Transfer of Training Aircraft Maintenance:

Perceptions of Blended Learning Impact

by

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ABSTRACT

The focus of this study was to investigate better learning opportunities at the epicenter of field-level aircraft maintenance technical training for the United States Air Force. While narrow in focus, this project may be informative for training communities across diverse industries. The intent of this project is to improve the transfer of training from the classroom to the workplace by implementing a blended learning classroom pedagogy, successively enhancing class time for more meaningful construction of student-centered learning. This mixed-methods research study utilized surveys, observations, and interviews with students, instructors and supervisors to explore perceptions that aircraft maintainers have about the current and potential value of curriculum. The first significant finding was that aircraft maintainers do believe there is opportunity to improve the current rote transmission style of curriculum and make it more learner-centered. The second significant finding is that aircraft maintainers do see a blended learning classroom as a means to explore the curriculum in more depth and improve the transfer of their knowledge in a more meaningful way to the workplace.

DEDICATION

This dissertation is dedicated to the strong, devoted, and empowering women in my family. To my mother, whose courage and dedication to family taught me to never give up on which you believe. To my wife and best friend, thank you for taking this journey, being patient, and always believing in my dreams. To my children, do not underestimate your value and never give up on that which you believe; there are a lot of people to prove wrong.

ACKNOWLEDGMENTS

I would like to express my sincere appreciation to the Airmen that supported me throughout this innovation. Your dedication to our country is second-to-none and your contributions to this project made it all possible…*Fly, Fight, and Win*! To my dissertation committee, Dr. Gee, Dr. Mertler, and Dr. Archambault, I am grateful for such an all-star supporting cast. Your time, guidance, and patience during this process were often the spark that kept me going and the flame that inspired iterations of this study, 'Forks up!'

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Chapter 1

INTRODUCTION AND CONTEXT

"Education is not the learning of facts, but the training of the mind to think."

–Albert Einstein

It is archetypal for organizations to look towards and rely upon training to effectively solve business needs in rapidly changing environments (Baldwin, Ford, & Blume, 2017). And despite the new knowledge and skills that employees gain, the learning is not considered effective until there is a positive transfer to the workplace (Grossman & Salas, 2011). It has been estimated that only around 10 percent of the total expenditures spent on training actually transfer to the job, exacerbating the gap and efficiencies between the training effort, employee behavioral change, and the organization's outcomes (Georgenson, 1982).

In most instances, I have observed that training stakeholders (both schools and organizations) tend to focus on employee attendance, completion, and satisfaction of the training as a measure to the overall success of the training effort. Determining the effectiveness of these training initiatives, or the return on training investment, can be subjective and often fails to accurately determine whether there was a reasonable transfer of employee training to the workplace. For successful transfer the "learned behavior must be generalized to the job context and maintained over a period of time on the job" (Baldwin & Ford, 1988, p. 63). These "transfer problems" were highlighted by Baldwin and Ford (1988) in their highly publicized research on transfer of training, further expounding the growing concern that employees are not adequately applying the knowledge, skills, and abilities they learned in training to their job.

Primary business concerns over transfer of training gaps are the inefficiencies and unknown impacts to organizational performance, both that can negatively impact the bottom line. Whether training new employees to perform the tasks necessary for a job or educating existing employees on new equipment or procedures, lessening these gaps between learning and sustained workplace performance should be a paramount concern (Burke & Hutchins, 2007). Paradoxically, available research on transfer of training contains similar, if not more gaps than the transfer problems themselves. According to Baldwin, Ford, and Blume (2017), transfer problems still exist and there needs to be additional evidence to inform the most important and relevant questions to improve training outcomes.

Baldwin and Ford (1988) argue that in their original transfer process model (see figure 1), *training inputs* are the most developed and rigorously researched direction for addressing transfer problems, leaving considerable opportunity for more developed research on *training outputs* and the *conditions of transfer*.

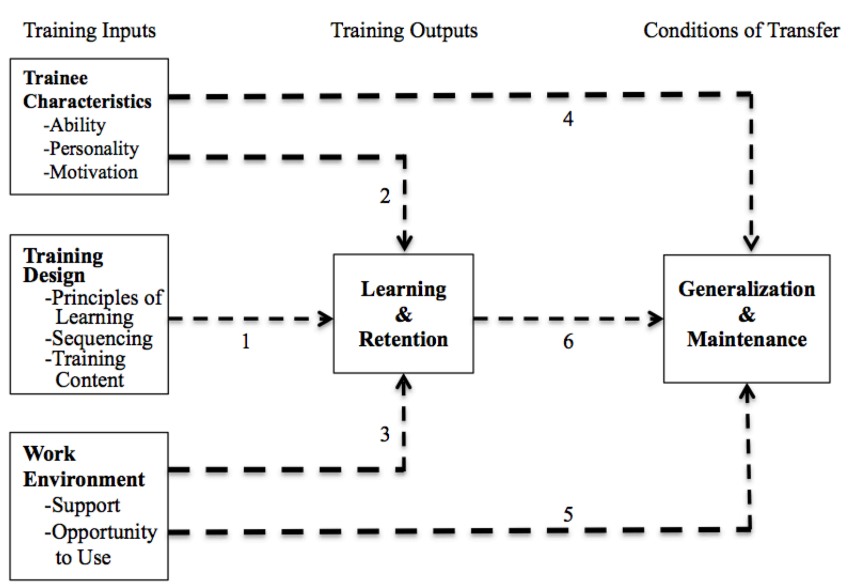

Figure 1. A Model of the Transfer Process

To further elucidate the transfer process, the linkages within the model are essential for understanding the impacts each component has upon one another. For example, training inputs (training design) have a direct effect on training output (learning and retention) (Linkage 1). Here, the sequencing of the training design can impact a trainee's overall learning and retention, later discussed as transfer of training.

While the nature of employee training differs in structure across various industries and organizations, it does share common goals: to improve the overall quality of the workforce and to strengthen the bottom line through better products and services. According to the Association for Talent Development's "State of the Industry Report 2017," organizational commitment to learning exceeds over 100-billion dollars annually and has substantially grown with year-over-year increases in both direct learning expenditures and the number of learning hours per employee ("State of," 2017). Yet, despite these sizeable investments in training programs, organizations often fail to fully capitalize on the successful transfer of trained tasks to the workplace. Employees who lose the training they have received before they are able to implement it in the work place are costing companies' valuable time and money and negatively impacting job performance and quality.

The intent of this study is to investigate better learning opportunities for aircraft maintenance technical training students by exploring the impacts on transfer of training by incorporating a blended learning strategy. According to Crippen and Archambault (2012), teachers need to become more aware of the existence of technologies to improve student learning. Within this study I aim to postulate whether this innovative, locally contextualized blended learning strategy will improve the perceived transfer problem experienced between the classroom and the workplace by aircraft maintenance technical training students. By disrupting the current pedagogical structure from a rote transmissive lecture to a more interactive strategy made possible by incorporating online learning, I investigate student, instructor, and supervisor perceptions of the blended learning environment and the relevance of the course activities to the workplace. According to Hilliard (2015), blended learning will make the following types of learning activities more possible in the classroom:

1. Group problem-solving and collaboration
2. Problem-based learning
3. Discussion groups
4. Case-based strategies
5. Simulation or role play
6. Student-generated content
7. Coaching, mentoring and advisement
8. Guided and exploratory learning

Implications of successfully incorporating the above learning activities in a blended learning environment can result in higher order learning, critical thought, and improved problem-solving skills by students (Palloff & Pratt, 2005).

The purpose of my research is to focus on modifying the training inputs initially identified by Baldwin and Ford (1988) (see figure 1) of (a) training design traits and (b) the work environment to improve the transfer training in aircraft maintenance technical training by incorporating online learning modules that students will complete prior to attending the face-to-face portion of the class. According to Eryilmaz (2015), while the online portion of blended learning improves flexibility, there is still a need for the face-to-face environment to further social collaborations. The combination of the blended and face-to-face portions of the class will work to better develop social collaborations between supervisors in the workplace, students, and instructors in the classroom. I will analyze the perceived impacts that blended learning has on the transfer of training (generalization and maintenance of learning) and how enhanced face-to-face instructor and supervisor involvement can improve the transfer process and learning outcomes for technical training graduates.

Larger Context

According to Grossman and Salas (2011), the knowledge, skills, and abilities required for companies to maintain a competitive edge are continuously growing and changing. Organizations continuously look towards effective employee training to develop workers' technical abilities and overall job quality, continuing to be some of the largest stakeholders in training initiatives that focus on improving people's performance (Salas et al., 2006). Striking a balance between training expenditures and the return on investment of the training initiatives continuously becomes more critical in developing economies, where organizations strive to improve their strategic foothold and improve goods and services.

Notwithstanding these efforts, ineffective transfer of training continues to plague all types of organizations. According to Grossman and Salas (2011) employers are left with a large gap between training efforts and organizational impact. There continues to be an assortment of conceptual and empirical research that attempts to identify opportunities for improved training designs that could increase the transfer of training. Osguthorpe and

Graham (2003) discussed six goals collected from a series of articles where educators espouse the benefits of blended learning as they look to design new learning experiences. An outcome relevant to my innovation is enhancing pedagogical richness as stated by Osguthorpe and Graham (2003), where a blended learning approach empowers instructors to change the way they use classroom time. Improving the flexibility that instructors have in the face-to-face classroom could yield better instructor-to-student interaction from activities that enable students to think more critically and better understand topics. Overall, blended learning has become one of the more widely adopted pedagogical practices for adult learning and is best defined as "a formal education program in which a student learns at least in part through online delivery of content and instruction with some element of student control over time, place, path, and/or pace at least in part at a supervised brick-and-mortar location away from home" (Hrastinski, 2019, p. 3).

Overall, organizations are continually looking for training programs that will maximize their return on the training investment. Addressing the issues involved in the transfer of training is a complex problem that will require a multi-faceted approach. Establishing a program that incorporates blended learning with a focus of improving the transfer of training is one step towards improving student and workplace learning outcomes.

Local Context

United States Air Force aircraft maintenance technical training programs are the backbone of initial and advanced skills training and development for tens of thousands of military aircraft maintainers globally. To be selected as aircraft maintainers, newly recruited United States Air Force enlisted members must first take the Armed Services Vocational Aptitude Battery (ASVAB) during the recruitment process to determine if they have the propensity to learn an aircraft maintenance skillset. The ASVAB is a multi-aptitude test that measures developed abilities and helps predict future academic and occupational success in the military ("U.S. Air Force," n.d.). After the analysis of ASVAB results by the military entry processing station, new recruits are assigned an Air Force Specialty Code (AFSC) that correlates with a job they qualify for. Once placed in an aircraft maintenance career field, new recruits enter "student status" where for the first few months (sometimes up to six months) they will build new knowledge of the Air Force and their AFSC.

The first in these series of courses is Basic Military Training (BMT). During eight weeks of BMT, recruits are challenged academically and physically to develop the foundation necessary to serve as an Airman in the United States Air Force.

Upon graduation from BMT, Airmen directly move to their next level of training, often referred to as tech school or technical training. During this initial level of technical training, Airmen will begin to learn the knowledge, skills, and abilities necessary for their AFSC. The majority of initial aircraft maintenance technical training is accomplished at Sheppard Air Force Base (SAFB) in Texas. Here trainees attend eight-hour-per-day classes, Monday through Friday, instructed by military and civilian instructors who were hired based on their subject matter expertise (SME) in the AFSC. These courses are composed of a series of knowledge and performance-based objectives that use active learning strategies to build students' knowledge about aircraft from simple to complex. The design of these courses from simple to complex is essential because of the wide variety of background and mechanical aptitudes from which students come. This simple to complex curriculum also serves as a foundation to build student knowledge, skills, and abilities in more advanced courses throughout their career.

The curriculum for aircraft maintenance courses is developed from task requirements set out by each AFSC's Career Field Education & Training Plan, developed by the designated Air Force Career Field Manager (AFCFM). The AFCFM for each AFSC is responsible for keeping specialty information about the career field up-to-date and accurate (AFCFM Guide, 2014). For courses that support training in the AFSC, the AFCFM will coordinate with Air Education and Training Command (AETC) to ensure that training courses for the career field suffice and direct changes and updates accordingly. Once course criteria have been established, AETC will direct the responsible technical training program for the AFSC to begin building the course with objectives that are based on the knowledge and performance criteria required for proficiency on the job as directed by the Career Field Education and Training Plan (CFETP).

Technical training courses are taught by certified Community College of the Air Force (CCAF) instructors who are hand-selected subject matter experts (SME) and hold a minimum of an associate degree. CCAF operates the only federally chartered institution that serves the United States Air Force enlisted force (CCAF, 2016). CCAF allows all enlisted members to earn college credits from technical training that can be applied towards a regionally accredited Associate of Applied Science degree from CCAF in their related field. The initial skills training received from BMT, initial technical training at SAFB, and other CCAF schools establish the foundation students need to achieve their three skill-level, the initial skill-level required upon arrival to their operational base.

