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about **the council**

ATEC was founded in 1961. Its mission is to promote and support aviation maintenance technical education.

The council actively engages with regulatory and legislative bodies to advocate on behalf of the community, and provides resources, continuing education, and networking opportunities for our members.

Our membership is made up of employers, vendors, and educational institutions with aviation technical programs. The vast majority of member schools are certificated by the FAA to provide aviation mechanic programs.

Membership supports the following activities and initiatives—

- Advocating for sound regulatory policy, the development of clear and concise guidance, and consistent enforcement and application
- Participating on industry and agency committees to further aviation technical education and workforce development
- Fostering and supporting career pipeline partnerships between industry and educational institutions
- Facilitating networking opportunities through the annual conference, Washington fly-in, regional outreach meetings, and virtual webinars
- Enhancing aviation technical career awareness through support of ATEC's sister organization, Choose Aerospace

about **the journal**

The *ATEC Journal* (ISSN 1068-5901) is a peer-reviewed, biannual electronic publication. The publication provides an opportunity for educators, administrators, students and industry personnel to share teaching techniques and research. Authors are encouraged to submit their articles for publication consideration, whether scholarly, research, application, or opinion, by using the submission form below. Papers supporting the council's regulatory and legislative agenda may be considered for presentation via online webinar and at the annual conference. Suggested topics include:

- Technical and soft-skills curriculum integration
- A history of legislative actions affecting aviation maintenance workforce development
- A study on implementing employer-education partnerships
- Funding implications stemming from Bureau of Labor Statistics occupational outlooks
- Highlighted innovations in the aviation maintenance industry
- A look at successful online teaching methods and subject matter in other technical fields
- Surveying currently used computer-based teaching across aviation maintenance training schools

SUBMISSION DEADLINES

Fall Issue Closing Date: October 1 • Spring Issue Closing Date: May 1

SUBMIT AN ARTICLE FOR REVIEW AT ATEC-AMT.ORG/THE-JOURNAL.HTML

from the EDITOR

Welcome back! The editorial board and I are thrilled to finally be back at it both in the classroom and in the Journal. Hopefully we have all made it through the darkest part of this storm and are moving ahead towards brighter times.

After a short hiatus, we've got two great articles to finally share with you in this issue. Samuel Beaumont at Hallmark University discusses the moral development and ethical behaviors among A&P students. Along with the presentation of findings from the working group at Clemson University, led by Katie Shakour and Eliza Gallagher, about how A&P administrators, instructors, and students coped with the changes to their education during the COVID-19 pandemic.

We hope to continue to see our community pick back up on their academic endeavors and research efforts. In addition to COVID-19 induced adaptations of our programs, I know we all patiently await the update to our Part 147 regulations. In these ever-changing times, I hope ATEC and the Journal can continue to be a source of communication, guidance, and insight for administrators and instructors alike.

Best,

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COMMITTEE UPDATES

COMMUNICATIONS COMMITTEE

The committee focused on two primary initiatives this year, publication of the *ATEC Pipeline Report*, and enhancing visibility on LinkedIn.

The Pipeline Report again proved to be a valuable resource for the aviation technical community—one of the few sources of workforce supply and demand data. While the report recognizes the significant decline in air transport, the findings suggest current workforce challenges are much more acute than they were pre-pandemic, and what we as a community can do together to help address them.

If you are a school representative, please be on the lookout for the annual survey—coming to inboxes in January—which serves as the primary source of information for the Pipeline Report. We know the questions necessitate research on the respondent's part, so we thank you in advance for taking the time to respond.

If you haven't already, sign up to receive the ATEC newsletter. We also encourage you to follow us on LinkedIn.

JEFFREY DUNAGAN

COMMUNICATIONS COMMITTEE CHAIR

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MEETING PLANNING COMMITTEE

With COVID-19 concerns still at the forefront of our daily lives, the 2021 ATEC Annual Conference again went virtual with our first online professional development series. Thanks to the incredible work from the committee, sponsors, and speakers, the event was a success with over 100 attendees. For those that were not able to attend, recorded versions of all the sessions—and other previously recorded webinars—are available in the members-only portal at atec-amt.org/webinars.

The committee is pleased to finally be planning the long-awaited in-person conference for March 20-23, 2022 in Fort Worth. If you haven't already you can see the agenda, reserve accommodation, and register to attend at atec-amt.org/annual-conference. Exhibitor, employer link and sponsorship opportunities are also available.

KELLY FILGO

MEETING PLANNING COMMITTEE CHAIR

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REGULATORY COMMITTEE

Committee members spent more time this past year reviewing and drafting proposed guidance material to accompany the new part 147, facilitating webinars and resource material to assist the community with the imminent changes to the regulation. Our members were active on the airman certification standards working group, a document which is also set to publish next year.

The committee has also worked with our sister organization, Choose Aerospace, to develop hands-on labs and projects to support high school curriculum development. The resources will also be available to the part 147 community, which we expect to be a valuable benefit to schools looking to update their programs when the new rule is published.

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MEMBERSHIP COMMITTEE

Despite another year of unprecedented challenges as the industry tries to regain traction from the COVID-19 pandemic, the trade association again enjoyed record high membership—for the sixth year running. The percentage of part 147 programs that are ATEC members also continues to rise, last year 73 percent of all certificated aviation maintenance technician schools were members of ATEC. We invite you to check out the entire community on our new and improved aviation maintenance school maps, available at atec-amt.org/school-map.

ATEC is currently processing 2022 membership renewals—we thank you in advance for your continued support in the new year. If you are not a member, we would encourage you to come on board. Members enjoy a wide array of benefits, including access to industry experts, curriculum resources, and discounts on events and ATEC-developed materials. (To see our full suite of benefits, visit atec-amt.org/members-only.)

Most importantly, member dues support our advocacy efforts and fund initiatives that promote aviation technical careers. We are stronger together and as of today, ATEC is stronger than ever.

KIM PRITCHARD

MEMBERSHIP COMMITTEE CHAIR

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COMMITTEE UPDATES

LEGISLATIVE COMMITTEE

The council is awaiting FAA implementation of the Promoting Aviation Regulations for Technical Training (PARTT) 147 Act, legislation mandating FAA promulgation of a community-drafted, performance-based part 147 by March 2021 (get more information about the rule at atec-amt.org/the-new-part-147). While that deadline has come and gone, we have continued to engage with our congressional champions and FAA officials and expect the final interim rule to publish early next year.

The council is planning a virtual fly-in for this spring, to ensure the part 147 rule stays top-of-mind for our legislative leaders. We encourage members to participate in that event (more information to come) as well as our in-person Washington Fly-in, scheduled for September. More information is available at atec-amt.org/fly-in.

