM remedial coursework may (or may not) count toward underrepresented groups’ STEM degree completion (National Academies of Sciences, Engineering, and Medicine, 2016). These courses may extend underrepresented students’ graduation time and cost. STEM gatekeeper courses can cause underrepresented students to continue (or not) along a STEM pathway (National Research Council, 2012). Researchers have found that few underrepresented students persist into more advanced STEM coursework when students enroll in remedial classes (Cohen & Kelly, 2019, 2020). How students manage and perform in these courses can determine how they further engage with their STEM journey. STEM course sequencing can also introduce and maintain STEM course gatekeeping (Chawla, 2020; Wang, 2020). The sequencing, rigidness, and inflexibility of the STEM curriculum can be a challenge for underrepresented students to execute during their postsecondary aviation journey (National Research Council, 2012; Wang, 2020).

From the Field: Sheet Metal Curriculum in Review

This curriculum review consisted of reviewing select material related to the aviation sheet metal program, including syllabi, presentations, tests, and other relevant content. This review presents the findings of the review of the curriculum, which is a component of the over-program review. The purpose of the review is to explore the extent to which the curriculum is culturally relevant for a broad array of students, including underrepresented minorities, international students, women, and others who are not broadly represented in the field. The review and recommendations are grouped in three primary areas that include culturally specific content, visual representation, guest speakers, mentors, and role models.

Culturally Specific Content

The content of the material is limited to only technical content with no reference to cultural diversity. There are several potential approaches to integrate culturally relevant material in technical course content. One such approach is to include culturally relevant content outside of the technical content as a module or lesson. For instance, a lesson on the history and impact of the Tuskegee Airman could

be used to highlight the contributions of African Americans during World War II. Images of aircraft used by the Tuskegee Airman could also be used to highlight certain types of sheet metal repair or to discuss the evolution of aircraft sheet metal and associated tools and techniques. This same approach could be used in discussing the accomplishments and mystery regarding Amelia Earhart to make content more relevant for female students.

There is also an opportunity to include international content to provide students with a global perspective. Discussing international aviation practices and standards by using content from organizations such as the International Civil Aviation Organization (ICAO) or the International Aviation Safety Assessment (IASA) program. Other strategies to include international and culturally relevant material could be embedded in course material. For instance, the lesson titled Corrosion Control covers corrosion severity zones in North America only. It would be easy to include corrosion zones from other regions of the world and compare these to North America corrosion zones. Additionally, a more in-depth exploration of a particular area in the North American zone such as Havana, Haiti, or Puerto Rico would allow the inclusion of more diverse populations.

Another option is to use information learned about students to inform the type of culturally relevant content to include in course teachings. This might include integrating books that include people from students' cultures into the curriculum. Extra effort should be made to make content from diverse perspectives in aviation available outside of the standard technical material. These resources could be highlighted and made more prominent in the library.

Visual Representation

The images used in the PowerPoint presentations lack diverse representation throughout. It is important for diverse students to see images of individuals who look like them in presentation materials. Such imagery is important and helps students to visualize success in the aviation industry. A simple strategy for improvement is to ensure there is diversity (individuals with disabilities, women, gender nonconforming, international, underrepresented minorities, etc.) in pictures, clipart, and videos.

It is also important to note that the PowerPoint presentations do not have videos, which may make paying attention challenging for Generation Z and other tech-savvy students. Including even simple videos of technical tasks being accomplished could improve student attention compared to basic PowerPoint slides. Recording and integrating videos also provides an opportunity to showcase students from diverse backgrounds in lesson presentations. Many of the images in the PowerPoint presentations appeared stretched and blurry or both. Some images were not readable on a standard laptop and would likely be difficult to read when projected on a large screen. Using such material makes it difficult for all students, but it is especially challenging for students who may be visually impaired. A simple fix would be to review all presentation slides and resize images using appropriate dimensions. It would also be beneficial to have the presentations reviewed by a specialist at a disability resource center.

Guests Speakers, Mentors and Role Models

The curriculum is absent of any intentional integration of external voices such as guest speakers, mentors, and other types of role models. Strategies that allow students to engage with individuals in the aviation field who look like them can provide for a very powerful experience and opportunity for connection and networking.