Upon arrival to their first base, aircraft maintainers are scheduled to attend an advanced-skills, field-level maintenance training course within the first six months of arrival. This next level of technical training is typically offered locally by one of the 48 technical training schools (referred to as Field Training Detachments) across the globe. Field training detachments are administratively controlled by SAFB and follow the same structure as initial skills training. The field training detachments have the same instructor requirements, follow the same course structure, and hold the same level of accreditation offered by CCAF as those at SAFB. Field training detachments are co-located with operational flying wings (host) and designed to support the host unit's mission aircraft and maintenance training needs through a series of locally developed technical training courses. Maintainers attend a variety of courses in series with their specific AFSC training plan.

The courses offered are aircraft and AFSC specific and take students though a sequence of knowledge and performance objectives that comprise each course. Unlike initial skills training developed from the CFETP, advanced skills training requirements are derived from aircraft maintenance requirements and technical order tasks for specific assigned aircraft in the students' workplace. Course lengths can vary depending on AFSC and range from one-week to several months of instruction. Course development is accomplished through the collaboration of a local SME that works in the host unit and the local technical training instructor. Both the SME and instructors hold the same AFSC that supports the systems requiring training.

Currently transfer problems exist between the technical training that aircraft maintenance Airmen receive and the complexity of workplace requirements. Dalkilic

(2017) discusses this growing complexity of aircraft systems and loss of operational capabilities experienced by flying organizations and has brought to light the need to improve aircraft safety and reliability through training. Inadequate technical knowledge and training gaps are a chief attribute of maintenance errors and reduced sortie production metrics; sortie production is the output of the maintenance effort required to successfully launch, recover, and repair aircraft in a specified time period. Sortie production is imperative to the United States Air Force because it is how leaders plan people, processes, and resources to project airpower and conduct combat operations during wartime. According to Dalkilic (2017), improved training is one way that aircraft maintenance errors can be managed. Expounded by Hafer (2016), the Secretary of the Air Force, Deborah Lee James, reported to Congress that the Air Force aircraft inventory is the oldest, smallest, and least prepared in history and that only about half of the combat aircraft are prepared for a high-end fight.

While training alone cannot change the fact that the Air Force's current fleet is over stressed, addressing the transfer problem in maintenance training is a fundamental step required to maintain sortie production and overall readiness as the USAF compensates for equipment shortages and aging aircraft.

Personal Context

It was during my transition from an aircraft maintenance instructor to that of a maintenance superintendent (approximately 16 years of service) that I was able to more clearly identify the gaps between technical training courses and the ability of Airmen to transfer their skills to the workplace. Often, I spoke with maintainers who expressed concerns over gaps between what they learned in the classroom versus what they could apply on the job. Additionally, there was a perceived lack of buy-in from supervisors in the workplace towards the value of what students were learning in the technical training. Supervisors often did not see the long-term payoff from the short-term cost of losing personnel to attend technical training courses. My perspective of the transfer of training gaps is based on the following adapted traits from Baldwin and Ford's (1988) *Model of the Transfer Process* (training inputs): training design and work environment. I have hypothesized that by changing the training design to blended learning and gaining more involvement from workplace supervisors, there stands an opportunity to improve the transfer of training across aircraft maintenance technical training courses and improve sortie production at the tactical level.

Purpose Statement

This action research study will explore new opportunities for Air Force aircraft maintenance technical training programs to improve their transfer of training from the classroom to the workplace by leveraging technologies like blended learning to address complex issues. The intention of this study was to garner and foster further research on how technology-based innovations like blended learning can positively influence technical training challenges like transfer of training and provide viable solutions to readiness gaps experienced in the workplace.

Research Questions

This study was designed to investigate two research questions that address the dissertation problem of practice. The first research question focuses on how blended learning will impact instructors' teaching practices. The second question focuses on determining how blended learning can impact the transfer of training from the classroom to the workplace.

The research questions are:

- RQ1: How does implementing a blended learning approach in aircraft maintenance technical training classrooms affect instructors' teaching practices?
- RQ2: How, and to what extent, does implementing a blended learning approach in aircraft maintenance technical training affect perceptions of the transfer of training?

To address the above research questions, I used two different statistical methods (qualitative and quantitative) to bear on the same research questions in a triangulated mixed methods design. I compared current course structure and future state blended course structure using pre- and post-course qualitative and quantitative data (observations, interviews, and surveys). Within a framework drawn from constructivism and prior research on the transfer of training and blended learning, I intended to gain insight on how to best position the complex nature of aircraft maintenance technical training to improve instructors' teaching practices and close transfer gaps.

I proposed to affect both the classroom and the workplace as follows:

1) Incorporate blended learning into current curriculum to increase classroom efficiency
2) Improve the transfer of knowledge from the classroom to the workplace

I collaborated with supervisors in the workplace to help instructors identify and restructure course knowledge-based objectives between an effective ratio of blended modules and face-to-face objectives. Students completed these blended modules prior to attending the face-to-face portion of the training. Additionally, I used the blended modules to help create space and flexibility for the instructors in the face-to-face portion of the course to address the complex issues that face aircraft maintenance organizations. This method allowed me to observe how instructors better use classroom time with students, with the hope that they will adopt a more reflective and problem-solving pedagogical method that will presumably lead to better transfer of training to the workplace.

Definition of Terms

Below are definitions of key terms relevant to my study:

Airman/Airmen: A member/members of the United States Air Force.

Blended Learning: The combination of online and traditional classroom teaching methods to improve curriculum flexibility over path, pace, and place.

Field-level: Job duties performed in the workplace assigned.

Field Training Detachment: A geographically separated Air Education and Training unit responsible for the advanced skills aircraft maintenance training of assigned flying wing maintainers. May also be referred to as a detachment.

Maintainer: A military aircraft mechanic.

Mission: A coordinated set of actions by military members in response to a developing situation or operational objectives.

Readiness: The ability to perform with purpose during combat military operations.

Sortie Production/Generation: The maintenance effort of generating one aircraft flight stated as a percentage.

Technical Orders: Publications used to fix aircraft, considered official orders.

Transfer of Training: The degree to which trainees effectively apply the knowledge, skills, and attitudes gained in a training context to the job.

Workplace: The aircraft maintenance squadron (organization) where maintenance takes place. Also called a host unit.

Chapter 2

THEORETICAL PERSPECTIVES AND GUIDING RESEARCH

In this chapter I will discuss theoretical frameworks, guiding research, and previous action research cycles that informed this innovation. The constructivist learning theory and its implications for pedagogy serve as the overarching perspective that informs my intervention. There are two additional frameworks that I have chosen to more specifically shape this study: transfer of training and blended learning.

Constructivist Learning Theory

Contemporary education continues to become more student-centered by challenging learners to become more actively involved in their own meaning-making and knowledge construction. Advocates of constructivism posit that learning happens when knowledge is built upon prior knowledge and that learning results from the integration of these experiences and ideas (Krahenbuhl, 2016). Additionally, Cobern (1993) goes on to explain that even after a concept has been elucidated, students often have varying interpretations of the concept, leaving gaps in the normativity of learning outcomes. An *impetus* for this study is honing how aircraft maintenance technical training students construct their learning experiences and develop meaning based on the greater mission. Furthermore, how students and instructors benefit from using blended learning modules to support constructivism and critical thought can overall improve the transfer of this newfound knowledge and help them assimilate new ways to become more effective and efficient problem solvers in the workplace.

According to Brandt (1997), the emphasis on knowledge construction and problem solving emphasized in constructivism serves well in domains of conceptual complexity and case-to-case irregularity by providing organizing structures. The job of an aircraft maintainer is full of complex tasks that require them to routinely troubleshoot and solve unexplained system malfunctions by relying on past practices and technical data. According to Dalkilic (2017), numerous studies have determined that the pressure of completion time, gaps in technical knowledge, and insufficient training have a direct impact on maintenance problems. Often aircraft maintainers rely upon internal mental models derived from past experiences to help them swiftly construct the knowledge necessary to solve complex issues. These mental models help maintainers make sense of how systems work and interact with each other based on previous experiences. Brandt (1997) describes in his Cognitive Model of Knowledge Construction (see figure 2) as a four-part process that diagrams the cognitive pathways that learners take to construct their knowledge and gain confidence with the material:

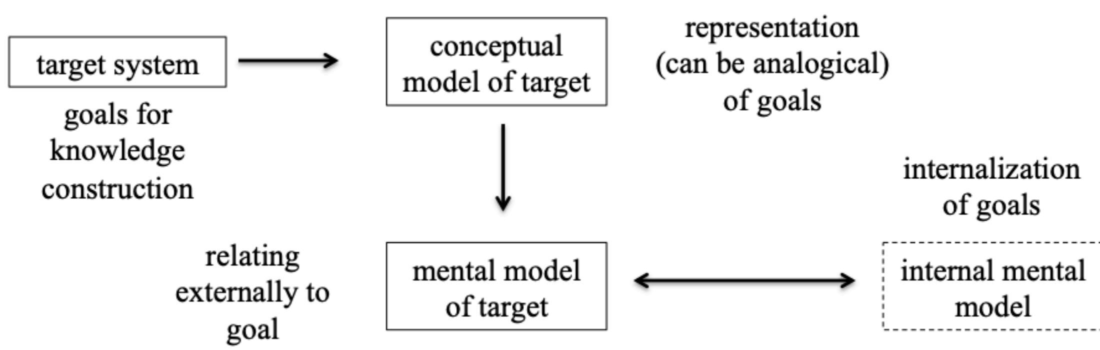

Figure 2: Cognitive Model of Knowledge Construction.

The cognitive model further serves as a compliment to constructivist theories by allowing aircraft maintenance technical training instructors to support students in conceptualizing the critical knowledge that needs to be transferred to the workplace. Improving a maintainer's ability to capitalize on their learning opportunities could serve as a catalyst for improving the overall transfer of training rates in this innovation and allow the instructors more flexibility to control the depth of the material they cover in the classroom.

Over a 21-year career as an aircraft maintainer and technical training instructor, I have had the opportunity to observe that when students have the ability to interact with the concepts and problems they face from the workplace in the classroom, there tends to be a more connected and meaningful relationship with the learning process. Jean Piaget (1972) is widely accepted as the founder of modern Constructivist Learning Theory and he laid the groundwork for describing the idea that people actively construct new knowledge or make meaning based on their experience and reflection. This active participation in the learning process is a foundation for my study and aims to stimulate learners to be more intrinsically motivated and intellectually curious, thus influencing their desire to improve transfer of training and their learning outcomes.

A constructivist view of learning has several additional positive implications for an aircraft maintenance technical training pedagogy. The tasks that students must solve in a training course are multidimensional and complex, extending beyond the basic theory of operation suggested in technical orders. Aircraft systems are often double and triple redundant causing a collision of interdependent functions that could yield several plausible solutions. Tee and Karney (2010) determined that classes that interact in discussion boards online better stimulate conditions that help students construct shared knowledge. In constructivism, the role of the participants is transformed by inquiry-based learning activities that require them to collaborate with peers, supervisors, and instructors to formulate solutions. Current aircraft maintenance curriculum supports such learning activities by structuring performance objectives so that small groups of two to four students collaborate and perform tasks under the guidance of an instructor. Additionally, the role of the instructor can be enhanced in constructivism as well; he or she is responsible to guide students through their knowledge construction, versus only requiring them to repeat a rote series of steps from a technical order. In this capacity, instructors serve as mentors to the students, creating curriculum that enriches a student's growth and provides them with the cognitive tools to solve complex problems in aircraft systems by thinking more critically and becoming better problem solvers.

According to Krahenbuhl (2016), constructivism has been a compelling consideration when looking to improve student-centered instruction. The constructivist learning theory serves as a robust framework for shaping the pedagogy that encompasses aircraft maintenance technical training. Figure 3 shows the four central characteristics believed to inform learning in the constructivist model by Krahenbuhl (2016).

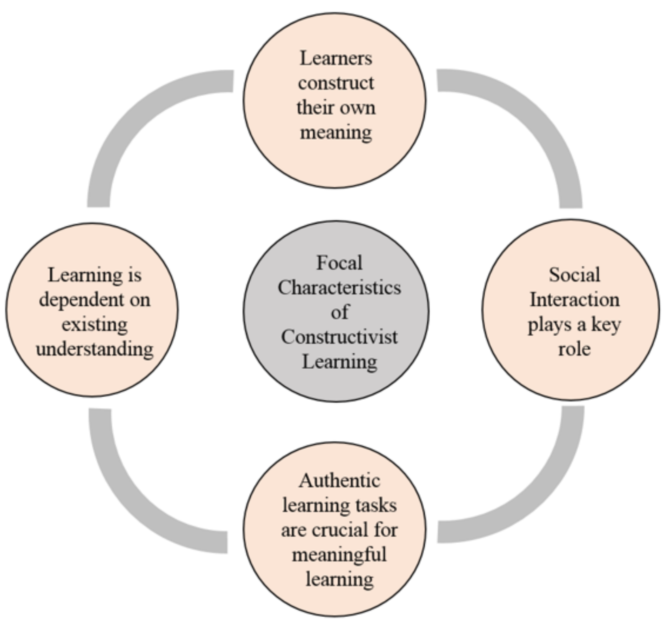

Figure 3. Focal Characteristics of Constructivism

In this model, teaching is focused on active learning by the student, a key component of aircraft maintenance technical training courses that intend to maximize the transfer of training to the workplace. The overarching epistemological assumption with constructivism is that students do not discover knowledge, but rather construct it based on their own experience. Often aircraft maintainers transfer to several different types of aircraft over their careers, and rather than learn an entirely new aircraft, they rely on past experience to construct understanding of their new aircraft systems. Constructivism has been attributed to keeping students more physically involved in learning by allowing them to discover, inquire, and collaborate their experiences (Krahenbuhl, 2016). Often strong advocates either favor ‘student-centered’ or ‘teacher-centered’ or ‘content-centered’ or ‘discipline-centered’ pedagogies and fail to recognize that there can be some middle ground to their methods (Krahenbuhl, 2016). I anticipate that, within the context of my study, participants will need to be mindful of a content-centered mindset and not be too fixated on what is written in the technical orders as the only prescribed way of trouble shooting an issue or solving a problem.