JARED BRITT
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CHOOSE AEROSPACE, INC.

ATEC's foundational arm turned one-year-old this year, and what a big year it was. The 501(c)(3) elected a fantastic slate of stakeholder representatives and conducted a procurement process to identify partners to support its inaugural mission to create aviation maintenance technical curriculum. In the fall, we kicked off a pilot of the curriculum, which is expected to officially roll out next fall.

As we explained in a recent webinar (available here), the final curriculum platform will create new pipelines into aviation maintenance technical schools and aviation technical careers. We look forward to collaborating with the community as we pursue the very ambitious initiative.

RYAN GOERTZEN
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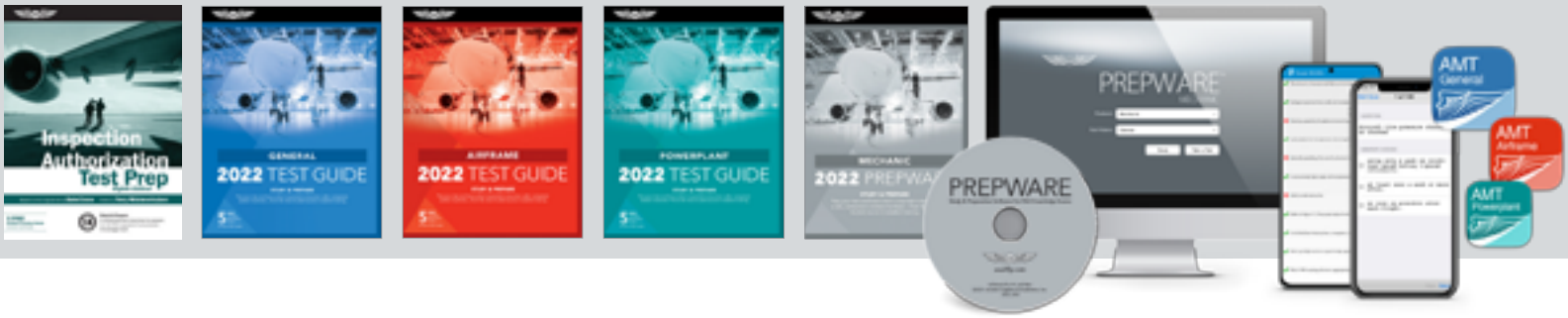

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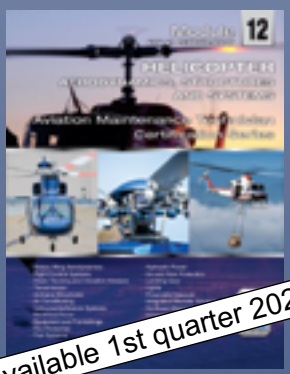

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The COVID-19 Pandemic's Effect on Student Learning at Aviation Maintenance Technology Schools

BY

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ABSTRACT

In March 2020, students across the country experienced disruptions to their learning due to the COVID-19 crisis. Aviation Maintenance Technology Schools (AMTS) were no exception. These schools relied heavily on hands-on learning to train the next generation of aircraft maintenance technicians, but, for varying periods, students were unable to attend in-person classes and complete hands-on projects. Schools could delay learning until they could resume in-person classes, or they could switch to remote lectures and complete required projects once they returned in-person.

Through a resilience engineering framework, this research explores AMTS' responses to the crisis and the effect both disruption and institutional response had on student learning. The research team conducted 43 semi-structured interviews with administrators, instructors, and students at AMTS nationally. During these interviews, participants shared their personal and their Part 147 schools' responses to the pandemic. Content analysis revealed that schools were under-prepared for any long-term disruption to their programs. Student learning suffered as a result. We discuss our research in relation to the effect on academic continuity and identify some ways which help mitigate disruptions.

Keywords: Aviation Maintenance Technology Schools; two-year college; COVID-19 learning adaptation; learning management system; resilience engineering; technology acceptance model

INTRODUCTION

Commercial and private air travel is critical to the United States economy (International Air Transport Association, 2018). The safety of that travel depends on a well-trained workforce of aviation maintenance technicians (AMT), and the Federal Aviation Administration (FAA) has oversight of all 183 Aviation Maintenance Technology Schools (AMTS). That oversight, granted and described in Part 147 of the Electronic Code of Federal Regulations, is so closely connected to the curriculum and certification requirements that AMTS are commonly referred to as "Part 147 programs."

According to the Boeing Pilot and Technician Outlook 2021-2040 Report, there will be a demand for 626,000 technicians in the coming years. Indeed, the aviation industry needs the number of new mechanics to increase 37 percent annually to bridge the gap between the retiring and hiring rates and to meet the projected demand (Aviation Technician Education Council [ATEC], 2018). These shortage estimates are exacerbated by findings that many individuals nearing retirement, including aviation maintenance workers, left the workforce early because of pandemic-related issues (Fry, 2020). Academic continuity for AMTS is crucial to meet current and upcoming demands in the field and thus to preserve the economic well-being of the country.

In March 2020, educational institutions across the United States experienced an abrupt halt to their in-person learning because of the novel COVID-19 virus spreading around the world. More than 25 million college students in the United States were affected, including all AMT students (Alexander, 2020). For AMTS, administrators and instructors had to consider how to continue to teach students while maintaining FAA accreditation standards. The FAA has strict requirements for student attendance, lab hours, classroom hours, order of instruction, total number of hours, and assessment methods (Barbagallo, 2015, pp.6-9). Many of those requirements had to be adjusted given the need to protect students, faculty, and staff from COVID-19, especially given numerous unknowns related to the virus in March 2020.

In response, the FAA provided six options for AMTS. One, AMTS administrators could build upon their existing, approved distance learning with some alterations, which included postponing examinations and testing. Two, administrators could create a temporary distance learning program. This option was included because the approval process for a permanent distance learning portion of the program would not meet the pandemic-induced immediate need for remote learning. Three, the FAA would permit a student to be absent up to 80 hours to account for the duration of COVID-19 infections. Four, AMTS could suspend their operations for a period. Five, a school could submit a proposal for an alternative response to COVID-19. Six, a school could request an exemption from a requirement.

Part 147 programs rely heavily on hands-on and kinesthetic learning to train students. Those established teaching techniques did not transfer directly or easily to remote learning, and the community was forced to evaluate how to teach students in changing circumstances that varied considerably from institution to institution. Each AMT program administrator applied for one of the options to their local flight standards office (FSDO) for approval (Black, 2020). However, schools were not guaranteed approval for curricular deviations. Each FSDO evaluated the proposed changes to curricula in their jurisdiction to determine if they complied with FAA regulations.

