DOI: 10.1002/cc.20619

WILEY

TRENDING TOPIC

Learning from the COVID-19 pandemic: Improving academic continuity in workforce development programs

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Abstract

The COVID-19 pandemic caused an abrupt change in educational programs worldwide, including workforce development education in community colleges. Given the hands-on requirements of these programs, considerations for changes included if and how instructors and students could maintain academic continuity during the pandemic. This article focuses on aviation maintenance technology schools (AMTS) as a case study to understand how programs that rely heavily on hands-on learning responded to COVID-19 significant disruption to education. The Federal Aviation Administration (FAA) must approve educational training for aviation maintenance careers, and the FAA requires specific hands-on activities in the curriculum. Of the 182 AMTS in the United States, 143 are located within community colleges. We conducted 43 interviews with AMTS students, administrators, and instructors from 18 different community colleges. Following content analysis of the interviews, the authors identified six findings related to how these programs responded to the pandemic, with special attention to maintaining academic stability. The article advocates for integrating digital learning tools (DLT) to create resilient educational programs when disruptions occur. These

tools allow for students to continue to asynchronously practice the procedures and familiarize themselves with the materials needed for projects, provide students immediate feedback on their learning, and save schools money on expensive resources when students require extra practice on certain skills and processes. The application of these tools is relevant beyond the pandemic, helping students in many scenarios succeed in the face of natural disasters, family obligations, and the need for extra learning resources.

INTRODUCTION

The COVID-19 pandemic caused an abrupt change in educational programs worldwide, and community colleges had to switch their in-person programs to remote learning to maintain academic continuity. Instructors and students in subjects with hands-on components had to consider how, if possible, to adapt, given the change in modality in spring 2020 and sometimes subsequent semesters. This article focuses on the pandemic's effects on workforce development education. These programs, like automotive maintenance, cosmetology, and aviation maintenance, have governmental requirements for learning competencies and specific project-focused outcomes that do not quickly transition to online learning. We use aviation maintenance technology schools as a case study to understand how programs that relied heavily on hands-on learning responded to COVID-19's significant disruption to education and training. There are 182 AMTS in the United States, and 143 (78%) of them are at community colleges (U.S. Department of Education, 2020). With help from our research partners at the Aviation Technician Education Council (ATEC), we contacted all 143 programs for participation in our interviews and surveys.

We discuss our findings with some preliminary suggestions for preserving learning opportunities during disruptive events. Based on the need to provide students with academic continuity and flexibility to learn in varied environments and situations, this research advocates for integrating DLT to create resilient educational programs.

AVIATION MAINTENANCE TECHNOLOGY SCHOOLS

AMTS trains students to become aircraft mechanics for the transportation industry (Aviation Maintenance Technician Schools, 2021). Aviation Maintenance Technicians (AMT) maintain commercial planes and aircraft fleets for logistic companies like FedEx and Amazon. They are highly integral to the economy and our daily lives. Boeing (2021) projects the need for 626,000 new AMTs in the next decade while ATEC (2018) reported that over 30% of the workforce is at or near retirement, and these numbers do not account for the new retirees that left the workforce during the height of the pandemic (Fry, 2020).

Under Federal Aviation Regulation Part 147 of the Code of Federal Regulations, the FAA prescribes requirements for all AMT programs, also known as Part 147 programs, and accredits Part 147 schools in the United States. FAA has set rigorous standards for AMTS. These requirements include student attendance, materials covered, the inclusion of hands-on projects, and testing. If a program deviates from its FAA-approved curriculum, the FAA

can revoke its certification. Deviations include, but are not limited to, hours of instruction and order of instruction (Barbagallo, 2015).

In spring 2020, the FAA and AMTS administrators acknowledged the need to temporarily halt in-person instruction, like post-secondary institutions worldwide, in response to the COVID-19 virus. The FAA provided six recommended options for a response to pausing in-person learning.

1) Expand their approved distance learning program.
2) Create and use a temporary distance learning program, but only some topics could be taught via distance learning.
3) Increase the allowable absence hours and make up additional missed time.
4) Temporarily suspend operations.
5) Propose alternate changes to their curriculum.
6) Request an exemption from a requirement.

Schools were required to submit a request for curricula changes to their local FAA representative (Black, 2020), who would review the proposed changes and decide if the deviations would comply with FAA regulations.

This project sought to understand the immediate e-learning responses to the COVID-19 crisis in spring 2020 that 2-year colleges with advanced technological education programs faced in their efforts to maintain continuity. We focused on aviation maintenance technology schools (AMTS) responses as a case study.