Transfer of Training

For decades, when organizational leaders looked at employee on-the-job performance, they realized that newly acquired skills from training were not being put into practice when employees left the classroom, thus compounding ‘transfer problems’ (Michalak, 1981). Countless other researchers have examined transfer problems between training and the workplace, yet I have observed that little of this research has informed training professionals on how to design and execute their training initiatives to minimize these gaps. Particularly challenging in the context of my innovation is adjusting training efforts in highly technical warfare to meet the demands of maintainers in the field. Often the cycle of tactics and technology change outpace the content addressed in training courses. Maximizing the speed and reliability at which employees can learn and transfer new knowledge to the workplace is paramount in a rapidly changing global economy (Baldwin, Ford, & Blume, 2017).

In a study conducted of 50 organizations by the Corporate Leadership Council, it was discovered that nearly 75 percent of the 1,500 senior level managers were discontented with the outcomes of their training initiatives. Furthermore, only 25 percent of this same sample of managers felt that the training received was critical to business outcomes (Beer, Finnstrom, & Schrader, 2016). These transfer problems continue to receive attention from academic and business professionals because of the impact to industries felt by technological, social, and economic change having exceeded that of training requirements. Zumrah and Boyle (2015) argue that contrary to previous research, there is still a need to better understand the factors that influence transfer of training. As the facade of organizations change due to external factors, so must their understanding of the change to task requirements to training initiatives.

Later iterations of Baldwin and Ford's transfer process model have been adapted by researchers like Grossman and Salas (2011) (see figure 4), where these researchers slightly expanded on the inputs of trainee characteristic, training design, and work environment of the original model to include: trainee self-efficacy, error management, realistic training environments, and post-training follow-up and feedback.

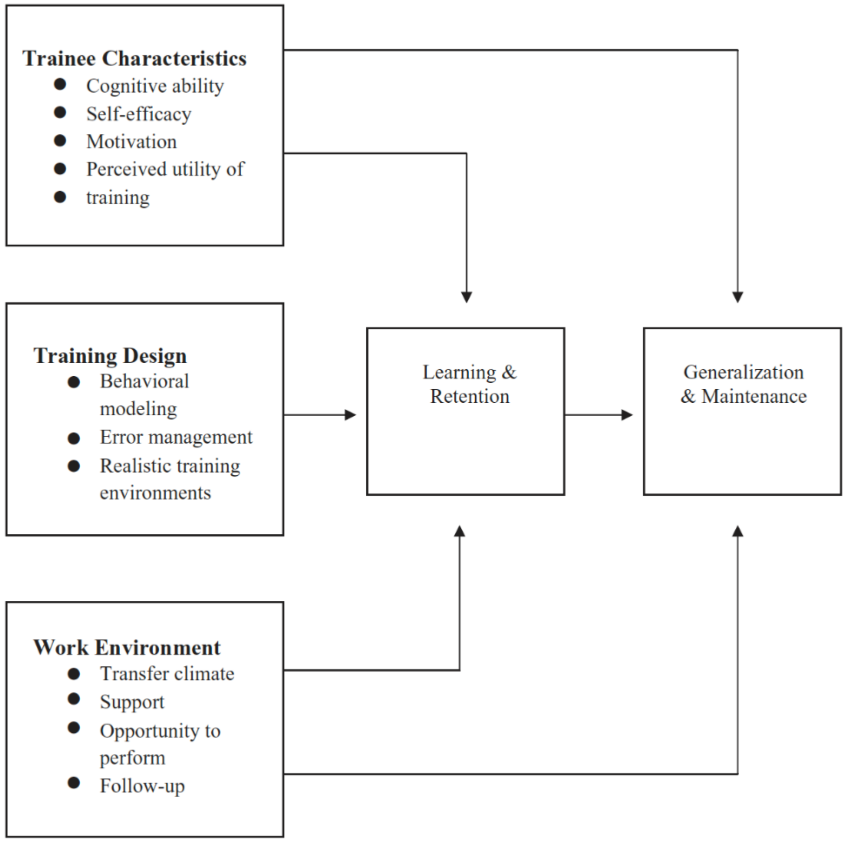

Figure 4. Adapted Model of the Transfer Process

By focusing on some of these expanded training input traits from Grossman and Salas (2011) adapted transfer process model, I have gained the ability within my study to address the beliefs students have about their capabilities, identify errors through more comprehensive curriculum that addresses complex issues, and include supervisors' feedback from the workplace to provide follow-up and feedback.

Over 30 years ago, Baldwin and Ford (1988) identified that many of the training initiatives conducted by organizations seldom transferred to the workplace. This lack of transfer points largely to the fact that most training initiatives up until then only attended to the training design (training input) and primarily analyzed learning that occurred at the end of training, rather than performance on the job after training occurred. As seen in

Baldwin and Ford's (1988) Model of the Transfer Process in Figure 1, many factors can influence training inputs, to include trainee characteristics, training design, and the work environment. Ford, Quinones, Sego, and Sorra (1992) looked at how the work environment impacted students' opportunity to use what they learned in the workplace. They determined that a student's opportunity to perform what he or she learned in the classroom is a significant factor for successful transfer of training. Furthermore, Zumrah and Boyle (2013) compared training inputs in regards to effective transfer of training by examining the combined effects of job satisfaction (trainee characteristic) and organizational support (work environment). They determined a significant positive relationship between job satisfaction and the transfer of training.

Other research has pointed towards motivation and self-efficacy (trainee characteristics) as ways to improve the transfer of training (Iqbal & Dastgeer, 2017). Influencing factors include how happy students are with their jobs, whether or not they feel capable of completing the trained task, and if they are encouraged to utilize the training in the workplace as contributing factors to a student's self-efficacy and his or her will to transfer the training. Burke and Hutchins (2007) concluded in their review of the factors impacting the transfer of training that self-efficacy regarding the trained task and motivation level were primary learner characteristics influencing transfer. They go on to emphasize that, all in all, trainee characteristics play a powerful role in the transfer of training.

Blended Learning

Implementing a blended learning approach to a training program disrupts the typical face-to-face classroom by infusing traditional classroom and online learning activities to combine the positive sides of both learning methods (Eryilmaz, 2015). According to Graham (2006), a key rationale for blended learning is to boost the effectiveness of education. This combination of online and face-to-face activities creates the opportunity for new knowledge and skills that can be transferred to the workplace (Hilliard, 2015). As a student and a teacher, I have witnessed first-hand the technological boom over the last twenty years and how it has made a tremendous impact on the learning environment, from higher education to corporations, computer-based training to online colleges and the opportunities presented are illimitable. A benefit that blended learning offers in this study is its connection to further promote constructivism and students' abilities to better develop meaning-making and knowledge construction.

According to Staker and Horn (2012), blended learning is a formal education program where students learn in part through some form of online delivery of content and instruction with an additional element consisting of supervised brick-and-mortar instructor away from the home. As seen in figure 5, the flipped-classroom model adapted for this study is situated as a sub-category under the rotational model. The rotational model provides the instructor discretion and flexibility between learning modalities. In this format, instructors, with the assistance of supervisors will deliver course content to students outside the classroom, better personalizing the face-to-face learning environment for improved student learning outcomes.

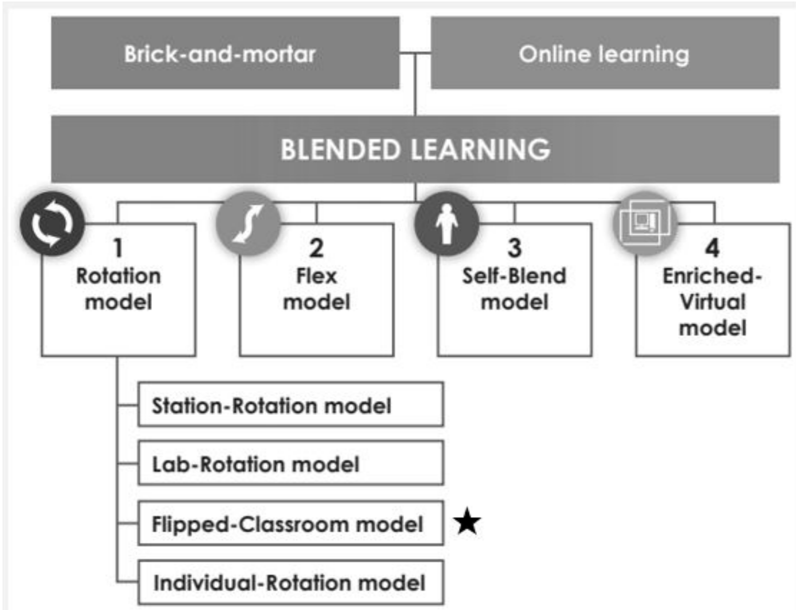

Figure 5. Blended Learning Taxonomy in Relation to Other Educational Practices

Research efforts in blended learning pedagogy have typically been seen in the K-12 environment, and aim to enrich pedagogy, improve access to knowledge, and maximize cost effectiveness (Bonk & Graham, 2006). Similarly, a more common reason for implementing a blended learning strategy in aircraft maintenance technical training is to enhance pedagogical practices. By doing so, educators can create a more interactive environment as seen by the IBM model in figure 6. Companies like IBM use blended learning models to transition learners through three phases (Phase 1) online self-paced to acquire background information, (Phase 2) face-to-face active/experience learning, and (Phase 3) online learning to support transfer of training to the workplace (Bonk & Graham, 2006).

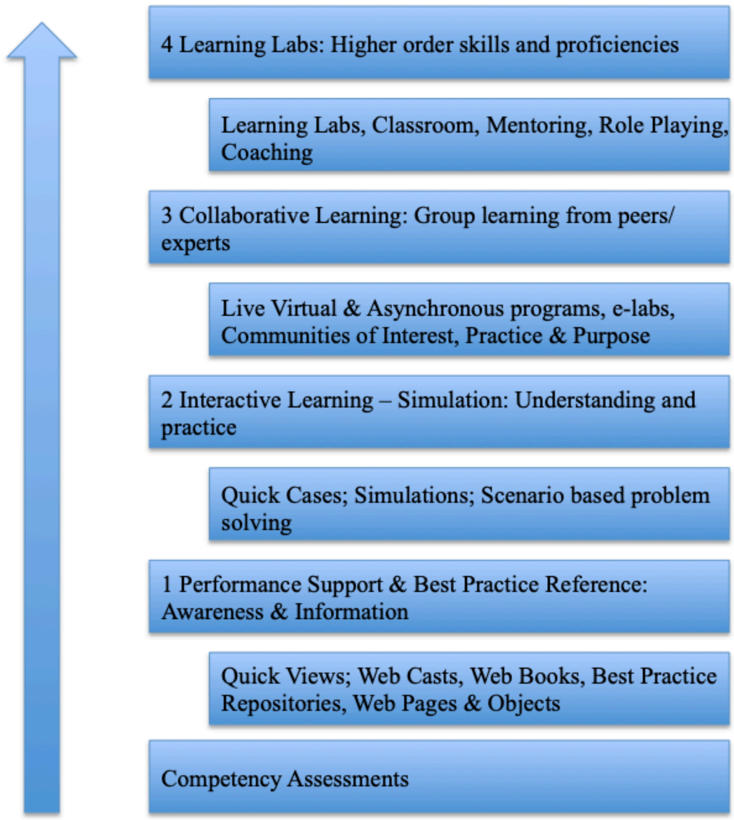

Figure 6. IBM's Four-tier Model. Bonk & Graham (2006)

The aforementioned corporate example of the IBM model is similar to how this study will be blended for the face-to-face portion of the aircraft maintenance technical training portion. When moving from the blended to the face-to-face portion of the class, students will receive performance support (mentoring) from their instructors, interact in the classroom, collaborate with peers, and advance into performance-based objectives.

By implementing blended learning into the current aircraft maintenance technical training curriculum, instructors have the ability to disrupt the current pedagogy and offer a new definition of what works for students and their transfer of training to the workplace (Christensen, Horn, & Staker, 2013). By modifying the current curriculum, there is an opportunity to better use face-to-face time to focus on how learning is occurring in the classroom and facilitate students' development of their own understanding to better capitalize on learning outcomes. By shifting the instructor's onus from lecturer to that of a questioner, he or she assumes the role of a coach or mentor, and one who guides students in determining their own conclusions in a constructivist way. This transformational shift in learning is important in my study because I posit that for transfer to be effective, students must become effective critical thinkers.