This research is part of a larger project exploring how AMTS responded to the COVID-19 crisis and maintained academic continuity. In this

paper specifically, we examine the pandemic's effect on AMT student learning.

THEORETICAL FRAMEWORK

We use the Resilience Engineering (RE) framework for this exploration of AMTS' responses to the COVID-19 crisis. RE is a "proactive approach that looks for ways to enhance the ability of organizations to explicitly monitor risks, and to make appropriate tradeoffs between required safely levels and production and economic pressures" (Madni & Jackson, 2009, p181). Resilient properties are linked to four basic abilities: respond, monitor, learn, and anticipate. The organization uses these abilities to adapt to disruptions. Within each disruption to the system, there are four phases to observe and evaluate: avoidance, absorption, recovery, and adaptation. Extending a preliminary study by Jain et al. (2021), we examine how resilience factors at AMTS affected student learning during the COVID-19 crisis.

METHODS

Building on the preliminary research by Jain et al. (2021), we developed interview protocols[1] that were then pilot-tested and refined to ensure communicative and theoretical validity (Tong, Sainsbury, & Craig 2007; Walther, Sochacka, & Kellam, 2013). Using these protocols, we conducted 43 semi-structured interviews with students, instructors, and administrators associated with AMTS in the United States. This interview approach allowed researchers to explore ideas and themes as they arose during interviews, rather than the inflexibility of structured interviews that do not allow any deviation from question sets. Throughout the larger study from which the results in this paper are drawn, we evaluated our research methods and analysis techniques using the COREQ checklist by Tong et al. (2007) to ensure quality.

While interviewing, we focused on the immediate learning responses AMTS took and probed about e-learning and digital learning tools such as virtual reality simulations and labs, technological resources designed to assist education, and ways administrators, instructors, and students maintained academic continuity. We were especially interested in how instructors and students continued required labs and practicals given the hands-on nature of Part 147 programs. These interviews provided a wealth of information about student learning in AMT programs during the pandemic, and those themes form the focus of this paper.

Participants and Sampling

In March 2020, Part 147 programs had two main options: switch to remote learning or temporarily halt instruction. Of our research participants' schools, about 11.6 percent closed until they could safely reopen for in-person learning. Students in those programs did not engage in any remote or distance learning. The remaining 88.4 percent of interview participants engaged in some sort of e-learning.

Once administrators made the choice to engage in online learning, they had various timelines for implementing online learning. Some instructors were allowed a month to move their courses online, while others had to use their evenings and weekends to create online courses in a shorter transition window.

To account for these stark differences in overall approach, we actively recruited individuals from programs that engaged with remote learning and from those that did not. Among those who engaged with remote learning, we made sure to include individuals from programs that implemented a temporary pause to make the transition online, as well as with those from programs that had an immediate transition. In some cases, we spoke with multiple individuals from the same program, which provided different perspectives and helped us triangulate relevant findings.

We identified study participants through established partnerships with the Center for Aviation and Automotive Technology Education Using Virtual E-Schools (CA2VES) at Clemson University, the NSF National Center for Autonomous Technologies (NCAT) at Northland Community and Technical College, and the Aviation Technician Education Council (ATEC). Participants were instructors, students, and administrators from AMTS from around the United States. We used email communication as our primary form of recruitment, and we advertised through the ATEC monthly newsletter. To expand the pool of participants, we also used snowball sampling, where a participant recommends other participants (Trotter, Schensul, & Kostick, 2015, p.675). We provided a $25 digital Amazon gift card incentive to each participant at the conclusion of the interview. The research team selected participants on the basis of two criteria: 1) if they were over the age of 18, and 2) they were a student, instructor, or administrator at an AMTS during March 2020 and for at least one subsequent semester. We stopped recruiting when we reached data saturation, meaning we gleaned no new information from subsequent interviews (Guest, 2015). This occurred within administrator, instructor, and student groups at different times during data collection because of the differing perspectives and experiences during the pandemic.

Data Collection

Three research team members conducted the interviews at a time convenient to the participant. The interviews ranged from 30-65 minutes and were conducted and recorded via Zoom with only researchers and participants present. Transcription was completed by the third-party secure service, GoTranscript, and transcripts were then verified against the audio recording to correct any transcription errors. After verification, transcripts were cleaned of all identifying information and participant names were replaced with a numerical code to protect anonymity. All quotations included in this paper use the numerical codes and we use they/their/theirs pronouns to further protect participants' anonymity.

Data Analysis

We created a code structure both inductively and deductively. In the familiarizing cycle of analysis, we used provisional codes from the

1 Please email authors for copy of the interview protocols.

preliminary study by Jain et al. (2021) to identify portions of the data that were strongly aligned with our theoretical frameworks. Multiple additional familiarizing passes used open coding in the Atlas.ti qualitative coding software to identify emerging themes and expand the existing code structure. These initial codes were reviewed and discussed to reach consensus among the research team, then sorted into categories as we transitioned to the sense-making cycles of analysis (Saldaña, 2016). Code-sorting resulted in five major categories: Perceptions of Administrative Structure, Perceptions of Learning Environment, Perceptions of Own Learning and Digital Self-Efficacy, Peer Interactions, and Broader Context.

One member of the team then made five separate passes through the entire set of interviews, extracting excerpts that fit within each category. Reorganizing the data in this way allowed us to identify salient themes within each of the overarching categories to make sense of the whole of the data (Saldaña, 2016). The findings in this paper include themes that fell in each of those five categories as they pertain particularly to student learning during each of the four RE phases.

RESULTS

These interview data provide helpful insight into how institutional and program resilience affected student learning in each of the four phases of the pandemic disruption.

Avoidance and Digital Learning Tools

Avoidance is the term used to describe aspects of a system or organization that help prevent a disruption from affecting normal operations. Avoidance includes the anticipation of disruptions and mechanisms in place before a disruption (Jackson 2010, p.12). In general, educational institutions across the United States were ill-prepared for a long-term disruption to in-person learning because they lacked avoidance mechanisms that maintained academic continuity. However, we found some exceptions and examples of avoidance mechanisms within AMTS. Participant 5, an administrator, had proactively addressed interest in distance learning from students who lived in remote places making a commute to the classroom difficult. To meet those needs, they had designed their program so that it could eventually become a distant-learning program for all the lecture portions. Half of their lecture courses were already approved for distance learning before the pandemic. “Really, as far as what we had to do, is secure final permission from the FAA for a number of courses…within a week we had the entire lecture.” Even before the COVID-19 crisis, they had “developed units that can be sent to the student to allow the students to do labs online.” For Participant 5, the change to a remote system was relatively seamless because of the prior incorporation of digital learning tools.