METHODS

The research team identified study participants through established partnerships with the Center for Aviation Automotive Technological Education Using Virtual E-School (CA2VES), an NSF Advanced Technological Education Center, the NSF National Center for Autonomous Technologies (NCAT), and ATEC. Participants included six administrators, 20 instructors (three also held administrative roles), and 17 students from 18 different community colleges nationwide for a total of 43 individual semi-structured interviews. We used email communication as our primary recruitment form and advertised through the ATEC monthly newsletter. In order to understand responses to the pandemic, we explored changes to programs during spring 2020 and subsequent semesters. Our focus was on e-learning and digital tools, specifically virtual reality (VR) simulations used for academic continuity and teaching modality in spring 2020, fall 2020, and spring 2021.

DATA COLLECTION

During winter 2020–2021, three research team members conducted the interviews, which ranged from 30 to 65 minutes, using interview protocols piloted before full implementation. Interviews were conducted online, during a day and time chosen by the participant, and recorded via Zoom (Zoom Video Communications, Inc., San Jose, CA), with only the interviewers and participant present. Participants were administrators, students, and instructors at AMT programs housed at community colleges. Participants were in their chosen location, most often home, work, or school. The interview team took notes during the interviews, but we recorded no identifying data in the notes. We continued recruit-

ing and interviewing until we achieved data saturation and compensated each participant with a $25 digital gift card. We outsourced transcriptions to GoTranscript. We verified the transcripts against the audio recording, clarified any aspects of the interview following transcription, and anonymized the transcription.

DATA ANALYSIS

We created a code structure using codes from a preliminary study by Jain and colleagues (Jain et al., 2001) and emerging codes from our interviews. One research team member coded the transcribed interviews using Atlas.ti software for the first cycle. Two additional team members participated in the first transition, second cycle, and second transition phases of coding as outlined by Saldaña (2016). These findings are the results of pattern development and recurring themes observed during the analysis of the interviews (Merriam, 1998). We use "they/their/theirs" to preserve anonymity when referring to participants throughout this article.

RESILIENCE ENGINEERING THEORETICAL FRAMEWORK

We used the Resilience Engineering Framework (RE) to explore educational institutions' 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" to maintain operations (Madni & Jackson, 2009). RE focuses on recognizing and adapting during external disruptions (Fujita, 2006; Steen & Aven, 2011). An organization that can adapt is said to have resilient characteristics that helps them respond, monitor, learn, and anticipate. These abilities work together to create a system that can adapt to interruptions (Hollnagel, 2015).

Disruptions to a system can take several forms, including operational continencies like building issues, equipment malfunction, natural disasters, political instability, and financial meltdown (Madni & Jackson, 2009). A system's resilience regarding a specific disaster can be evaluated in four phases: avoidance, absorption, recovery, and adaptation. Avoidance mechanisms are the ones designed to prevent a disruption. Absorption is how a system or organization handles the immediate aftermath of the disruption to minimize long-term damage. Absorption mechanisms are in place to allow a system to withstand a disruption without completely reconfiguring itself. Recovery is how a system can survive major disruptions after the immediate impact is passed. Finally, the adaptation phase consists of the lasting organizational changes in response to the disruption (Madni & Jackson, 2009).

In our research, we evaluate RE based on the disruption caused by COVID-19 and schools' ability to maintain academic continuity by avoiding, absorbing, recovering, and adapting to interruptions caused by the pandemic. Schools have mechanisms integrated into their system that help avoid, absorb, recovery, and adapt during disruptions, especially short-term disruptions. For example, schools have snow days or hurricane days integrated in their calendars to absorb negative effects of these weather-related disruptions.

RESULTS

While many schools switched to remote instruction during COVID-19, programs with government-mandated, hands-on components could not do so without compromising

some aspect of their curricula for unknown periods. The FAA-regulated Part 147 programs have obligatory hands-on projects, and any changes to their curricula required approval during the pandemic. While the FAA provided suggestions for temporary changes; they did not guarantee approval. The AMTS immediate responses to the pandemic included:

1) Temporarily stopping the program until in-person learning was permitted. These schools closed for varying lengths of time depending on their institution, health and safety departments, and local government. Five of the 43 interviewees (7.6%) said that their program experienced a temporary halt. Four were closed for a few weeks, but one program was closed for 6 months.
2) Temporarily suspend the AMTS while applying for remote learning for a portion of their curricula. Over 87% ($n = 12$) of programs in our study experienced this option, of which 10 began remote teaching within two weeks. The other two schools allowed their instructors a month to prepare their remote courses before resuming classes.
3) Immediate transition to remote learning. This option was only available to two programs in our study. One program administrator created their program to be hybrid because they had lived in a rural area and wanted to be able to provide accessible education to students. They had worked with the FAA to incorporate DLT into their curriculum years before the pandemic.