Having guest speakers and lecturers from diverse backgrounds present course content or provide career advice can help students visualize themselves in the aviation industry and provide an opportunity to build a network of support during their education and upon entering the field.

Another strategy is to establish a formal or informal mentorship program that aligns students from diverse backgrounds with positive role models in the field to help with student matriculation and success. Mentors and role models that align with a student's own identity is important, but it is not paramount. It is most important that students have a mentor or role model whom they can connect with on a personal level, regardless of culture or gender alignment.

Finally, it is also important to expose students to organizations that support diversity in aviation. This will provide opportunities to gain access to others in the field of aviation who come from and support diversity in the field. One example is the Global Conference on Diversity in Aviation, Aerospace and STEM, which is held at Ohio State University. This conference focuses on education, collaboration, and innovation in the field. It also covers culturally relevant topics for individuals from diverse backgrounds. Such conferences offer an opportunity for students to interact and network with existing diverse professionals in the field while learning best practices around issues of diversity, inclusion, and equity. Encouraging and supporting students and staff to attend such conferences provides a unique opportunity for growth and development from external, culturally relevant material.

Suggestions for Practice

In summary, today's aviation teaching and learning experiences are driven mainly by the instructional choices of faculty at postsecondary programs as well as the FAA requirements and AABI standards. Aviation scholars and other educators have pushed for more customized learning approaches within instructional practices. The COVID-19 pandemic has accelerated the delivery of aviation curriculum through the utilization of technology. Due to the ongoing presence of COVID-19 variants, aviation educators may continue to use virtual-learning strategies for the foreseeable future. Though virtual formats remove learners' in-person, hands-on learning experiences, it is critical to note that industry-university partnerships can alleviate the financial burdens of moving past aviation curriculum to virtual learning settings. Additionally, customized virtual content delivery may provide remote access to career professionals that further students' understanding of their chosen field and deepen connections between students and career experts (Jackson et al., 2021).

Ultimately, aviation stakeholders should work with aviation educators and students to understand and implement the best virtual remote teaching and learning practices to develop the next generation of persons in the aviation industry.

In conclusion, the following recommendations are considerations that may prove feasible for aviation education programs depending on the respective setting and context:

Aviation Teaching and Learning.

1. Improve aviation curriculum to produce customizable learning experiences;
2. Establish industry-university partnerships to subsidize the expenses for virtual content delivery and assess the quality of learning using this approach;
3. Connect students to industry professionals using a variety of available in-person and virtual formats;
4. Ask teachers, students, and current and retired aviation professionals about their aviation educational journey and strategies to improve learning conditions for future students.