At the other end of the spectrum were schools that did not use any digital learning tools. One program administrator had to tell students

to actually check their emails, which they had never done before. Another program administrator, Participant 4, said "Everything was in-person lectures and in-person labs and projects" and the pandemic required a quick implementation of a learning management system (LMS) for all of their courses as they were not using one before March 2020. Where Part 147 programs with established digital footprints were able to avoid some of the immediate pandemic disruption, programs without this avoidance element bore the full brunt, making the next phase, absorption, more challenging.

Absorption and Struggles with Online Instruction

Absorption is the phase in which an organization continues to operate under disrupted circumstances, often with loss of functionality in key systems. In a resilient system, loss of functionality at one point can be absorbed by distributing the effects to other systems, allowing the system to continue functioning until the disruption is past. In the context of the COVID-19 pandemic, the absorption phase relates to the immediate responses in spring 2020.

Some Part 147 programs were unable to absorb the effect and instead suspended operations. "We're not teaching it or we're teaching it in-person." This firm statement by Participant 15, an instructor, captures the sentiment from Part 147 programs that chose to pause instruction rather than transition online. Such decisions were generally driven by concerns about maintaining the same standard online as in-person and about the amount of work it would take to move classes online. Instructors and administrators at these programs chose instead to work with health and safety officers to create COVID-19 safety protocols under which in-person instruction could resume. In some cases, the return was delayed as long as 6 months, creating a large break in academic continuity and student learning.

Even with online options, AMT students experienced interconnected issues with academic continuity. First, students experienced an abrupt change in learning and teaching. Before the pandemic, students were accustomed to going into school, listening to a lecture, and completing lab projects. They could get updates about their classes and schedule from daily in-person conversations. When the pandemic affected Part 147 programs, some students struggled because their program lacked avoidance mechanisms, and they had to learn new hardware and software. Participant 17, a student at a Part 147 school, said, "I'm barely getting used to it. I've never really been tech savvy to be honest. I can run a computer but going through the [LMS], uploading files, using Acrobat, all that stuff was new for me. It wasn't a pretty transition." Using digital learning tools and communication was new for many students, and some were reluctant to engage with these resources.

During the absorption period, instructors had a very short time to transition their classes to an online format, limiting their ability to create a robust online curriculum. As Kelly and Columbus (2020) noted, uploading lectures and accompanying slides is not the same as an in-person class. Students commented on the lack of engaging material when their classes moved to distance learning, with one participant describing "Death by PowerPoint" in contrast to the engaged in-person lectures. During remote learning, students listened and watched a lecture. However, they no longer had the projects that followed or hands-on demonstrations. Rather, they were assigned extra reading and writing assignments. Many instructors sent the students links of videos to watch on platforms like YouTube. Some instructors were able to livestream or record themselves conducting the labs, so the students could watch them immediately after the lecture. During the absorption phase, students relied heavily on digital learning tools and communication, with extra material that lacked the engagement they relied on in pre-pandemic times. This approach helped maintain academic continuity and avoid pandemic-caused disruptions, but the learning was not equivalent to pre-pandemic, in-person education.

In contrast, when administrators and instructors had previously incorporated e-learning and digital learning tools into their program, students did not express as much frustration with their pandemic-caused remote learning. Rather, students commented on technology being outdated or in need of an upgrade. "The software that we use for the drawings and the software we used for the basic electricity and the electric circuits is extremely outdated," said Participant 41, an AMT student. They wanted better and more resources, and when they elaborated they said, "actually, it's like a real good way of learning basic electricity but the execution. It was slow and unresponsive. All the modules that you would do were really, really, really long." Participant 37, a student at a different AMTS, wanted more 3-D models with cutaways and more virtual reality simulations because they "can see the internal components of things that we're discussing, [the instructor] could highlight what was going on, like, 'hey, when the piston is up in the compression stroke this is what's happening over on this side, exhaust gases are coming.'" They appreciated the immediate reinforcement of lecture material some of these digital learning tools provided. These students extensively using digital learning tools before March 2020 were not hesitant to engage in online learning, demonstrating its usefulness for avoiding effects from the pandemic. This is especially true when compared to their peers at schools that used digital tools minimally, such as using an LMS solely as a file repository, before the pandemic.

Recovery and Struggles with In-Person Learning

The recovery phase of RE includes the steps an organization takes to return to pre-disruption functioning (Jackson, 2010). After the initial disruption in spring 2020, schools entered the recovery phase during summer and fall, where they saw what worked and what did not for students. Whether programs paused instruction or transitioned to remote instruction, AMTS' return to any level of in-person instruction had their own struggles. Students had to maintain distance to comply with health and safety protocols, which was not always easy in a Part 147 program. Participant 37, a student, said they attempted to ask a nearby student a question, but their instructor reprimanded them to maintain distance. Participant 37 notes, "I'm like 12 feet away...It was almost like they didn't want us even talking to other students...it felt like we're always being watched." They de-

scribed how it was a completely different learning environment when they returned to the classroom, and the sense of community was different because of lost or reduced informal interactions.

Regardless of whether schools engaged with online learning, students also commented on the rushed schedule to complete all the hands-on projects when in-person classes resumed. Many schools created a compressed project-only schedule or conducted class when students would normally be on a break to get the students to complete the classes they began in January 2020. "It was very accelerated, so I wasn't able to take my time and understand the theories about it. It was more challenging…Everything was just rushed," said Participant 14 when speaking about the return to in-person learning. Because of the major disruption in academic continuity, students like Participant 14 struggled to keep up with the schedules their program instructors and administrators created.

Adaptation and Lasting Change

Adaptation refers to the long-term changes an organization makes to prevent further disruptive events in the future. In this phase, organizations change in response to what they learned. Adaptations within an organization are often determined by managers, so the administrator interviews are especially revealing for this phase. Administrators were generally hesitant to incorporate new technology into their programs moving forward, citing three main reasons. First, they were not confident the investment was worth their time. They perceived the digital learning tools as too expensive for their programs. Second, administrators argued that they had been teaching in-person for decades, and they did not see reasons to change even with the pandemic's effect on learning. Finally, instructors and administrators said that the AMT profession is hands-on and the teaching should be as well.