Most lab classes and practical projects were delayed with the three options. The length of the delay for projects depended on local government and college policies.

Based on our analysis of the interviews, ATM programs struggled to maintain pre-COVID educational standards. The 15 students in our study struggled with the interruption to in-person learning. Our six main findings illuminate why this occurred and describe the exception within our case study.

1) Programs used required hands-on projects to reinforce lectures.

An Interviewee told us that that instructors relied on projects to reinforce lecture materials. Participant 23, an AMTS instructor, said their courses are "30% academic or lecture and 70% hands-on." Participant 23 was not unique; multiple instructors told us that it was common to have a short lecture, and then move the class into the hangar to use aircraft to explain concepts and engage students. Lacking hands-on components, instructors used supplemental videos and readings to reinforce lecture materials.

2) Schools were underprepared for disruptions to learning.

Schools, including AMTS, often had avoidance mechanisms incorporated into their programs to handle temporary, short-term interruptions. The AMTS administrators incorporated extra days or schedule make-up days to account for any short-term disruptions like snowstorms or hurricanes. This avoidance mechanism delays learning by a few days but is routine for the programs and does not affect academic stability. During the start of the pandemic, students were missing multiple weeks of class and labs, including federally required projects, because AMTS could not maintain academic continuity during the long-term disruption caused by COVID-19.

3) Students struggled with a lack of hands-on learning.

During our interviews, students described their learning difficulties during the start of the pandemic. They said they preferred hands-on activities to learn because that is how they usually learned. Instructors supplemented lectures with independent learning mate-

rials, like reading and videos. Participant 28, a second-year AMT student, described their struggle, "I am not the best reader. It takes me awhile. I have to read it a couple of times before it sinks in… I don't have that time." They were not alone in their frustrations; 13 of the 15 students we spoke with struggled to learn without hands-on projects.

4) Instructors lacked the time and resources to create online programs.

Many AMTS program administrators directed their instructors to transition their courses to online formats quickly. None of the instructors or administrators we spoke with had formal training in online education, and they were given limited time and resources to create online courses. Participant 21, an AMTS instructor, was given a single night and no support to transition their classes. Other instructors described the help they received from their institutions' teaching resource centers over the weeks they worked to move their classes to e-learning platforms.

However, when we spoke to them, students were frustrated with their online courses and felt that they did not meet pre-pandemic standards. Participant 17, an AMT student, described it as "Death by PowerPoint" because the instructors lectured with a PowerPoint during remote learning, rather than engage the students in a robust online course. Participant 4 said 33% of his students were concerned with their "lack of knowledge" due to the online courses and curriculum changes.

5) Administrators and instructors were hesitant to incorporate DLT.

Program administrators described their hesitation to incorporate DLT into their curriculum. They cited three reasons. First, they described their limited financial resources and their perceived high cost of DLT. Second, they felt that any remote learning would need significant in-person reinforcement due to the hands-on nature of the AMT profession. Third, administrators and instructors cited decades of success for in-person learning. While all of the administrators and instructors we spoke to received approval from the FAA to change their curricula, they were nervous about losing their FAA approval with any long-term changes to their program. However, it is this hesitation which resulted in insufficient contingency plans for any long-term disruption.

6) AMTS students, instructors, and administrators had an easier time maintaining academic continuity when DLT were already incorporated into their curriculum.

Students, instructors, and administrators had an easier time avoiding some of the pandemic's effects on learning if they had previously incorporated DLT into their curricula in substantial ways. For example, Participant 19, a program director who had previously worked in computer technology and video conferencing, has already incorporated online learning resources into their program as much as the budget allowed. When the pandemic began, their students did not have to learn new software or drastically change their study habits by switching to remote learning because they were already learning with DLT. During our interviews, students at programs who did not use digital learning resources before the pandemic struggled. Participant 17 said, "I'm barely getting used to it…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." On the other hand, students from two programs that had integrated DLT did not complain about using the technology, rather, the three students and two program administrators wanted more and improved resources.

LEARNING FROM 2020

From this study, we observed that workforce development programs struggled to maintain pre-disruption standards. However, our research found two programs that were the exception. The following scenario is based on students' experiences at one program.