Graham (2006) references several reasons for blended learning expansion, with the following implications on this study: improved pedagogy structure, increased interest in self-study for academic improvement, and better preparation of student knowledge and skills. By implementing a blended learning approach, instructors will be able to explore both the gains and tradeoffs that a blended learning curriculum offers versus the existing technical training structure. According to Eryilmaz (2015), blended learning offers advantages such as flexibility in time and space, student interaction in and out of the classroom, and increased instructor to student one-on-one time. By introducing students to course content prior to attending class, they have the opportunity to become familiar with a structured approach to the technical aspect of aircraft: systems components and theory of operation. Constructing knowledge early in the blended learning modules prior to attending the face-to-face portion of a course allows students to arrange their thoughts in more detail and develop quicker attainment of concepts when face-to-face with an instructor.

To further the intent behind the effectiveness of blended learning, Garrison and Kanuka (2004) observed in their assessments of face-to-face and blended learning environments that learning in a blended environment was more effective and efficient versus a face-to-face environment. The comparisons assumed that both forms of instruction provide sufficient content for learning, with blended learning adding a positive effect on learning outcomes to include improved attention, motivation, and knowledge attainment.

Organizational culture and innovation versus production are two factors that potentially limit the implementation of blended learning in aircraft maintenance technical training. According to Gamble (2005), blended learning can provide numerous organizational benefits over using a single learning delivery system. Disrupting a face-to-face dominant learning environment by introducing blended learning poses several questions, including who will be responsible to develop the blended instruction and who will ensure it stays relevant and meaningful towards desired learning outcomes? Additionally, what opportunity costs will be associated with implementing a blended learning strategy?

Previous Cycles of Action Research

Previous action research cycles produced feedback from technical training instructors, workplace supervisors, and recent graduates that helped shape this study. This feedback indicated that training in aircraft maintenance learning environments was sometimes inefficient and did not always correlate between tasks taught in the classroom and job requirements in the workplace. What I garnered from this feedback is that recent graduates, at times, do not find what they learned in technical training to be a productive opportunity cost of their time spent in training. They went on to explain that the rigorous structure of technical training creates a lack of realism between the training they receive and the ever-changing mission requirements in their workplace. Maintainers face a myriad of complex issues that range from interdependent system theories to constantly changing mission demands. They echo that these challenges and the current format of technical training prevent them from constructing knowledge that is required to become better troubleshooters and problem solvers in the workplace. In efforts to address these problems, the following implications for the study were derived.

Research Implications

Three main areas of literature have been examined: constructivism, transfer of training, and blended learning. Each of the aforementioned topics build a foundation and often complement each other throughout this study.

The effort to improve the transfer of training is contingent upon freeing up face-to-face classroom time and creating more flexible learning environments through blended learning. On the independent front, improving the transfer of training from the classroom to the workplace is reliant on the instructor’s time as a mentor or coach to help facilitate students’ knowledge construction. Being able to reach back to prior experiences, blended modules could provide the spark of curiosity that helps facilitate maintainer’s abilities to build more meaningful and relevant learning outcomes. Blended learning assumes several important functions in this innovation. First, it serves as a more efficient and cost savings method to deliver foundational knowledge about aircraft systems. Currently, instructors are responsible to teach foundational knowledge (theory) in a face-to-face informal classroom environment. In this environment the instructors will teach aircraft theory to students who have not been required to complete any pre-reading on the subject beforehand. The face-to-face teaching of aircraft theory, on average, accounts for 25 to

50 percent of the total class time in the local context of my study, time that could be recaptured in a more valuable way. Second, it provides an instructor flexibility with time spent in the classroom, where he or she would gain the opportunity to teach more in-depth, workplace centric systems in the face-to-face environment. Freeing up this time would allow instructors and students the ability to deep dive more critical aspects, leading towards better transfer of training outcomes. Lastly, a subset of blended learning is that it challenges students and workplace supervisors to take a more active role in the learning process. By completing the blended modules outside the classroom, students can collaborate with supervisors on how the theory would apply to the classroom and workplace setting, carrying valuable insight forward to the face-to-face portion of the course.

Chapter 3

METHODS

Introduction

In this chapter, I will describe the research methodology used in my action research study. Mertler (2014) discussed how action research is increasingly being conducted by practitioners whose primary education and experience is not based in research methodology, but within a vested interest in teaching within their field. It is this form of practitioner-based research that I utilize for this study within the context of United States Air Force aircraft maintenance technical training. In terms of specific research design, this study used a triangulated mixed-methods research strategy to examine how blended learning could change the face-to-face classroom environment and impact transfer of training.

According to Mertler (2014), mixed-methods research tends to align well with action research and more researchers see a benefit in collecting both qualitative and quantitative data. For data analysis, I triangulated qualitative observation and interview data in this study with a quantitative phase of research that used pre and post surveys to capture the perceptions of blended learning impact on the transfer of training in aircraft maintenance technical training. By using this mixed-methods design, I merged qualitative and quantitative data simultaneously to compare and analyze aircraft maintenance technical training, giving equal emphasis to the strengths of each data set (Mertler, 2014).

In support of this innovation, Goldstein and Gilliam (1990) argued that one way to improve workplace quality is to improve the technical training skills of employees. To improve these skills, aircraft maintenance organizations should shift their training emphasis from unstructured on-the-job training (OJT) and transition their focus to a more structured field-level technical training agenda. According to Fasse and Kolodner (2013), collecting detailed information that can be used to develop curriculum is a complex undertaking and the success of the effort requires more than recording what students have learned (or not learned) to explicate the utility of such information. In the next section, I will review the current setting of aircraft maintenance and technical training, where I have over 21 years of professional expertise in both maintenance training and aircraft operations, to provide a context for understanding what training was and was not utilized by the participants in the study. Next, I will discuss my role as the researcher and overview the intentions of the intervention. I will then describe my research plan, timeline, and the instruments involved for data collection and analysis.

Setting

This study took place during the spring and summer of 2019 at an Air Force base in California. This medium sized Field Training Detachment (FTD) offered advanced skills aircraft maintenance technical training for two different types of aircraft, across seven different aircraft specialties. The technical training detachment had a faculty of 10 instructors that encompassed the seven different maintenance AFSCs. Courses were offered on an “as needed” basis based on host flying units demand and throughput and ranged in length from a few days to several weeks. The typical academic day for each class as prescribed by the course chart training standard (see Appendix A & B) consisted of 8-hours of instruction, divided into eight equal 50-minute blocks with 10-minute breaks. The instructor-to-student ratio ranged from 1:2 to 1:4 and students remained intact with the instructor for the duration of the course. The same instructor and students remained intact throughout the entire class.

Most FTDs are equipped with aircraft maintenance training devices that function as simulated mockups of the actual aircraft assigned to the base. The instructors at these locations use a combination of classroom instruction (knowledge), simulated instruction (performance), or on aircraft instruction (performance) to teach the objectives of the technical training course. The curriculum is a pass/fail format that requires students to pass all objectives to graduate the course and receive a certificate. Upon completion of field level technical training, students return to their workplace to put their newfound learning to work on the job.

Participants

There were three types of participants selected for this study: students, instructors, and supervisors from the workplace. All of the participants held an AFSC in aircraft maintenance and were either directly or indirectly impacted by technical training outcomes at the time of the study. Selection of the classes and participants for this study and the structure and sampling for the qualitative and quantitative data collection, was based on convenience and consisted of the same 12 students, two instructors, and two supervisors involved throughout the entire intervention. Table 1 lists the number of classes, students and instructor per class, and the relationships between the participants.

Table 1

Relationships among Participants

Class #	Instructor	Student	Supervisor	Notes
1	A	1, 2, 3, 4	1 & 2	Supervisor A leads students 1,2, & 4 Supervisor B leads student 3
2	B	5,6,7,8	1 & 2	Supervisor A leads students 7 & 8 Supervisor B leads students 5 & 6
3	B	9,10,11,12	1 & 2	Supervisor A leads students 9 & 11 Supervisor B leads students 10 & 12

Students. The students ranged in age from 18 to 30 years old, were all males, and had an average of 6 months to 12 years' experience on current and/or previous aircraft systems and held a high school diploma. Four of the students were new to the Air Force and only had aircraft experience from initial skills technical training and 6 months at their current job, while the other eight students had prior advanced skills aircraft experience on various other aircraft. All students had some previous exposure to blended learning in high school or professional development. Selecting the students was a function of convenience based on choosing courses in which scheduling aligned with the timeline for this study and corresponding action research cycles.

Instructors. Two instructors participated in the study; one participated in one set of data collection and the other in two sets of data collection. The instructor that participated in two sets of data collection was observed, interviewed, and surveyed separate for each set of data collection under the assumption that he could have a different experience with each group of students. The instructors were both non-commissioned officers in the pay grade of E-5 and held the same AFSC. One had seven years of experience in aircraft maintenance and the other had eight years' experience. Both instructors held an Associate of Applied Science degree in Aviation Maintenance Technology from the CCAF, had been teaching for more than one year and had previous experience with blended learning during professional development.

Supervisors. The supervisors consisted of a junior and senior non-commissioned officer, pay grades E-6 and E-7, with 10 and 16 years' experience respectively in their AFSC. The supervisors both had more than three years' experience on the aircraft taught in the courses and had worked with the students in the courses between six months to a year. They both were working towards their Associate of Applied Science degree in Aviation Maintenance Technology from CCAF and had previous experience with blended learning during professional development.

Role of the Researcher. In this action research study, my role and involvement was a mixed approach of participant and observer, with extensive inside and outside perspectives on aircraft maintenance and technical training. As an inside participant, I involved myself with the aircraft maintenance FTD to develop the innovation within the parameters and scope of the organization. My prior experience with technical training and as an aircraft maintenance superintendent allowed me to function highly effectively as an educational leader who could analyze how to maximize the benefit of aircraft maintenance technical training in regard to complexity of mission requirements in the workplace. Externally as an observer I watched technical training classes and workplace activities beforehand to identify areas for consideration in the innovation, and during the intervention to identify possible effects on instruction. Whether it was as an insider or an outsider, a participant or an observer, my involvement provided a uniquely experienced perspective with 21 years of aircraft maintenance experience, 10 of which were involved with technical training.

As a participant (action) researcher, I collected pre-intervention observation, interview, and survey data that was used to evaluate the applicability of my proposed intervention and determine if it required any revision. I first discussed the intervention with the two instructors for the classes I planned to use in the study. We collaborated on the quantity of classes to use based on their convenience to action research cycles and which course objectives should be included in the study. After we determined that three classes would be appropriate to study, I prepared the students that were scheduled for the classes that I was going to use by discussing the intent of the study and gathering their necessary consent. Lastly, I collaborated with the supervisors of the student participants to prepare them for the uniqueness of the innovation and how their role as participants would impact the study. Once the innovation was implemented, I collected post-innovation observation, interview, and survey data to determine effectiveness and what changes may be needed in the future for advancement of the study. I collected data with the same participants both pre and post innovation and maintained 100 percent participation throughout.

Intervention

This study was developed to examine the impact of converting a portion of existing knowledge-based objectives in United State Air Force field level aircraft maintenance technical training courses to blended learning modules that would be completed by students prior to attending the face-to-face portion of the course. The study also examined how instructors use the increased classroom time resulting from shifting portions of knowledge objectives to online blended modules to address complex issues that students face in the workplace. Additionally, the study culminated by analyzing how blended learning impacted the transfer of training in an aircraft maintenance training course from the classroom to the workplace.

The two research questions postured in this action research study are:

- RQ1: How does implementing a blended learning approach in aircraft maintenance technical training classrooms affect instructors' teaching practices?
- RQ2: How, and to what extent, does implementing a blended learning approach in aircraft maintenance technical training affect perceptions of the transfer of training?

This study analyzed one type of aircraft maintenance technical training course which was chosen because of its proximity to the action research data collection cycle and the concomitance of subsequent classes over a three-month period. The course was taught a total of three times, by two different instructors (see Table 2), providing sufficient opportunity to conduct data collection during the spring of 2019. Each class was two weeks long and met 8-hours per day, 5 days per week. The content of the course covered advanced airframe systems knowledge and theory of operations for newly assigned aircraft electricians assigned to the base. The courses were broken down into knowledge and performance-based criterion objectives that were divided into units based on different aircraft systems and sub-systems (see Appendix A & B). The knowledge-based objectives were taught in a classroom that was set up similar to what would be expected in a college setting; a lectern from which the instructor lectured, desks for students with laptop computers to follow aircraft technical orders, and a projector displaying visual aids. The performance-based objectives were either taught on an aircraft maintenance trainer or an actual production model aircraft supplied by the host unit. The ratio of students-to-instructor was four students to one instructor.