Contrary to the hesitations we heard about in our interviews, some AMT community members are eager to incorporate technology into their classrooms. Several articles in the ATEC Journal discuss ways to incorporate new technology and digital learning resources into schools. Steigerwald and Steigerwald (2018) discussed ways to use online systems to evaluate student understanding of the material. They found that overall student learning improved because online formats allowed for self-testing. Manson (2018) advocated using newer technology like virtual reality training for beginners. Morris (2018) advocates for using software like AutoCad to teach students drawing. Kim and Sterkenburg (2017) looked at implementing 3-D modeling and reverse engineering into their curriculum. Filgo (2017) advocated for incorporating simulations into the AMT classroom, and he provided a list of resources for interested individuals. Despite these calls for increased technology use in AMTS, Russo (2018) found that instructors were hesitant to integrate changes into their teaching. Filgo (2017) called aviation maintenance instructors "stubborn people, hesitant to change because they trust what works." In a later journal, Smith (2019) asks if AMT programs are training students for the test or the industry, and he joined Dyen (2017) in expressing a need for revisions to the curriculum. The pandemic might have provided the catalyst to respond to these calls, as revisions are currently underway with one of the COVID-19 relief bills. These digital learning resources would provide students tools to engage them if they were learning in-person or attending school remotely.

Overall Effects on Student Learning

The most significant effect on student learning was the delay between lectures and the hands-on projects. Students experienced delays whether their Part 147 school participated in remote learning or not. Some AMTS experienced as much as a 6-month delay between a lecture and the lab that accompanied it. Other schools were able to bring the students back after only a 1-month delay. No matter the length of the delay, instructors reviewed the relevant material with the students. However, students said that they still struggled with retaining the material. Participant 14 discussed how the delay affected their learning.

> I don't think it was that great because the PowerPoint right there in class, and then immediately doing the lab afterwards, you understand it more. When you separate those, you lose knowledge about it, I guess, over time, and then you forget how to do things.

Before the COVID-19 crisis, AMT students reinforced their learning with hands-on activities, rather than extra reading or writing on the concepts. With remote learning, they were expected to learn new material without reinforcement of previous material. Students were less confident of their learning in the online environment because of lack of active reinforcement through projects. As students struggled to learn, there was some hesitancy about how prepared they would be when they graduated. Participant 28 was especially concerned with learning basic electricity via e-learning. "Remote learning hurt me really bad because now I'm struggling when they bring up electricity questions or I have to troubleshoot something electrical. It's just hard for me to even know where to start." The student was told that they would make up the lost knowledge in the next class for electricity, but they felt that this was an insufficient answer because their foundational knowledge would always be weak. After an interview with one participant who was both an AMT instructor and administrator, we received a follow-up email that they had asked their students how they felt about their online learning. The students resoundingly responded that they were not confident in what they learned online, despite their instructor reviewing the material and expressing confidence in their knowledge

The largest challenge with switching to remote learning was that AMTS were unprepared for the mass disruption to learning that COVID-19 caused. In March 2020, many AMTS rushed to create online programs for their students. However, students struggled with the delays between lectures and projects and new learning styles. Robust online courses can be as effective as in-person, especially for lecture portions of courses, but they must go beyond uploading a PowerPoint and recorded lecture to an LMS. Instructors need time and resources to create online courses, and the rush to adapt in

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spring 2020 provided no such opportunity. As a result, student learning was negatively affected.

AMTs are in high demand (ATEC, 2018; Boeing, 2021), and the COVID-19 crisis created issues with academic continuity for the next new hires in the profession. The transition to an online program was harder for students whose programs did not engage with an LMS or digital learning tools. They were more hesitant to turn assignments in remotely. This could have been mitigated if the schools had used an LMS and other digital learning tools, the students and instructors would not have had such an abrupt change in learning when the time came to learn remotely. Students that were familiar with e-learning before the pandemic had an easier transition when the pandemic abruptly halted in-person learning.

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Character Education: Insights on Moral Reasoning Development in New Aviation Technician Students using the Defining Issues Test 2

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ABSTRACT

In this study, the principal investigator assessed the initial moral development levels of 94 new undergraduate students majoring in Associates of Applied Science in Airframe and Powerplant technology at a university in the southwest United States. Scores from the Defining Issues Test 2 (DIT-2) were compared to student age, religious orthodoxy (RO), and human liberalism (HL) subscales to determine if a relationship existed. The subscales on the DIT-2 include personal interest (PI), maintaining norms (MN), post-conventional (P), and the N2. In addition, this study compared the mean P and N2 scores from the incoming cohort of students with the national norms of other student and professional groups. The results showed no relationship between age, nor veteran status, and any subscale measured by the DIT-2. Demonstrating a weak positive association were religious orthodoxy (RO) and the maintaining norms (MN) subscale, and human liberalism (HL) and post-conventional thinking (P). Overall, the incoming aviation technician students post-conventional scores (P) fell below the national norms for high school students and above those in junior high.

Keywords: Aviation technician, aviation maintenance, Defining Issues Test 2, character education, ethics development, moral reasoning development

INTRODUCTION

Employees' ethical behavior is a concern for all industries in the wake of issues such as the Enron scandal and the financial collapse of 2008. When discussing ethics and codes of conduct, many people think of those in the fields of business, finance, medicine, and law, where some of the most publicized breaches of ethics have occurred, but ethical issues in the career field of maintenance do not usually come to mind. When ethical breaches by those in maintenance occur, equipment failure, decreased lifespan of valuable assets, and potentially injury and the loss of life could occur. The field of aviation is unique because of its emphasis on the passengers and crew safety, as required by numerous federal regulations governing the industry. Aviation safety is preeminently dependent on the maintenance technicians who repair and maintain the equipment to precise and exacting standards. The ethical development of those with a Federal Aviation Administration (FAA) issued airframe and powerplant (A&P) certificate represents an essential prerequisite to safe operations and flight in the aviation field. Risks inherent in the aviation industry are mitigated through government regulations and standard operating procedures. However, when individual maintainers make daily judgment calls about the sufficiency of their work and reporting, such judgments have ethical implications and are directly informed by their personal character and commitment to apply their aviation safety training.

Aviation Ethics Education

In his work Democracy and Education, John Dewey (1916) argued learning is a life-long endeavor providing individuals opportunities for development at all stages of life. Moreover, Baron (2011) pondered if teaching integrity and professionalism is possible when training aviation technicians, citing incidents, such as American Airlines Flight 191 in 1979, where technicians deviated from protocol and procedures because of various pressures to get jobs completed. In the same vein, Oderman (2002) researched the prevalence of ethics training in 4-year aviation bachelor's degree programs, finding little formal research and a low level of ethical instruction across aviation education programs. Oderman (2004) recommended that aviation schools invest in ethics instruction through the development and implementation of ethics training programs and materials.

The above studies echoed statements made by industry partners in professional advisory committee meetings with the study site. The development of soft skills in addition to technical abilities are an important component of the educational process and desired by employers. Like Dewey (1916) pondered, the study site believes development is a lifelong process and that ethical instruction can increase integrity in aspiring aviation technicians.