APPENDIX D: REFERENCES

- AAR (2018, December 13). [*Mayor Emanuel, City Colleges of Chicago and AAR announce the Aviation Futures Training Center.*](#)
- Allen, T. D., & Eby, L. T. (Eds.). (2010). *The Blackwell handbook of mentoring: A multiple perspectives approach*. Wiley-Blackwell.
- Anthes, E. (2021, June 22). The delta variant: What scientists know. *The New York Times*. <https://www.nytimes.com/2021/06/22/health/delta-variant-covid.html>
- Aviation Institute of Maintenance. (2021a). [*Campuses.*](#)
- Aviation Institute of Maintenance. (2021b). [*Norfolk-VA.*](#)
- Boeing. (2016). *2016 Pilot & technician outlook support and services*.
- Burack, C., Melchoir, A., & Hoover, M. (2019). Do after-school robotics programs expand the pipeline into STEM majors in college? *Journal of Pre-College Engineering Education Research*, 9(2), 85-97. eric.
- Çelik, H., & Watson, F. (2021). Understanding the leaky pipeline system: behavioural ecological approach to the social marketing of women thriving in STEM careers. *Journal of Social Marketing*.
- Center for MSIs. (2020). [*List of Minority Serving Institutions.*](#) Rutgers Graduate School of Education.
- Chawla, D. S. (2020). *Surviving weed-out classes in science may be a state of mind.* The New York Times. <https://www.nytimes.com/2020/11/16/science/weed-out-classes-stem.html>
- Cohen, R., & Kelly, A. M. (2019). Community college chemistry coursetaking and STEM academic persistence. *Journal of Chemical Education*, 96(1), 3-11. <https://doi.org/10.1021/acs.jchemed.8b00586>
- Cohen, R., & Kelly, A. M. (2020). Mathematics as a factor in community college STEM performance, persistence, and degree attainment. *Journal of Research in Science Teaching*, 57(2), 279-307. <https://doi.org/10.1002/tea.21594>
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Sage Publications, Inc.
- Crutchfield, O. S., Harrison, C. D., Haas, G., Garcia, D. D., Humphreys, S. M., Lewis, C. M., & Khooshabeh, P. (2011). Berkeley foundation for opportunities in information technology: A decade of broadening participation. *ACM Transactions on Computing Education (TOCE)*, 11(3), 1-24.
- Federal Aviation Administration. (2021). *Become an aviation mechanic*. <https://www.faa.gov/mechanics/become/>
- Findley-Van Nostrand, D., & Pollenz, R. S. (2017). Evaluating psychosocial mechanisms underlying STEM persistence in undergraduates: Evidence of impact from a six-day pre-college engagement STEM academy program. *CBE - Life Sciences Education*, 16(2). <http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ1145690&site=ehost-live> <http://dx.doi.org/10.1187/cbe.16-10-0294>
- Foster, P. (2016). Diversity recruiting in aviation maintenance. In E. A. Hoppe (Ed.), *Ethical issues in aviation* (pp. 187-200). Routledge.
- Friedmann, E. (2018). Increasing women's participation in the STEM industry: A first step for developing a social marketing strategy. *Journal of Social Marketing*.
- Gilmore, J., Vieyra, M., Timmerman, B., Feldon, D., & Maher, M. (2015). The relationship between undergraduate research participation and subsequent research performance of early career STEM graduate students. *The Journal of Higher Education*, 86(6), 834-863.

- Gorlin, I., & Bridges, D. (2021). Aviation culture: A ‘glass sky’ for women pilots - Literature review. *International Journal of Aviation, Aeronautics, and Aerospace*. <https://doi.org/10.15394/ijaaa.2021.1587>
- Hubbard, S., & Lopp, D. (2015). A case study reflecting successful industry engagement: Utilizing industry projects as a mechanism for discovery and STEM education in aviation technology. *Journal of Education and Human Development*, 4(2), 175-181.
- Institute of Medicine. (2011). *Expanding underrepresented minority participation: America’s science and technology talent at the crossroads* (Vol. 97). National Academies Press. <http://doi.wiley.com/10.1002/sci.21032>
- Ison, D. C., Herron, R., & Weiland, L. (2016). Two decades of progress for minorities in aviation. *Journal of Aviation Technology and Engineering*, 6(1). <https://doi.org/10.7771/2159-6670.1141>
- Jackson, C., Jenkins, J., Alexander, A., Bisker, A., Cronin, C., Dorbian, J., Dray, K., Iliev, S., Peji, J., Smart, R., & Cullen, Laurie. (2021). *Playbook for cultivating talent in the airport environment*.
- Jackson, D. L. (2013). A balancing act: Impacting and initiating the success of African American female community college transfer students in STEM into the HBCU environment. *The Journal of Negro Education*, 82(3), 255-271.
- Jain, M., Morris, T., Beck, J., Johnson, K., Short, R., Shakour, K., & Chalil Madathil, K. (2021). Educational challenges presented by Covid-19 at technical colleges offering aviation maintenance technology program. *Computers in Education Journal*, 12(1), 2.
- Jorstad, J., Starobin, S. S., Chen, Y. (April), & Kollasch, A. (2017). STEM Aspiration: The Influence of Social Capital and Chilly Climate on Female Community College Students. *Community College Journal of Research and Practice*, 41(4-5), 253-266.
- Kearns, S. K. (2016). *E-learning in aviation*. Routledge.
- Kearns, S. K., Mavin, T. J., & Hodge, S. (2017). *Competency-based education in aviation: Exploring alternate training pathways*. Routledge.
- Kitchen, J. A., Sadler, P., & Sonnert, G. (2018). The Impact of summer bridge programs on college students’ STEM career aspirations. *Journal of College Student Development*, 59(6), 698–715. Education Full Text (H.W. Wilson).
- Kowarski, I. (2020). *A guide to pilot school and how to become a pilot*. *US News & World Report*.
- Laursen, S., Hunter, A.-B., Seymour, E., Thiry, H., & Melton, G. (2010). *Undergraduate research in the sciences: Engaging students in real science*. John Wiley & Sons.
- Mayhew, M. M., Rockenbach, A. N., Bowman, N. A., Seifert, T. A., Wolniak, G. C., Pascarella, E. T., & Terenzini, P. T. (2016). *How college affects students* (Third Edition). Jossey-Bass Publishers.
- National Academies of Sciences, Engineering, and Medicine. (2016). *Barriers and opportunities for 2-year and 4-year STEM degrees: Systemic change to support students’ diverse pathways* (S. Malcom & M. Feder, Eds.; p. 21739). National Academies Press.
- National Academies of Sciences, Engineering, and Medicine. (2018). *An American crisis: The growing absence of Black men in medicine and science: Proceedings of a joint workshop*. National Academies Press.
- National Center for Education Statistics. (2022a). [Aviation Institute of Maintenance-Norfolk](#).
- National Center for Education Statistics. (2022b). [City Colleges of Chicago-Olive Harvey College](#).
- National Center for Education Statistics. (2022c). [Vincennes University](#).
- National Research Council. (1997). *Taking flight: Education and training for aviation careers*. National Academies Press.
- National Research Council (Ed.). (2012). *Community colleges in the evolving STEM education landscape: Summary of a summit*. National Academies Press.