The purpose behind the small instructor-to-student ratios in aircraft maintenance technical training courses is multifaceted. First is the criticality of ensuring the reliable airworthiness of aircraft throughout the maintenance process, a fundamental that starts in training. Internationally, maintenance actions are governed under the Standards and Recommended Practices established by the International Civil Aviation Organization, a United Nations specialized agency (ICAO, 2018). A governing agency is essential to the safe operation and reliability of aircraft operations across the globe. On a national level, the Federal Aviation Administration is recognized at the United States governing agency for the safety of aviation. Both agencies emphasize the human factors in aviation maintenance and stress the importance of performing their jobs correctly to ensure safe flight. According to Johnson and Dagmar (2013), human factors impact the safety and efficiency of maintenance and we need to pay attention to the issues that affect maintainer's performance. Small class sizes help instructors efficiently manage the classroom space and provide the right amount of individual attention each student requires in complex training environments.

Preliminary analysis of the course revealed a total of 16 knowledge and 10 performance-based objectives that were taught respectfully in the classroom and on-equipment (training device or aircraft). I developed summarized versions of the pre and post Course Chart Training Standard (CCTS) and Plan of Instruction (POI) to facilitate the construction of the blended modules (see Appendix A through D). Through analysis of the CCTS and POI, I identified five knowledge-based objectives to be converted to blended learning modules (see Appendix E). For ease and flexibility of implementation, I developed the modules in PowerPoint and placed them in Google Classroom as a learning management platform. Selection of the five modules was based on the instructors' feedback as to which knowledge objectives they believed would yield a seamless transition from the online to the face-to-face environment. The process of creating the blended modules was to convert the teaching steps from the knowledge-based objectives to bullet points in the corresponding PowerPoint. One month prior to students attending the face-to-face portion of the course, I introduced them and their supervisors to the blended modules. The guidance was for students to work on the blended modules in their spare time at work under the guidance of their supervisor. At the end of each blended module the supervisor would administer and record the end of module progress check. If the students experienced any difficulty with the blended module or its content, they would refer to their supervisor and, if the supervisor had any issues, he would seek assistance from the course instructor or myself. Upon completion of all of the required blended modules, the instructor at the FTD would review a transcript of the modules completed online prior to the student coming to the face-to-face portion of the course.

The goal of my intervention is to investigate how implementing a blended learning approach to aircraft maintenance technical training will change the way instructor and student interact in the classroom and the overall impact blended learning has on the transfer of training to the workplace.

Research Plan

For this study, I conducted a triangulated mixed-methods approach for data collection and analysis. The goal was to simultaneously collect qualitative data from my observations and interviews while collecting quantitative survey data that measures the change in perceptions of the transfer of training from pre to post course implementation. According to Mertler (2014), when your data (observations, interviews, and surveys) support each other, you can have more confidence in the findings.

The observations were conducted during the beginning of the pre and post objectives for the two-week course. By using a semi-structured approach, I was able to attend to other parts of the innovation with participants as I prepared for the interviews at the end of the course.

The interviews were conducted after students completed the post innovation objectives, while the courses were still being instructed, to see what current students and instructors thought about the course and its ability to help students when they returned back to their workplace. I also interviewed supervisors within 60 days after the course completed to gather their input on graduate performance after students finished the technical training course.

Data Collection

Qualitative data collection consisted of observations of three technical training courses (pre and post-innovation), and interviews of students and instructors during the implementation of the same technical training courses (pre and post-innovation) and supervisors after the course completed. For the observations I observed a total of six 50-minute blocks of instruction. There were two observations per class, one during the pre-innovation and one during the post-innovation, I repeated this process across all three classes used in this study. To maintain consistency during the observations, I developed an observation script (see Appendix H) to record participant behaviors and interaction in the classroom.

The interviews were conducted during the class where the observations were conducted, but followed the post-innovation observation. The interviews used a semi-structured approach and were used to gather direct feedback from the participants about their experience in the classroom, both pre and post innovation. Two interviews were conducted for each class, one with the instructor and one with the group of students. The interviews used an interview guide (see Appendix I) and took 45-minutes to collect student and instructor perceptions of the impact that the innovation would have on students' ability to perform their job. Additionally, I conducted interviews with workplace supervisors within the first 60 days that students returned to their workplace. I used the same interview guide (see Appendix I) utilized during the classroom phase of the intervention, mainly to gather supervisor perceptions about the innovation and determine how much of the innovation content transferred to the workplace.

Quantitative data collection consisted of a pair of Likert based questionnaires (see Appendix J and K) that were administered by the instructor to students to collect some basic demographics (gender, age, and experience) about participants and to analyze course content, student performance, and job application categories in relation to the study for a total of 20 items. The intent of the surveys was to reveal any unexpected thoughts and feelings from participants that were not discovered during the qualitative phase (Mertler, 2014).

The surveys were administered pre- and post- for the traditional face-to-face and the blended modules portion of the course, towards the end of the qualitative data collection during class time. In total, there were 24 surveys administered across the three classes, yielding 12-pre and 12-post innovation sets of data.

Data Analysis

This action research study used a triangulated mixed methods approach where the majority of the qualitative and quantitative data was collected and analyzed concurrently. The point behind this type of design was to be able to interpret the data simultaneously and make comparisons of participant's perceptions on training effectiveness. According to Mertler (2014), triangulation mixed methods analysis allows the researcher to compare the results of somewhat similar data sets in a convergent manner, allowing them to make an informal comparison. It was with these comparisons of pre and post qualitative and quantitative data that I was able to test my claim that blended learning could have a positive impact on the transfer of technical training to the workplace. Though compared simultaneously, each data collection method (quantitative and qualitative) tended to retain their distinct roles and will be explained further below (Howe, 2012).

Qualitative Data. The qualitative data gathered during observations and interviews were used to discover and compare how participants felt about the current (pre-innovation) training they were receiving in aircraft maintenance technical training and the potential impact that the innovated blended learning modules (post-innovation) could have on the transfer of training.

For the observations, I sought to better organize the field notes by adapting a coding process from Leedy and Ormrod (2005) in which I divided the pages of my notebook into two columns. The left column of my notebook was labelled “actual” for actual behaviors observed by participants and the right column “thoughts” for how I interpreted their behaviors. To enhance the process of taking field notes, I used an audio recorder with consent so that I could play back and document any important details that I may have missed during the observation period. The observation period culminated with five hours of classroom observations that were divided equally between pre and post innovation for each class. I transcribed the field notes from the observations while referencing the observation script (see Appendix H) as a post observation routine to better synthesize my reflections.

The interviews were conducted in a group setting for the students in each class and on an individual basis for the instructors and, like the observations, were semi-structured in nature. After each group of students completed the blended modules and subsequent face-to-face objectives in the classroom, I administered the interviews. I used an interview guide (see Appendix I) with a predetermined set of questions for each of the 45-minute interviews and similar to the observations, I used an audio recorder with consent to replay any details that may have been missed. All of the interviews were conducted by me as the researcher and accomplished only after the participants completed the traditional course objectives and the innovated blended learning modules. Additionally, I conducted interviews with the workplace supervisors of the students within 60 days of course completion, using the same interview guide as the other participants to gauge their perception of success.

I transcribed my field notes from the interviews into Microsoft Word, using rich text features to build categories and themes. The transcribed text was then indexed into columns using thematic (color) analysis of sentences to reveal common themes presented by the participants. The purpose behind using thematic analysis was to create a systematic way to identify and analyze the themes presented in the phrases of data from the observations first, then the interviews. According to Brinkmann and Kvale (2015), the researcher should "thematize" or define the concept under investigation prior to the interviews. Using thematic analysis allowed me to scrutinize both sets of qualitative data and ensure my questions were carefully planned out.

Quantitative data. The quantitative data collected from the pre- and post-surveys (see Appendix J & K) were analyzed using a paired t-test (repeated-measures *t* test). This test was most appropriate because it is designed to measure one group (students) twice and compare the means (Mertler, 2014). The first survey (pre) was administered to the students (n=12) in the spring of 2019 after they completed the traditional face-to-face objectives in the course, then again (post) after they completed the objectives that included the blended modules for a total of 24 surveys. The surveys were not linked to student identities, only collecting demographic information across five items: gender, age, job classification, job, and Air Force tenure. After the demographic questions, the survey consisted of 15 items broken evenly into three categories. The categories contained five questions each that were based on course content, personal performance, and job criteria. All of the items were based on a 5-point Likert rating scale using a continuum where "5" was "strongly agree" and "1" was "strongly disagree" to measure the strength of the participant responses. In total, there were 24 surveys, with 15 items each, evenly administered across three classes, yielding 12-pre and 12-post innovation surveys, and 360 items.

Timeline

Preparation for data collection began in the fall of 2018, where the qualitative and quantitative data collection instruments (observation scripts, interview guides, and surveys) were finalized and reviewed by experts. The triangulated data collection for this study ran from January through April of 2019, beginning with classroom observations and pre-intervention surveys, culminating with post intervention surveys and interviews. Table 2 illustrates the overall timeline of the study.

Table 2

Action Research Timeline

Time frame	Actions	Procedures
June-July, 2018	Write, submit, and defend action research dissertation proposal	Develop draft of Chapters 1-3 and data collection instruments (observation, interviews, and surveys).

August-December, 2018	Revise proposal effort	Revise feedback from proposal defense and resubmit Chapters 1-3
January-April, 2019	Conduct data collection, implement innovation.	Begin qualitative and quantitative data collection.
May-June, 2019	Draft/submit Chapter 4	Write data analysis and findings in Chapter 4
June, 2019	Revise Chapter 4 and draft Chapter 5	Implement revisions from Chapter 4 and write Chapter 5 Discussions and Implications
July-August, 2019	Submit Chapters 1-5 for review	Revise feedback on Chapters 1-5
September-October, 2019	Finalize reviews and submit for dissertation defense	Submit dissertation to ProQuest and defend dissertation

Chapter 4

DATA ANALYSIS AND FINDINGS

This chapter captures the results from my mixed methods action research study that investigated the impact that blended learning had on the transfer of training in aircraft maintenance technical training. I initially hypothesized that the implementation of a blended learning strategy would enhance several capabilities within technical training: first, it would accelerate student learning during the course, next it would allow instructors to provide more relevant content while teaching, and finally a blended strategy would result in better transfer of training from the classroom to the workplace. While the two methods of data collection selected for this study were collected concurrently, the analysis and findings of the pre and post observations, interviews, and surveys will be discussed in two separate sections: results from qualitative data and results from quantitative data. To serve as bookends to the data results, this chapter will begin with a review of the data collection process and conclude with a review of the findings. A triangulation mixed method design that concurrently used quantitative and qualitative data collection was developed to answer the following research questions:

- RQ1: How does implementing a blended learning approach in aircraft maintenance technical training classrooms affect instructors' teaching practices?
- RQ2: How, and to what extent, does implementing a blended learning approach in aircraft maintenance technical training affect perceptions of the transfer of training?

Review of Data Collection Process

Qualitative data. Qualitative data was collected during the spring and summer of 2019 through observations and interviews that were conducted during class time. The participants selected for the observation period (n=15) were the students and instructors from the three classes chosen based on convenience for this study (see Chapter 3, Table 1). The instructor-to-student ratio for each class was small (1:4), providing a highly interactive foundation for participants in this innovation. I observed a total of six 50-minute blocks of instruction culminating in five hours of carefully watched and systematically recorded interactions in the classroom environment. These observations were broken down into two observations per class, one during the pre-innovation and one during the post innovation. I consistently repeated this process for all three classes in this study. To maintain reliability during the observations; I used an observation script (see Appendix H) to guide my focus of participant behaviors and interactions in the classroom. The interviews were the second set of qualitative data collected and were conducted in groups based on type of participant (instructors, students, supervisors). I piloted the interview guide (see Appendix I) with four supervisors from the field of aircraft maintenance to predetermine the questions for the interviews that best supported the research questions and categories of this study. Similar to the observations, the interviews were semi-structured in nature and conducted after each group of students completed the blended modules and subsequent face-to-face objectives in the classroom (post innovation). Each interview was set for 45-minutes and consistent with the observations I used an audio recorder with consent to replay any details that may have been missed. The only exception to the interview process was the addition of the interview that I conducted with the workplace supervisors (see Chapter 3, Table 1) within 60 days of the student participants' graduation from the course. The intent of the supervisor interviews was to capture supervisors' experiences with students during implementation of the blended modules and their perceptions on the impact of the innovation on student graduates and the workplace.

Quantitative data. Quantitative data was collected concurrently with the qualitative data in the spring of 2019 in the form of pre and post surveys (see Appendix J & K). The purpose of the surveys was to measure participants' perceptions about the training environment and their views on the effectiveness blended learning would have on transfer of training. According to Mertler (2014), it is important to understand the relationship that validity and reliability share when developing a survey that measures what it is intended to measure. Prior to survey administration, a team of four experts from the field of aircraft maintenance (supervisors and instructors) were utilized to establish validity. The team provided an external assessment of content-related validity to determine if the questions accurately addressed fundamental aspects relevant to the overall research questions posited in this dissertation (Fraenkel & Wallen, 2005). Several suggestions and improvements (i.e. removal of short answer items) were made during this process, and I used the feedback to modify the survey instrument yielding more accurate and meaningful questionnaires that were easy to administer, score, and interpret. After establishing content validity, the surveys were administered to the participants in the study. Upon completion of the surveys, they were assessed for reliability (internal consistency) using Cronbach's alpha in SPSS. Cronbach's alpha analysis was performed on the three aforementioned survey categories and associated questions for both pre and post surveys to evaluate how well they would yield consistent results once administered.