Continuing to examine moral development in aviation, Asim et al. (2015) examined the influence of an ethics course on second-year aviation students studying to be pilots. The researchers used a pre- and post-test survey, and the sample consisted of 149 students. Students took the survey before the ethics course and after its completion, and the survey assessed the areas of cheating, moral behavior, and code of conduct. Over the same period, a control group not participating in the ethics course also received both surveys at two different times. The authors compared the DIT-2 scores of students who participated in the ethics course against students who did not participate. Findings indicated that students who completed the ethics course possessed a statistically significant difference in positive beliefs about not cheating and the importance of demonstrating moral behavior. The authors concluded their study with recommendations to instill ethical training for all aviation students seeking to become pilots. This specific experimental finding aligns with other ethics writers' research observations: "behavioral economists have shown that people can be trusted experimentally to do the right thing when reminded of their responsibilities as principled adults"

(Ariely, 2010).

Citing Olderman's (2002, 2004) work, Diels (2007) used the DIT-2 to analyze moral reasoning levels in three groups of pilots at Embry-Riddle Aeronautical University. The sample included 17 students, 18 pilot instructors, and 7 professors. The results indicated P-scores, which measure the level of moral reasoning development, increased with educational level. Scores ranged from 38.85 in students to 36.47 in flight instructors, and professors possessed the highest scores of 50. The N2 scores, another measurement of post-conventional thinking, followed a similar trend, with students scoring 29.56, flight instructors scoring 38, and professors scoring 45.39.

Furthermore, the observed moral reasoning levels of the student pilots fell below the national level for college students. According to Rest (1986), the average college student possesses a mean P-score of 42.3, high school students 31.8, junior high students 21.9; the higher end of the scale is philosophy doctoral students scoring 65.2. However, the small sample for this study by Diels limits generalizing the findings to a broader population. Diels (2007) recommended that future studies occur with larger populations to further examine moral development in aviation education.

Moral Reasoning Development and Education

Student's character and ethical development occur through educational interventions seen from the primary to the post-secondary level (Abduloh, 2018). Character cannot develop in a vacuum and is acquired through repeated behaviors throughout life. It requires forming relationships and role-learning from others who are engaging in moral actions (Crossan et al., 2013). In a meta-analysis of 52 studies focused on the primary and secondary school levels, Jeynes (2019) found numerous traits positively associated with character education training. These included improved moral judgment, improved behavior, improved social skills, and increased compassion and honesty. Furthermore, post-secondary educational interventions appear linked to growth in moral reasoning development. In a study in the United States, using the DIT-2, Auger and Gee (2016) examined the effect of a media ethics course on moral reasoning judgment. After taking the course, students showed an increase in N2 scores, indicating a rise in their level of post-conventional thinking.

Relationships that could be associated with moral reasoning levels are political preference, religiosity, and age. Students who identify as politically left demonstrated higher scores in moral judgment competence than students who identify as politically right in a study at a university in Switzerland (Hummel et al., 2018). A different study at an urban university in the United States found that students with a fundamentalist interpretation of the Bible had lower gains than students with more liberal religious views (Thomas & Dunphy, 2017). Behar-Horenstein and Tolention (2019) also discovered that dental students who scored high on the religious orthodoxy scale possessed higher maintaining-norms scores, lower personal interest scores, and lower P- and N2 scores than those scoring lower on the scale. According to a meta-analysis of 52 studies conducted by Jeynes (2019), the effect of a character education program rises with student's age. After distributing Clark and Clark's Personal Business Ethics Scores, an assessment written as ethical business scenarios, to 178 individuals, researchers found that people aged 36–45 scored higher on perceptions of ethics than those aged 26–35. Individuals in the 17–25 age group scored the lowest of all the age ranges (Sarkessian & Nguyen, 2017).

According to the FAA's Human Factors Guide (2006), three levels of decision-making exist. Level one is an individual who makes decisions based on their self-interest, level two is someone who bases decisions on societal expectations, and level three is making decisions with the public's interest in mind and a focus on others. The manual also discussed the challenges facing aviation technicians' balancing safety and speed, situations where the correct tools are not present, or insufficiency of training and recollection for a specific task. Kohlberg's theory of moral development also possesses three similar stages (Kohlberg, 1969).

The Character Education Program of Study

The character education program of study is a vital component of the academic curriculum and educational process at the study site. Seven primary character traits form the foundation of the character program: dependable, integrity, honesty, communicator, agile, servant, and leadership. Part of the institutional mission statement calls for the development of superior character in students.

Superior character, as defined by the study site, is the result of a life-long effort (process) of developing and refining one's moral and ethical qualities (core values) through critical and reflective thinking on lived experiences and self-assessment of motives behind (driving) behaviors and emotional responses (self-control).

Development of superior character results in:

- An individual with a full understanding of what they view as right and wrong
- An individual who incorporates the university's seven core traits into their decision-making process and how they react to life situations
- An individual who understands character building is a never-ending process with the goal of building emotional trust with other people though decision-making that values others
- An individual with the forethought to consider how one's actions might affect others.
- One who analyzes if their course of action and decisions are aligned with the type of person they want to be
- Someone who reflects on prior choices and decisions then analyzes if their current set of moral considerations/beliefs should be revised, reinterpreted, or changed

Assessing the initial moral reasoning level of incoming aviation tech-

nician students is part of the university character education program evaluation process, which is part of the institutional effectiveness plan. According to the literature, the ethical and moral development of students at aviation technician educational institutions plays an important part in aviation safety, as a positive association exists between an individual's moral development level, knowledge of wrong and right, and engaging in moral action.

Purpose Statement

The purpose of this study is to measure the initial moral development of students to establish a baseline measurement comparing those levels to other populations and determine what role demographic factors might or might not influence moral development levels in incoming students earning an Associates of Applied Science in Airframe and Powerplant and the associated FAA A&P certificates. Moral development is defined as the ability of an individual to judge which of their available options is right, which in turns leads to a decision on what to do (Rest, 1986).

Research Questions

RQ1: Is there a significant relationship between aviation technician students' mean moral judgment scores and tudent religiosity?

RQ2: Is there a significant relationship between aviation technician students' mean moral judgment scores and students' political preferences?

RQ3: Is there a significant relationship between aviation technician student mean moral judgment scores and student age?

RQ4: Is there a significant relationship between aviation technician student mean moral judgment scores and student veteran status?

RQ5: Is there a significant difference in moral judgment scores between incoming aviation technician students, as measured by DIT-2 P and N2 mean scores, and the national norms for college students?