- Pippert, T. D., Essenburg, L. J., & Matchett, E. J. (2013). We've got minorities, yes we do: Visual representations of racial and ethnic diversity in college recruitment materials. *Journal of Marketing for Higher Education*, 23(2), 258-282.
- Reyes, M.-E. (2011). Unique challenges for women of color in STEM transferring from community colleges to universities. *Harvard Educational Review*, 81(2), 241-263.
- Seligson, D. (2019). *Women and aviation: Quality jobs, attraction and retention*. International Labour Organization.
- U.S. Air Force. (n.d.-a). *Career detail—Air traffic control*. <https://www.airforce.com/careers/detail/air-traffic-control>
- U.S. Air Force. (n.d.-b). *Career detail—Pilot*. <https://www.airforce.com/careers/detail/pilot>
- U.S. Air Force. (n.d.-c). *Career detail—Tactical aircraft maintenance*. <https://www.airforce.com/careers/detail/tactical-aircraft-maintenance>
- U. S. Bureau of Labor Statistics. (2021). *Aircraft and avionics equipment mechanics and technicians*.
- U.S. Department of Transportation & Federal Aviation Administration. (2018). *Section 601 youth in aviation student outreach report*
- Vincennes University. (2022). *Indianapolis aviation technology center*.
- Wang, X. (2020). *On my own: The challenge and promise of building equitable STEM transfer pathways*. Harvard Education Press.
- Watkins, D., Newcomer, J. M., Earnhardt, M. P., Marion, J. W., Opengart, R. A., & Glassman, A. M. (2016). A cross-sectional investigation of the relationships education, certification, and experience have with knowledge, skills, and abilities among aviation professionals. *International Journal of Aviation, Aeronautics, and Aerospace*, 3(1), 6.
- Winkleby, M. A., Ned, J., Ahn, D., Koehler, A., & Kennedy, J. D. (2009). Increasing diversity in science and health professions: A 21-year longitudinal study documenting college and career success. *Journal of Science Education and Technology*, 18(6), 535-545.
- Yelamarthi, K., & Mawasha, P. (2008). A pre-engineering program for the under-represented, low-income and/or first generation college students to pursue higher education. *Journal of STEM Education*, 9(3).
- Young, S., Byers, D., Bisker, A., Cronin-Blair, C., Pavlik, L., Norris, K. L., Borowiec, J., & Prather, D. (2021). *Enhancing academic programs to prepare future airport industry professionals*.
- Zhe, J., Doverspike, D., Zhao, J., Lam, P. C., & Menzemer, C. C. (2010). High school bridge program: A multidisciplinary STEM research program. *Journal of STEM Education: Innovations and Research*, 11(1-2), 61.