Results of Qualitative Data

To provide a recap, qualitative data was collected through observations and interviews conducted during class time across three classes, both pre and post innovation. There were 15 participants (instructors and students) selected for the observation period (n=15), and 17 participants (instructors, students, and supervisors) selected for the interview portion (n=17). All participants consented to the observations and interviews and approved of my use of an audio recording device to capture the events.

Observations. The observation period per class was divided into two portions; one observation was conducted during the pre-innovation and one during the post innovation; I consistently repeated this process for all three classes during this study. Each observation was 50 minutes in duration and proved instrumental in my ability to better understand how students and instructors interact and communicate in class. I found the use of three tools as vital to improving my opportunities to collect quality data. First, the use of a recording device was instrumental in maximizing my ability to concentrate on the participants and not excessively focus on note taking. Second, an observation script (see Appendix H) that supported the categories (course content, student performance, and job applications) used in the pre and post survey helped consistently guide me across all the observations by strategically supporting the quantitative data collection themes. Finally, summarizing and documenting the observations systematically using an adapted coding process from Leedy and Ormrod (2005) was helpful, in which I divided my notes into two columns: actual behaviors and thought about behaviors (see

Table 3). I observed a total of six 50-minute blocks of instruction, culminating in 5 hours of carefully watched and systematically recorded interactions. After each observation I would transcribe notes from the audio recordings to the two-column coding process in Microsoft Word and describe what I observed and my perceptions about them. There were a lot of parallels between the observations that I made from each class, so I consolidated and summarized repetitive information. I coded the observation data and derived themes and patterns between the two columns as seen in Table 3 (Leedy & Ormond, 2005). Overall, the observations revealed much of what I hypothesized early in my action research study prior to data collection: that implementing a blended learning strategy has the opportunity to affect instructors' teaching practices and better prepare maintainers who transfer knowledge more effectively to the workplace.

Table 3

Observation Data Themes

Actual Observation Notes	Thoughts About Observation
Pre-Innovation	
1. High volume of instruction for time allotted by lesson plan	Instructors had a lot of information to disseminate, little time for questions
2. Student spent a lot of time looking up/following along in tech data	Did not appear that students were 100% engaged with instructor lecture
3. Very few questions asked from students on how content related to job	Did not see enough time to ask questions and instructor did not relate content course very often
4. Review of content was rote level and geared towards students looking up answers in tech data	Not a lot of critical thinking used in the student evaluation tool (progress check), did not see much relation to real world problems or workplace issues
5. A lot of time spent reviewing content after each set of main points, at mid-lecture, and prior to evaluation	Did not seem like time was spent efficiently by students. Very little note taking and most information could have been looked up in tech data

Post-Innovation

1. Less time spent covering component and system descriptions	Instructor was able to jump right into theory of operation and answer more questions that were more unique and insightful
2. Some students did not even log into tech data when instructor was lecturing	Students seemed more comfortable with material and more engaged with what the instructor was explaining
3. Less lecture from instructor, more dialog between instructor and students	Instructor seemed more confident with question and answer techniques that students were proficient with material
4. Approximately 20 percent of class time was spent in informal lecture	Students asked a lot of questions about how systems operated in the field, sought instructor's perspective on operating principles
5. Instructors dove into stories they experienced from when they worked as a maintainer on aircraft	Instructor appeared less focused on checking off lesson plan milestones and more willing to take the lesson towards realistic problems

The qualitative data that was gathered during the observations revealed several interesting themes that later informed the thematic analysis of the interview data. First, during the pre-innovation observations, I consistently noticed how time-constrained instructors were while teaching. Despite having eight 50-minute blocks of instruction per day, they were constantly spending excessive time reviewing content they covered from previous sections even though students had access to the information in their tech data. Second, due to the rapid amount of information flowing from instructor-to-student, there was not a lot of time for questions and answers during the pre-observations lessons. Finally, during the post observation I did notice an uptick in student interaction, creative questions, and instructor willingness to take topics off script. I relate the change I saw from the pre to post observations as a result of the blended modules giving the students more understanding of the course content prior to the instructors' lecture and the ability of instructors to use the white space in their lessons to interrelate student questions with workplace issues.

Interviews. The interviews were the second method of qualitative data collection and were conducted in individual and group settings for all participants in the study. Similar to the observations, the interviews were semi-structured in nature and provided me flexibility as the researcher to purposely sample a specific population to better understand the phenomenon of the innovation (Moustakas, 1994). After the instructor and students completed the blended modules and subsequent face-to-face objectives in the classroom, I immediately conducted an interview to gather their thoughts about the innovation. Instructor interviews were conducted individually and students were interviewed as a group for each class. I used an interview guide (see Appendix I) that contained a predetermined set of questions to focus each of the 45-minute interviews. The interview questions were strategically placed as part of the research design to gather perceptions about the difference between pre- and post-innovation training and the level of perceived effectiveness of the training. As a form of member checking, to explore the credibility of how I recorded the interview responses, I paraphrased each participant's response back to them to check for accuracy. Congruent with the observations, I used an audio recorder with participant consent that allowed me to capture the moment while focusing on the interviewees and not on note taking. The only difference in the interview process compared to the observations was the addition of an interview conducted with the two workplace supervisors (see Table 1) within 60 days of the student participants' graduation from the course. The purpose behind interviewing the supervisors was to collect an external-to-the-classroom perspective on how well the blended modules prepared the students for the face-to-face portion of the class and the overall innovation prepared them for their job in the workplace.

I transcribed the audio recordings to use along with my field notes in identifying categories and thematic statements relevant to my research questions. According to Gelo, Braakmann, and Benetka (2008), interpreting qualitative data is based on inductive inference that requires the researcher to make meaningful and consistent understandings and explanations. The transcribed text was then indexed into columns where I began to pre-code "codable moments" using thematic (color) analysis to reveal common themes presented by the participants (Boyatzis, 1998). Thematic analysis was used because it provided the most efficient means for analyzing sentences and linking common themes across the categories based on participants' experiences throughout the innovation. Additionally, thematic analysis allowed me as the researcher to investigate the phenomenology of participants' perceptions and feelings about the impacts of the study. According to Aanstoos (1982), a phenomenological approach emphasizes participants' understanding of phenomena (blended module impact) on their own terms and complements the interview questions that investigate how the learner experienced the innovation. I discovered that using thematic analysis allowed me to objectively scrutinize both sets of qualitative data, reduce researcher bias, and discover opportunities to dig deeper into unexpected findings (Belotto, 2018).

According to Saldaña (2016) "themeing" data is not an expedient method of qualitative analysis, but it is as equally intensive as coding with "comparable reflection on participant meanings and outcomes" (p. 288). I used thematic analysis to build categorical themes, based on three categories derived during this study (see Table 4). The table contains summarized student comments, organized by theme, where interviewee feedback from pre-coding and thematic interview analysis was organized. Data from the thematic analysis were later used in this section to inform three overall themes: *time* spent, prior *knowledge*, and the *workplace* that allowed me to summarize interviewee feedback.

Table 4

Student Interview Data Thematic Analysis

Categories & Themes
Course Content
Theme: Time
1. The blended modules allowed more time for discussion in the face-to-face part of the class
2. Time was better utilized in the innovated class to address our (student) questions
3. Class time could have been a little shorter or more content added
4. Overall the instructional time of the new format was good, can add more integrated systems learning
5. Do not recommend having students in blended modules while they are doing their Career Development Courses (CDC), cannot allocate that much study time during work
6. It was helpful to see the terms used in the blended modules, it made understanding the instructors "maintenance slang" easier to follow
Theme: Knowledge
1. Blended modules served as a guide as to "what" to study for when students came to class
2. References to how it was nice to have blended module content and how students were able to build on this during the classroom portion and look at the information differently
3. A more summarized or concise review of blended modules would have been helpful before each objective, rather than not all at once on day one
4. The prior knowledge from the online portion made it easier for students to learn the information presented by the instructor
5. It would be beneficial if some CDC content was tied to the blended modules
6. Learning content in the blended modules stopped students from having to cram for the test like in the previous format
Job Application
Theme: Time
1. Instructors spent more time relating course content to our workplace in the new structure versus previous objectives that didn't have blended modules
2. Students would like to see even more content put into the blended modules and spend all of the classroom time in discussion, problem solving

3. Students inquired about spending classroom time exclusively in the workplace and working on actual jobs in the queue

Theme: Workplace

1. Have the opportunity for instructors to spend more time in the maintenance areas to learn how our days really go and bring that to the classroom
2. The new format with blended modules was a better fit for how learning carries over to a maintenance workplace
3. When able to get supervisors' undivided attention, students were able to go over the blended modules with them for better understanding of how content related to the workplace
4. Interacting with supervisor during blended modules helped students ask better (critical thought) questions during class

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Student Performance

Theme: Workplace

1. Students felt more prepared (confident) because of the new course structure classroom time to perform harder tasks in my job
2. Students found it easier to remember (recall) what they learned in the new blended format versus traditional FTD courses
3. Students made better connections between course content and job requirements because of the blended knowledge they learned

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Additional thematic analysis was performed on the supervisor interviews (see Table 5), in which I used the same set of categorical themes as seen in Table 4. The supervisor interview table contains summarized, actual supervisor comments, from their encounters with students while they were completing their blended modules in the workplace prior to attending the face-to-face portion of the class. During the interviews, workplace supervisors expressed improved connection with students and course curriculum as the students completed the blended learning modules. Supervisors reported that they spent several hours with each student per blended module, answering questions they had between course content and aircraft systems and proctoring each end of module exam. Additionally, supervisors mentioned how the blended modules motivated them to engage student through the lifecycle of technical training, before, during, and after students attended technical training. The feedback provided by supervisors during the interview process was insightful and helped me better understand how supervisors related to students during the blended module portion of the innovation and how they felt about student knowledge transfer to the workplace.

Table 5

Supervisor Interview Data Thematic Analysis

Categories & Themes
Course Content Theme: Time 1. On average 1-2 hours were spent with each student per blended module 2. The more time a student spent working on the blended modules, the more time each supervisor spent engaged with students 3. Proctoring the tests for each blended module did not take more than 20-30 minutes Theme: Knowledge 1. The content of each module was very consistent with technical data that students had access to in the workplace 2. Supervisors like to have seen more test types, not just multiple choice. It appeared easy for students to look up most answers with the "open book" format Job Application Theme: Time 1. Supervisors noted it was nice being able to connect what students were learning in the blended module with what was going on in the workplace. This increased the amount of time spent with each student while reviewing blended content, but it was worth it 2. On average we found 2-3 hours' worth of actual workplace activities that coincided with each blended module in which the students engaged Theme: Workplace 1. Direct correlation between what students were learning during the blended modules and jobs going on in the workplace 2. Found opportunities to use tools, parts, and aircraft in the workplace as visual aids to help students better understand some of the blended content

Themes and assertions. According to Nolen and Talbert (2011), to make a qualitative claim with confidence the researcher must meet three conditions: his or her role as researcher must be clearly described, he or she must be fully transparent, and the study must be derived from other research. In effort to establish more robust asserted outcomes, I have applied transparency across data collection protocols and utilized tables to better communicate outcomes to the reader. The use of themes by category (as seen in Table 4) proved as a practical way to cluster interviewee feedback into relatable experiences. I subsequently used this data to build a set of themes (see Table 6) from the categories that allowed me to form a more precise understanding of participant responses.

Table 6

Themes and Assertions

Theme	Assertions
Time	1. Overall students did not mind completing the blended modules prior to class on their own/work time 2. All participants noticed an increased rate in learning that developed from the innovated blended course structure 3. Instructors and students recognized that classroom time was more impactful in innovated objectives in the course
Knowledge	1. Student and instructor participants agreed that the prior knowledge gained from blended modules as most important factor in innovation 2. Students were able to make connections between the workplace, to course content, and back to workplace in innovated course 3. Opportunity exists to connect learning acquired during CDCs to blended modules of FTD
Workplace	1. Participants perceived a better transfer of FTD course content to the workplace with innovated (blended) format due to increased stakeholder commitment to learning outcomes 2. Improved learner confidence throughout stages of training (blended → face-to-face → workplace)

In summary of the interview responses, I noted a recurring relationship between themes and how they were interdependent for each other's outcomes. Take, for instance, the recurring theme of time; whether it was adding to or taken away, the impact that the innovation had on participants' time was widely impactful to their knowledge and workplace setting. Knowledge, on the other hand, was a catalyst for time and workplace. By implementing blended learning I was able to free up classroom time, which in turn allowed instructors to deliver more meaningful and relevant content that tied to the workplace. Finally, the workplace, while the principal recipient of the previous two themes, in itself enabled supervisors to work with students in the blended modules and increased awareness as to how effective the transfer of training process was working.