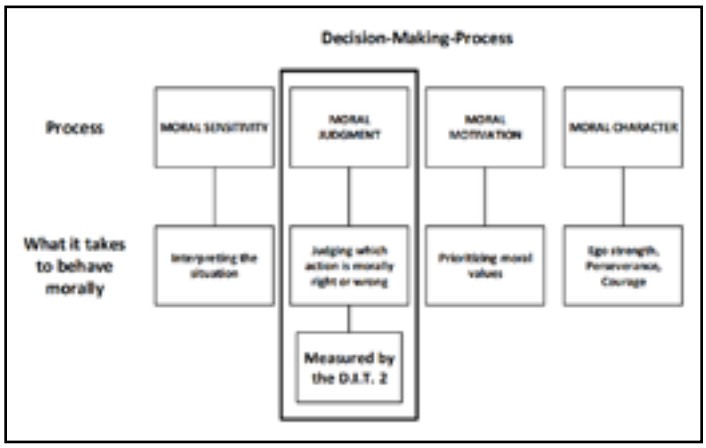
The hypotheses for this study predict that students older, those with low religious orthodoxy scores, and high liberalism scores will possess higher moral development levels, as evidenced by P and N2 scores. Students with prior military service are expected to demonstrate lower levels of pre-conventional thinking (PI) and higher levels of maintaining norms (MN) and post-conventional thinking (P). Furthermore, it is hypothesized, aviation students will exhibit lower post-conventional thinking scores (P) than the average college student.

Theoretical Foundation

Kohlberg's Theory of Moral Development is the theoretical foundation for this study. Piaget's (1932) Cognitive Development Theory influenced the work of Kohlberg. Piaget's theory contained four stages: sensorimotor stage, preoperational stage, concrete operational stage, and the formal operating stage. Kohlberg (1969) modified these into three levels of development termed: pre-conventional, conventional, and post-conventional, with pre-conventional being the lowest level of moral development and post-conventional being the highest or most advanced. Kohlberg goes on to declare that while individuals go through these stages at different paces, they go through them in the same order. Furthermore, individuals solve moral issues more effectively at the higher level than those still in the lower stages of development (Colby & Kohlberg, 1987).

James Rest (1986) modified Kohlberg's rigid stages of development into permeable stages or schemas. Rest's schemas in order from lowest to highest level are personal interest (PI), maintaining norms (MN), and post-conventional (P-score). Rest believed moral development was a continual process and possessed a cumulative effect over an individual's life. Rest also stated developmental levels could differ between unique groups of people (Rest et al., 2000). To determine an individual's moral development level, Rest created the DIT as an instrument to gauge the preferred schema individuals used when solving moral dilemmas (Rest et al., 1999).

Figure 1: Rest's four-component model



Note: Developed based on description from Rest (1986).

METHODS

A convenience sample of all incoming aviation undergraduate students enrolling between October 2019 and April 2020 composed the sample for this study. There was no control group or randomization of participants, all incoming students were offered the opportunity to engage in the study, and participation was voluntary. The P and N2 scores retrieved from the DIT-2 are reported numerically along with religiosity, age, and human liberalism scores.

Instrument

The instrument for this study was the Defining Issues Test 2. This assessment measures moral reasoning by using ethical dilemmas to activate moral schemas. While based on Kohlberg's theory of moral development, the DIT-2 uses the three schemas defined by Rest et

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al. (1999) rather than Kohlberg's six stages. The assessment consists of five stories requiring the participant to respond to a series of 12 statements for each story. The DIT-2 measures human liberalism by matching the participants answers to a certain question found in each of the five moral dilemmas. The score can range from 0–5 depending on how many matches are present. An example of a positive match would be if a respondent answered Heinz should steal the drug for his dying wife. Likewise, the religious orthodoxy variable is calculated using the ranks for item 9 found in the doctor's moral dilemma story. Specifically, the participant is asked if administrating a drug capable of hastening a dying woman's death is appropriate. The range for this variable is 1–9 (Bebeau & Thoma, 2003).

In use since 1974, the DIT demonstrates reliability with a Cronbach alpha in the high .70s to the low .80s, including a test and retest reliability (Bebeau & Thoma, 2003). The DIT-2 has been used in more than 400 published articles and demonstrates that educational level is responsible for 30–50% of the difference seen in the scores (Rest et al., 1999). The DIT-2 is validated according to several criteria as an instrument to measure moral judgment development. These included age groups, educational groups, moral comprehension, cognitive capacity, a link to moral actions, and links to political tendencies. Assessment scores demonstrate validity for both males and females with a minimal difference of less than half a percent variation (Thoma & Dong, 2014).

Data Collection

The Center for the Study of Ethical Development at the University of Alabama provided permission for use of the DIT-2. The study site's internal review board approved the data collection. All incoming aviation students received an email to their university account, inviting them to participate in the study. Email links redirected them to a SurveyMonkey® landing page, which contained the internal review board study consent language and the assessment. The students had no exposure to the character education program of study before taking the assessment. The raw data was sent to the Center for the Study of Ethical Development at The University of Alabama for scoring. The scored file was returned to the researcher in Excel® format and uploaded to SPSS for analysis. The file contained results for all developmental indices (P-score, PI, MN, and N2), religious orthodoxy score, and the human liberalism score.

RESULTS

A total of 94 students participated in the study. The sample composed mainly of males 84.4% (n=84), non-veterans 58.5% (n=55), and an average age of 26.9 (Table 1.1).

Results showed no significant statistical difference between veterans and non-veterans on any subscale of the DIT-2 (Table 1.2).

Participants were broken into age groups; those aged 30–39 scored significantly lower on the P and N2 scores and higher on the personal interested (PI) and maintaining norms (MN) scales than the other groups (Table 1.3). A gender demographic comparison was not made because of an inadequate sample of female students.

Table 1: Descriptive Statistics

Variable	Percentage (n)
Gender	
Male	84.4% (41)
Female	10.6% (10)
Veteran Status	
Veteran	41.5% (39)
Non-veteran	58.5% (55)
Age	Average 26.9 Range 17–57
Average P-score	23.6
Average N2 Score	20.47

Table 2: DIT-2 Mean Sub Scores by Veteran Status

Veteran Status	PI	MN	P	N2
Veteran	30.36	37.64	22.31	19.99
Non-veteran	31.93	35.24	24.51	20.82

Table 3: DIT-2 Mean Sub Scores by Age Group

Age Group	PI	MN	P	N2
20 and under (n=23)	33.48	34.52	24.35	21.94
21–29 (n=49)	31.31	34.08	24.82	21.15
30–39 (n=11)	30.55	44	15.45	12.39
40–49 (n=8)	26.25	43.25	24.25	22.92
50 and older (n=3)	31.28	37.33	26	21.22

The relationship between the DIT-2 subscales and the test variables of age, religious orthodoxy (RO), human liberalism (HL), and veteran status were calculated using a Pearson's correlation. In answer to research questions one through four no significant relationship existed between age, veteran status, and the DIT-2 subscales. A positive weak correlation between RO and MN appeared, in addition to a weak correlation between HL and P-score.