When COVID-19 caused schools to shut down, workforce development programs had to respond, monitor, learn, and adapt to avoid the disruption and maintain academic continuity. Many schools had ways to absorb short-term disruptions to academic continuity through extra make-up days integrated into the calendar. Long-term disruptions were hard to absorb. While the intent was not to be able to maintain academic continuousness during a pandemic, the resilient characteristics worked in the same way. The following actual scenario describes how multiple resilient characteristics helped one program avoid, absorb, learn, and adapt during the pandemic.

An AMTS administrator and instructor previously lived in a state with many remote and rural areas. When they moved to a new part of the country, they wanted to provide equitable access to AMT education. They worked with the FAA and designed their program to be hybrid. Students took lecture classes and performed some of the lab classes remotely, but then joined for in-person learning for more advanced lab classes. If needed they could care for family members or work without compromising their education because they had flexibility to attend from their homes asynchronously. Instructors had a repository of materials they provided students each semester, and the students could use the material for review when they struggled with a concept or before the FAA certification exams.

When the pandemic closed in-person school, this FAA-approved AMTS continued to operate as it had before and they avoided some of the impact of the pandemic. For example, students in the electricity class continued to attend lectures remotely. They used software to complete the necessary projects and demonstrate their comprehension of topics like circuits. Some in-person labs were delayed until students could return to the classroom, so there was some disruption to their learning. However, the AMTS was able to absorb by giving students more resources for remote learning. In this scenario, students did not express concern about their education or struggle with the transition because they continued to learn through familiar methods.

The AMTS absorbed the effects of the pandemic by continuing remote learning for their classes. They operated at the same standard as they had before the pandemic. Students had the DLT enabling them to asynchronously practice the procedures familiarize themselves with the necessary materials for projects, immediately receive feedback on their learning. Students in these programs did not struggle with a changes in content delivery or new software. Rather, they asked for improved and expanded DLT to enhance e-learning.

We are in the stage of learning from the disruption caused by the pandemic, and schools will need to adapt to ensure they can maintain continuity the next time there is a disruption. A spectrum of DLT helped the AMTS avoid and absorb the pandemic's impacts, and we advocate for integrating DLT to maintain academic continuity.

CONCLUSION

We are not arguing that a disruption like COVID caused could completely be avoided; rather, we contend that there are ways to mitigate and prevent some of the impacts of long-term disruptions. Huang and colleagues (2020) and Zhao and Lucas (2015) documented these same benefits described in the scenario above. Other scholars argue for integrating DLT into programs that require hands-on training, like workforce development programs

like automotive manufacturing training (Borsci et al., 2015; Lawson et al., 2016), welding (Huang et al., 2020), and other technical education (Ausburn & Ausburn, 2004; Heckman & Joseph, 2003). For workforce development cosmetology, automotive, and aviation careers, DLT foster conceptual-procedural knowledge that can be used to teach as a precursor to in-person projects, even when in-person learning is not limited. While DLT have been shown to enhance student engagement and offer opportunities for flexible and personalized learning, there is a need for more comprehensive research to establish the full extent of their impact on workforce development education.

This study has limitations. First, there were recruitment limitations. AMT students are extremely busy. They are often in school for most of the day, and many have part-time jobs and family obligations. The students were even busier as schools changed schedules due to the pandemic. Instructors who did not use e-learning resources felt like they could not contribute to the conversation and declined to participate. Second, the self-reported nature of this data is a limitation. We asked students, instructors, and administrators to discuss an extremely stressful time, and there may have been instances of selective memory.

There is no turning back to pre-COVID times. Schools should continue the improvements they began in 2020, whether to the physical structure, learning services, or educational opportunities for students (Kim & Kessler-Eng, 2021). More DLT will need to become available for workforce development education. These programs train essential workers and should have the resources to do so without disruption. DLT will help programs have more resilient characteristics during disruptions, and program administrators should incorporate them into long-term contingency planning.

ACKNOWLEDGMENTS

We thank the National Science Foundation. This material is based upon work supported by the National Science Foundation under Grant # 2037809. We would also like to thank the external evaluators for the research suggestions. Our research is supported by the Clemson University College of Engineering, Computing, and Applied Sciences and the Center for Workforce Development. Finally, we want to thank the Aviation Maintenance Technology community, especially the Aviation Technology Education Council, and the students, instructors, and administrators who participated in our research.

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How to cite this article: Shakour, K., Ransom, T., Gallagher, E., Johnson, K., Short, R., Beck, J., & Chalil Madathil, K. (2024). Learning from the COVID-19 pandemic: Improving academic continuity in workforce development programs. *New Directions for Community Colleges*, *2024*, pp, 143–151. https://doi.org/10.1002/cc.20619

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