Results of Quantitative Data

Quantitative data was collected to measure participant's perceptions about the training environment and their views on the impact that blended learning would have on the transfer of training. A team of four experts from the field of aircraft maintenance (supervisors and instructors) was asked to help pilot the surveys during the fall of 2017 to establish validity. The experts were able to provide an external assessment of content validity that helped determine if the questions accurately addressed all of the fundamental aspects to support the three survey categories: course content, student performance, job application and the overall research questions posited in this dissertation. Several suggestions and improvements were made during this process and I utilized the results to modify the survey instrument, yielding more accurate and meaningful surveys that were easy to administer, score, and interpret. After establishing a baseline for content validity, the surveys were then measured for reliability (internal consistency) using Cronbach's alpha in SPSS.

Cronbach's alpha. Cronbach's alpha analysis was performed on the three survey categories: course content, student performance, and job application for both pre- and post- surveys to determine how well they would yield consistent results once administered. According to Cronbach (1951), receiving an alpha coefficient of 0.70 or greater is an adequate result for reliability and the overall Cronbach alpha for the pre survey was ($\alpha = 0.866$) and the post survey ($\alpha = 0.847$). The pre and post surveys were only administered to student participants (n=24). The first survey (n=12) was administered pre-innovation to the students of each of the three classes before students were introduced to the blended modules. The intent of the pre survey was to collect students' perceptions about the usefulness of the course as it pertained to their job in the workplace. The second survey (n=12) was administered post innovation to the same students after they completed the objectives that included the blended modules and aimed to collect students' perceptions about how useful the innovated course would be towards their job in the workplace. The three categories in the surveys contained five items each and were based on course content, student performance, and job application. The means for the pre and post survey responses were compared in SPSS using paired *t*-tests to draw conclusions about students' perceptions of the innovation and its perceived impact on their overall training experience.

Reliability analysis of the pre and post survey categories resulted in alphas that ranged from $\alpha = .857$ to $\alpha =.272$ (see Table 7). While the alphas for the course content and student performance were individually acceptable with an alpha greater than 0.70, the range of the alpha for job application was lower and will be discussed in next paragraph. According to Tavakol & Dennick (2011), it is important to consider that high coefficient alphas do not always mean that there is an equally high level of internal consistency because the alpha is also impacted by the length of the survey. In this case, a short survey of 15 questions with only 5 items per category could impact the value of alpha. The small sample size also increases the possibility that standard error may affect the results.

Table 7

Survey Content and Reliability Analysis

Category	Item	Coefficient Alpha Estimate of Reliability Pre-Survey	Coefficient Alpha Estimate of Reliability Post Survey
Content	6, 7, 8, 9, 10	.857	.792
Performance	11, 12, 13, 14, 15	.826	.813
Job	16, 17, 18, 19, 20	.628	.272
Overall	6-20	.866	.847

Inter-Item Correlation Matrix. In response to the lower alphas for the job application category, I performed an inter-item correlation matrix (see Tables 8-11) to look at the fidelity of scores across the category in pre and post surveys.

Table 8

Inter-Item Correlation Matrix for Job Application in the Pre-Survey

	Item 16	Item 17	Item 18	Item 19	Item 20
Item 16	1.000	.258	.522	.522	.408
Item 17	.258	1.000	.135	.135	-.316
Item 18	.522	.135	1.000	1.000	.213
Item 19	.522	.135	1.000	1.000	.213
Item 20	.408	-.316	.213	.213	1.000

Table 9

Inter-Item Correlation Matrix for Job Application in the Post Survey

	Item 16	Item 17	Item 18	Item 19	Item 20
Item 16	1.000	.674	.316	-.258	.158
Item 17	.674	1.000	.213	-.174	-.213
Item 18	.316	.213	1.000	.000	.125
Item 19	-.258	-.174	.000	1.000	.000
Item 20	.158	-.213	.125	.000	1.000

Table 10

Item total statistics for Job Application in the Pre Survey

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Item 17	9.08	1.356	.033	-	.730
Item 20	9.25	1.114	.175	-	.707

Table 11

Item total statistics for Job Application in the Post Survey

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Item 19	18.75	1.114	-.143	.076	.472

It was evident by the weak and sometimes inverse correlations that Pre-Survey Items 17 and 20 were causing variations and should be considered for removal from the surveys. For the post survey, most item correlations were inconsistent with each other, though Item 19 stood out as the only question that if removed, would increase

Cronbach's alpha. Pre survey items 17 and 20 inquired about the course's ability to enhance students' troubleshooting/problem solving capabilities and their ability to work collaboratively with other AFSCs. I believe there were inconsistencies between student responses on these two items because of their previous aircraft experience and tenure. Per demographic data gathered during the surveys, student experience in this study ranged from 6 months to 12 years on the job; results typical from varied apprentice to journeyman and craftsman level aircraft maintainers. For the post survey, I believe the inconsistencies with how the students viewed the course's ability to help them to understand how they impacted sortie generation was also due impart to their level of previous experience working with other aircraft maintenance career fields. Despite the lower coefficient alphas in the job application category, all of the items were retained because the data captured when comparing means between the pre and post surveys proved valuable in determining change in a participant's experiences. The overall Cronbach alpha for the pre survey was at ($\alpha = .866$) and for the post survey was at ($\alpha = .847$), moderately high results that demonstrate an acceptable level of internal consistency for the survey instruments as a whole.

Means analysis. A paired-samples *t* test was conducted in SPSS to compare the mean scores for each category between pre and post survey to measure the change in how students rated their blended learning training experience. As a reminder, all survey items were based on a 5-point Likert rating scale using a continuum where "5" was "strongly agree" and "1" was "strongly disagree" to measure the strength of the participants' responses. I conducted the data analysis per paired survey (pre and post) and reported the data (see Table 12) as averages per category.

Table 12

Survey Category Means Analysis

Category	Item	Mean (Pre)	Mean (Post)	Δ	Δ%
Course Content	6, 7, 8, 9, 10	3.99	4.85	.86	21.43
Student Performance	11, 12, 13, 14, 15	3.60	4.86	1.26	35.00
Job Application	16, 17, 18, 19, 20	2.82	4.70	2.31	97.31
Overall	6-20			1.48	51.25

The data revealed a difference across all three categories with increased student mean scores from the pre to post surveys. The *course content* category had the smallest increase of .86 (21.43%) from the pre to the post survey responses. This category primarily looked at the relevancy of course content to the students' jobs and if they felt the course improved their knowledge and skills. The second largest change was in the *student performance* category with a 1.26 (35%) increase. Here students were asked about the course's impact on their critical thinking and problem solving skills. Early in the innovation, I hypothesized this as an area that would improve post innovation. The *job application* category is where I observed the largest change with 2.31 (97.31%) increase from pre to post survey responses. While all of the categories support the two research questions in this study, the change in the job category relates strongest with the innovation's second research question for improving transfer of training.

Paired samples *t*-test. The application of the paired samples *t* test (see Table 13) was conducted to compare pre and post survey data and assess the effectiveness that the blended learning modules would have on the transfer of training in aircraft maintenance technical training. I was looking to support the research questions of the study by determining whether the students perceived a change associated with the blended learning modules that positively or negatively impacted their transfer of training to the workplace.

There was sufficient evidence to suggest that the change in student survey results from pre to post survey were statistically significant across paired tests, with a $p<.001$ for all three subscale categories. The change in student responses to the surveys was meaningful, particularly in the job application category, which saw a double digit increase in mean score by grouped items.

Table 13

Paired-Samples T-Test

Subscale	Measure	*n*	Mean	Std Dev	Mean Diff	df	*t*-stat	*p*-value
Course Content	Pretest	12	20.00	.60	4.25	11	9.92	<.001
	Posttest	12	24.25	1.36				
Student Performance	Pretest	12	18.00	1.65	6.33	11	10.65	<.001
	Posttest	12	24.25	1.23				
Job Application	Pretest	12	11.92	1.09	11.58	11	19.86	<.001
	Posttest	12	23.50	1.24				

All three subscale categories experienced higher mean response scores in the post survey, reporting improved performance and more meaningful results for the study. Eclipsing the results was the job application category, where the mean score difference increased 97% from the pre to post survey, demonstrating student feedback that substantiated my hypothesis that the implementation of a blended learning strategy would enhance technical training and result in better transfer of training from the classroom to the workplace. More specifically, students seemed to have higher post survey scores on the subscale categories that measured their ability to think more critically and solve problems. According to Van den Bosch and Helsdingen (2012), the goal of critical thinking is to keep students from assessing situations only on isolated events and teaching them how to integrate other knowledge into context.

Review of Findings

Rich data were discovered when conducting the mixed methods research for this study. Qualitative and quantitative data were collected on individuals during the innovation, but for the purpose of brevity, the data were discussed at the subscale (category) level. Both, qualitative and quantitative data revealed participant feedback that not only supported, but also substantiated my assertion that blended learning has the potential to improve instructor teaching practices and transfer of training to the workplace.

During the qualitative phase, the pre and post observations presented me a firsthand account as to how the students and instructors interact during class. I was able to witness the strengths and weaknesses of the traditional course format and leverage that understanding to better inform subsequent data collection efforts. An example would be how constrained instructors were for time because of the amount of information they had to present to students. Another observation was the improved two-way interaction between students and instructors post innovation. The interviews were the only research method that included the supervisors from the field and proved beneficial in making early connections between the research questions of this study and the three categories: course content, student performance, and job application, prior to analyzing the quantitative survey data.

The quantitative phase consistent of pre and post surveys that were administered to twelve students across three classes. Despite having a few outlier pieces of data when determining reliability, the surveys painted a compelling picture of the perceived impact that blended learning could have on technical training and its transfer to the workplace. The statistically significant increase in response scores from the pre to post surveys demonstrated an innovation that has convincible effect on the technical training community.

Chapter 5

DISCUSSION AND IMPLICATIONS

The purpose of this action research mixed methods study was to investigate better learning opportunities for aircraft maintenance technical training students by exploring the impact that blended learning would have on the transfer of training. Initially, I hypothesized that by changing the training design from purely face-to-face to that of a blended learning environment, the innovation could free up classroom time in which instructors, students, and supervisors could co-create knowledge that would facilitate better transfer of training. What I learned was that the participants in this study discovered opportunities within this innovation to accelerate student learning and better integrate stakeholders in the technical training enterprise. In this chapter, I will recount the relationships discovered between the quantitative and qualitative findings as they related to the research questions. Furthermore, I will discuss study implications for practice, limitations of the study, and recommendations for future research that are organized in relation to the following research questions:

- RQ1: How does implementing a blended learning approach in aircraft maintenance technical training classrooms affect instructors' teaching practices?
- RQ2: How, and to what extent, does implementing a blended learning approach in aircraft maintenance technical training affect perceptions of the transfer of training?

Discussion of Results

Research Question One. To address the first research question of how blended learning affects instructors' teaching practices, I will first revisit Graham (2006), who referenced several reasons for blended learning expansion that included: improved pedagogical structure, increased interest in self-study for academic improvement, and better preparation of student knowledge and skills. I discovered through this study's qualitative and quantitative analysis that these three reasons are in fact credible expectations for the implementation of a blended learning strategy in aircraft maintenance technical training.

Results from student and instructor participants in this study affirmed through interview and survey analyses that the blended learning structure did influence instructors' teaching practices, as the instructor's classroom pedagogy shifted from that of a knowledge provider to more of a mentor or coach. According to Horn and Fisher (2017), shifting portions of instruction online allows instructors to devote more of their limited time to face-to-face coaching in small groups. By moving basic information online, this new pedagogical structure allowed instructors more time to better collaborate with students who demonstrated increased engagement and motivation for higher order learning while face-to-face in the classroom. According to Brodsky (2003), higher education organizations (technical training) should consider blended learning if they wish to develop training programs that will include group problem-solving, problem-based learning, and simulation or role play. Instructors described during the interview process that they were able to capitalize on what students learned in the blended modules with better use of time in the classroom to address mission related issues and increased critical thinking. Instructors stated that they were able to present course content in a more detailed manner, improving student understanding of advanced concepts.

The implementation of blended learning modules also formed participant connections outside the classroom that improved student self-study. Supervisors of the graduates echoed during their interviews how the blended modules improved student and instructor interactions with them over technical training course content while operating in the workplace. Eryilmaz (2015) discussed the advantage of students' positive opinions of blended learning and how they can result in improved interaction both inside and outside the classroom, therefore leading to faster learning. The opportunity for students to bring technical training content to the workplace proved to be a hub for connecting instructor, student, and supervisor involvement in learning. The results of implementing a blended learning strategy in this innovation resulted in a face-to-face classroom environment that was better prepared to provide timely and relevant training that prepared students with the knowledge and skills necessary to transfer their learning to the workplace (Grossman & Salas, 2011).

Research Question Two. The second research question of how implementing a blended learning approach can affect transfer of training was answered through robust results during both qualitative and quantitative analysis. A segue from the first research question is the ability for instructors to devote more time in the classroom with students, provoking a more reflective, in-depth, workplace-centric instruction that would presumably lead to better transfer of training to the workplace. Staker and Horn (2012) discussed that an important element of blended learning is what students learn online informs what they learn face-to-face, and vice versa. This idea was central to the success of this innovation due in part to the inclusion of learning that participants shared with each other throughout the study.