For research question four, the mean P scores for the aviation technician students, 23.6, were significantly lower than those of other undergraduate students,43.20 (Table 1.4) and ranked lower than P scores seen in high school students.

Table 4: Mean P-Scores of Various Professions

Profession	P-Scores
Seminarians/Philosophers	65.1
Medical Students	50.20
Practicing Physicians	49.20
Journalist	48.68
Dental Students	47.60
Nursing	46.30
Graduate Students	44.90
Undergraduate Students	43.20
Accounting Students	42.80
Veterinary Students	42.20
Adults in General	40.00
Business Professionals	38.13
Business Students	37.40
High School Students	31.00
Aviation Technician Students	**23.60**
Junior High Students	20.00

Note: Adapted by the principal investigator from Coleman and Wilkins (2004).

DISCUSSION

As a key component of the education outcomes for the study site, a need existed for an initial assessment of incoming students' moral development levels and to determine if there was a relationship between moral development, as evidenced by DIT-2 scores, and student demographics. The assessment findings suggest that student demographic factors of age, religious orthodoxy, human liberalism, and veteran status exert little to no influence on the moral development levels of incoming students. Furthermore, the P-score's average level indicates the moral development level of the study site's student cohort is far below that of other college-level students. Although these were weak, the only correlations that possessed a statistically significant relationship were RO and MN, and HL and P-score.

The correlation between RO and MN could indicate that students are guided during ethical decision-making by their understanding of their religious instruction or upbringing. They prefer to support the status quo rather than making decisions based on greater societal needs and those of personal interest. The correlation between human liberalism and P-scores indicates that students who are more liberal politically use post-conventional thinking when making ethical decisions instead of maintaining the status quo and decisions that would benefit them personally.

Bara (2015) examined the role of universities and character education by reviewing the work of Wilhelm von Humboldt, Cardinal John Henry Newman, and Jose Ortega y Gasset. All three individuals believed the university represents a key component of a thriving society, and it should encompass more than just transferring knowledge. The three philosophers concluded that nurturing of the individual through character development, and developing ethical citizens, is an essential component of the educational system. The literature implies that educational interventions can influence moral reasoning development in students.

Studies have noted group differences in moral development levels based on student demographics. Researchers used the DIT- 2 to measure moral development levels at Ursuline College, finding differences in moral development levels between graduate and undergraduate students. Furthermore, moral reasoning scores differed significantly between first-year students and sophomores, but not between juniors and seniors. Age also played a role with first-year students in their 20s possessing lower scores than first-year students in their 30s (Butler et al., 2011).

Chen (2013) outlined the presence of an individualization of moral development level and the continued moral development through character education efforts. A perceived sense of individual responsibility to act rightly and in accordance with something outside one's personal gain that is morally acceptable, arises from an individual's lifestyle, temperament, and life experiences. Collectively these lead to various virtues and different degrees of virtues between individuals. Also, Chen (2013) discussed how occupations attract individuals with certain temperaments, and backgrounds, come with societal expectations. The most successful students at the study site came from structured backgrounds, which indicates why veterans, with their inherent sense of duty to finish their academic mission, historically experience higher levels of academic success. Students who come from situations lacking positive role models and little experience in outcomes-oriented behaviors struggle with the academic, technical, and character aspects of the aviation program at the study site.

The ideal role models for aviation technician students are the aviation faculty. Miller and Coady (1986) discussed how teaching vocational ethics provides a framework for students to resolve ethical conflicts, positively influence work productivity and job satisfaction. They go on to emphasize the importance of faculty modeling the appropriate behaviors and serving as facilitators. Diels (2007) supported the ideal of modeling finding that faculty possessed sub-

stantially higher moral reasoning scores than students and significant influence on students. The character program at the study site weaves student-faculty interaction and mentoring into its academic and character curriculum allowing these relationships to flourish. This includes discussing and prompting reflection about moral and ethical dilemmas that students might face in their personal and workplace lives, developing individual and team solutions to resolve dilemmas, as well as hearing thoughtful critiques from other students, faculty members, and experts currently working in the field. Student engagement in ethical reasoning and the development of critical thinking and reflective thinking skills, when combined with the academic and character curriculum, should increase post-conventional thinking levels and lower personal interest scores over the course of the academic degree program. It is hoped this higher level of moral reasoning resulting from the character education program of study will result in more pro-social workplace behaviors and higher professional ethical standards by the program graduates.

Limitations of this study include the fact the responses are only from individuals who volunteered to participate in the assessment. It is possible those not responding possess far different moral reasoning levels than the sample. The DIT-2 defines religious orthodoxy as Christian only, which excludes those with no religion, or other religious beliefs. This study also lacks a control group and represents only one institution. The student profile at the study site is unique. It is a Hispanic Serving Institution with a high population of veterans and non-traditional students. Therefore, generalizing the results of this study to other schools and student populations might not be applicable.

The future direction of this study is to require all students to take the DIT-2 upon matriculation and then reassess the students at the end of their academic career immediately before graduation. Moral reasoning levels for all subscales of the DIT-2 will be analyzed to determine if and to what extent change occurred after completion of the academic and character program. Group comparisons will be studied to determine if the character education program is producing the desired effect across different types of students in the study and to determine if any mitigating factors exist. The group comparisons will be age, gender, veteran status, cumulative GPA, between graduates who obtained their A&P certifications and those who did not. Researchers also plan to analyze how long it took A&P graduates to be placed in-field after graduation and against students in other academic programs at the study site who also participate in the character education program of study.

CONCLUSION

The principal investigator found that new students majoring in an Associates of Applied Science in Airframe and Powerplant technology degree possess P scores lower than the national norms for college-level students. Results indicate there is no trend between RO and moral reasoning scores, and there is only a weak correlation between RO and MN. Human liberalism also failed to demonstrate a trend, with only a weak correlation between HL and P-scores. Veterans show higher MN scores, and lower P-scores than non-veterans but these did not approach significant levels. An anomaly in the age group of 30–39 emerged with P and N2 scores far below the national norms and those seen in the other age groups for this study. The 30–39 grouping also possess higher PI and MN scores than other study participants.

By evaluating character and ethical development programs of study in different settings, educational leaders can develop effective policies and interventions designed to enhance moral reasoning levels in students. The unique student body at the study site matriculates with established life philosophies developed from their cumulative life experiences. The ongoing concern for the study site is: How can the institution create a meaningful and highly effective program full of crucible moments that fundamentally disrupt cognitive thinking? The overarching goal is to further develop the student's moral reasoning levels, thus preparing them for employment as aviation technicians with the technical, academic, and soft skills required by employers.

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