Qualitative data revealed that participant stakeholders were more engaged with the post innovation course content and found an increased level of realism with the training. In A Model of the Transfer Process by Baldwin and Ford (1988) from Chapter 1, Figure 1, support from supervisors was noted as an important training input (work environment) for successful training outputs and subsequent conditions of transfer. Prior to this study, supervisors scheduled students for training with an unknown level of utility for course outcomes and rarely engaged with students while they were attending class. It was difficult for supervisors to value the training that students were receiving because of the lack of their involvement in the training process. During post innovation interviews, workplace supervisors discussed a newfound connection with students when they were completing the blended modules prior to attending the face-to-face portion of the class. Supervisors also cited improved motivation to follow students through the lifecycle of their training because of their interest in learning outcomes. Additionally, students reported an increase in confidence during interviews that translated to an improved motivation to learn because of supervisor involvement and more realism in training. In A Model of the Transfer Process by Baldwin and Ford (1988) from Chapter 1, Figure 1, motivation (trainee characteristic) and realistic training environments (training design) were two additional training inputs that were key to training outputs and overall conditions of transfer.

The growth of quantitative results from the pre to post innovation statistics proved to be the most significant findings in this study. Data were gathered with a pair of surveys, pre survey (α = 0.866) and the post survey (α = 0.847), that were both found to be highly consistent and reliable in Chapter 4, Table 7. A paired samples t-test was used to determine the mean difference between the pre and post survey subscale responses from students. The three subscales measured student perceptions about course content, student performance, and job application. There was sufficient evidence to suggest that the change in student survey results from pre to post survey was statistically significant across paired tests, with a $p<.001$ for all three subscale categories as seen in Chapter 4, Table 13. The change in student responses from the pre to post surveys was meaningful, particularly in the job application category, which experienced a double-digit increase in mean score by grouped items. The job application category (mean diff of 11.58) was strikingly more significant with values that nearly doubled that of the course content and student performance categories combined average (mean diff of 5.29). It was evident that student perceptions about utility of the innovated, blended learning course and improved time with instructors could enhance their abilities to think more critically, solve complex problems, and effectively transfer their knowledge to the workplace.

Implications

Implications of this study will be discussed in two sections: practice and research. It is important to elucidate how this study could influence current and future aircraft maintenance technical training programs and inspire successive research efforts across technical training enterprises.

Practice. Innumerable amounts of research have been conducted and recognize the positive impact blended learning can have on teacher practices and student learning. From this study, I have garnered evidence that can be used to support further implementation of blended learning into additional aircraft maintenance technical training courses. Blended learning modules for this study proved to modify the existing path, pace, time, and place for teaching and learning in aircraft maintenance technical training for the betterment of participants (O'Byrne and Pytash, 2015). Despite these positive results, the current intervention only represents an incremental change in practice as it applies to aircraft maintenance technical training. Kim, Bonk, and Oh (2008) predicted that blended learning could enable learners to engage in just-in-time (JIT) training or performance support. With lifecycles of tactics and technology changes that outpace the content addressed in traditionally formatted training courses, there stems a need to implement a JIT process that links training and performance outcomes more closely. According to Tatro (2010), blended learning opportunities in technical training provide more flexibility for student learning with increased effectiveness in pedagogical practice and access to collaborative learning. Further leveraging technologies like blended learning, and discovering more effective ways of involving course materials to achieve higher order learning and solve problems, will be indispensable to solving training shortfalls and maximizing transfer of training. As a participant researcher, I believe that my intervention is a reason to begin a shift towards implementing blended learning into aircraft maintenance technical training courses.

Research. Since Baldwin and Ford’s (1988) initial call for future research directions on transfer, there have been droves of inquiry into transfer related gaps in training. Research is now needed to create a logical sequence of investigation that could succeed this study in determining the successful implementation of blended learning across different aircraft maintenance technical training courses. Studying training courses for other maintenance AFSCs is necessary to establish a consistency of findings across technical training. Additionally, due to time limitations and access to broader resources, further data collection should be conducted to investigate the long term impacts blended learning has on the transfer of training in aircraft maintenance technical training. Strategic analysis of how implementing a blended learning pedagogy and successive transfer of training affects student understanding of mission effectiveness and overall sortie generation performance measures would be paramount in determining the training return on investment of such initiatives. Personally, my own continued research interests lie in collecting data on actual learning outcomes and applications of training over time for aircraft maintenance technical training students. There is a need to verify the perceptions of impact with these actual student learning outcomes and expand this study's findings across a wider range of aircraft maintenance technical training.

Limitations

This study has several limitations that need to be addressed with further research. First, due to the limited sample size, the study was restricted to active duty service members, in one maintenance AFSC, all assigned to the same type of aircraft. Organizational barriers and time constraints of the study limited my ability to test the innovation on other maintenance career fields or different types of aircraft. Further exploration on the effectiveness of the innovation athwart other maintenance training courses would yield a more comprehensive look at the possibility of implementing blended learning system-wide.

Additionally, frequent changes in technology and organizational support for course upkeep prevented me from implementing and studying a full maintenance training course. According to Kim, Bonk, and Oh (2008), fast changes in technology, insufficient management support, and commitment were the most significant issues to successfully implement blended learning. Research for this study was conducted on a small series of innovated course objectives and only considered perceived participant satisfaction as the dependent variable. The ability to collect and analyze additional learning performance and student scores as dependent variables would have generated rich results on the effectiveness of the innovation.

Despite these limitations, this study indicates that participants (students, instructors, and supervisors) involved perceived blended learning as a value-added option for improving instructors' teaching practices and subsequent transfer of training to the workplace. The study also highlights the need to innovate current aircraft maintenance technical training to better support the mission of aircraft maintainers in the workplace and enhance overall sortie generation.

Lessons Learned

As a researcher, two important lessons were learned during this study: (1) the rigor of a mixed methods research design, and (2) connecting research through a vigorous literature review.

My initial methodological plan for this study was to create a purely qualitative research design that would use observations and interviews to gather perceptions about implementing a blended learning strategy into aircraft maintenance technical training and its impact on the transfer of training. It was not until taking a quantitative research design course in pursuit of the requirements for this doctorate degree that I realized the benefits of combining qualitative and quantitative data in a mixed methods design. By triangulating the data collection methods, I was able to leverage the strengths of each data set to better inform the other data collected. For instance, the development of the surveys informed the construction of the observation script and the interview guide to categorically organize data collection based on course content, student performance, and job application. Additionally, the significance of the quantitative data analyzed in the paired samples t-test solidified the feedback received from participants during the qualitative portion of data collection.

My development as a researcher grew considerably as I progressed through the literature review process during this study. Interpreting the theoretical perspectives of other researchers in constructivism, blended learning, and transfer of training not only guided, but often reshaped this study and helped me locate my own research within the context existing perspectives. Fitting the uniqueness of this study into larger fields of study helped provide a synergy between the theoretical perspectives and provided a new way to interpret the prior research as fit my innovation.

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APPENDIX A

COURSE CHART TRAINING STANDARD: PRE-INNOVATION

COURSE CHART AND TRAINING STANDARD

AIRCRAFT ELECTRO/ENVIRONMENTAL SYSTEM JOURNEYMAN

COURSE NUMBER: J4AMP2A6X6 XXXX

COURSE SECURITY CLASSIFICATION: UNCLASSIFIED

COURSE LENGTH: 270 Hrs (34 Academic Days)

EFFECTIVE DATE: DD MMM YYYY

ENTRY PREREQUISITES: 6 Months aircraft or system experience

INSTRUCTOR TO STUDENT RATIO: Maximum 1:4, minimum 1:2. When the instructor to student ratio is exceeded for practical application, the course length will be extended to complete objective, or the assistance of assigned host craftsman or qualified detachment instructor will be required.

COURSE CONTENT:		HOURS
1.	COURSE ORIENTATION	1
2.	E-3 SWITCHLIGHT AND ANNUNCIATOR MODULES	2
	a. Using TO, identify switchlight module and annunciator module operating principles, with a minimum accuracy of 80 percent.	
3.	POWER SYSTEMS	10
	a. Using TO, identify power system characteristics, with a minimum accuracy of 70 percent.	(4)
	b. Using TO and the TAU-197/E Electrical System Trainer, perform main AC power system operational check, with no more than two instructor assists.	(6)

COURSE SUPPORT RESOURCES

a. AETC FURNISHED:
Electrical Systems Trainer (TAU-197/E)
Air Conditioning System Trainer (TAU-200/E)

b. HOST UNIT FURNISHED:

APPENDIX B

COURSE CHART TRAINING STANDARD: POST-INNOVATION

COURSE CHART AND TRAINING STANDARD

AIRCRAFT ELECTRO/ENVIRONMENTAL SYSTEM JOURNEYMAN

COURSE NUMBER: J4AMP2A6X6 XXXX

COURSE SECURITY CLASSIFICATION: UNCLASSIFIED

COURSE LENGTH: 270 Hrs (34 Academic Days)

EFFECTIVE DATE: DD MMM YYYY

ENTRY PREREQUISITES: 6 Months aircraft or system experience

INSTRUCTOR TO STUDENT RATIO: Maximum 1:4, minimum 1:2. When the instructor to student ratio is exceeded for practical application, the course length will be extended to complete objective, or the assistance of assigned host craftsman or qualified detachment instructor will be required.

COURSE CONTENT:	HOURS
1. COURSE ORIENTATION (Online and Face-to-Face)	1
2. E-3 SWITCHLIGHT AND ANNUNCIATOR MODULES	2
a. (ONLINE) Using TO, identify switchlight module and annunciator module operating principles, with a minimum accuracy of 80 percent.	
3. POWER SYSTEMS	10
a. (ONLINE) Using TO, identify power system characteristics, with a minimum accuracy of 70 percent	(4)
b. (F2F) Using TO and the TAU-197/E Electrical System Trainer, perform main AC power system operational check, with no more than two instructor assists.	(6)

COURSE SUPPORT RESOURCES

a. AETC FURNISHED:
Electrical Systems Trainer (TAU-197/E)
Air Conditioning System Trainer (TAU-200/E)

APPENDIX C

PLAN OF INSTRUCTION: PRE-INNOVATION

PLAN OF INSTRUCTION/LESSON PLAN - PART I

COURSE TITLE: AIRCRAFT ELECTRO/ENVIRO SYSTEM JOURNEYMAN

3.	POWER SYSTEMS	10 Hrs
	a. Using TO, identify power system characteristics, with a minimum accuracy of 70 percent. Meas: PC - Knowledge	(4)
	b. Using TO and the TAU-197/E Electrical System Trainer, perform main AC power system operational check, with no more than two instructor assists. Meas: PC - Performance	(6)

SUPPORT MATERIAL AND GUIDANCE

Student Instructional Material
Technical Order (TO) 1E-3A-2-110-33-1

Audiovisual Aids
Power Point Presentation (*Switch Lights)*

Training Resources
E-3 Aircraft
Electrical Systems Trainer (TAU-197/E)

Training Method
Lecture/Discussion (4 hrs)
Demonstration/Performance (6 hrs)

Instructional Guidance
For objectives utilizing the trainer or simulator, stress equipment-peculiar safety concerns prior to allowing students access to the equipment. After administration of each progress check, review all missed items to ensure complete understanding of the system.

3a: Using technical order, explain how the different sources of AC power are used on the aircraft. Identify component locations and accessibility problems. Administer knowledge based Progress Check 3a to evaluate student performance.

3b: Using the TAU-197/E trainer, demonstrate the operational check procedures. *Stress trainer-peculiar safety concerns prior to allowing students access to the equipment.* Administer performance based progress check 3b using the TO as evaluation checklist.

APPENDIX D

PLAN OF INSTRUCTION: POST-INNOVATION

PLAN OF INSTRUCTION/LESSON PLAN - PART I

COURSE TITLE: AIRCRAFT ELECTRO/ENVIRO SYSTEM JOURNEYMAN

3. POWER SYSTEMS 10 Hrs

a. Using TO, identify power system characteristics, with a minimum accuracy of 70 percent. Meas: PC – Knowledge (ONLINE) (4)

b. Using TO and the TAU-197/E Electrical System Trainer, perform main AC power system operational check, with no more than two instructor assists. Meas: PC - Performance (6)

SUPPORT MATERIAL AND GUIDANCE

Student Instructional Material
Technical Order (TO) 1E-3A-2-110-33-1

Audiovisual Aids
Power Point Presentation (*Switch Lights)*

Training Resources
E-3 Aircraft
Electrical Systems Trainer (TAU-197/E)

Training Method
Lecture/Discussion (4 hrs) - ONLINE
Demonstration/Performance (6 hrs) – F2F

Instructional Guidance
For objectives utilizing the trainer or simulator, stress equipment-peculiar safety concerns prior to allowing students access to the equipment. After administration of each progress check, review all missed items to ensure complete understanding of the system.

3a: Students will use blended modules and technical orders to understand how the different sources of AC power are used on the aircraft. They will identify component locations and accessibility problems. Upon completion of the module they will complete a progress check to evaluation their performance.

3b: Using the TAU-197/E trainer, demonstrate the operational check procedures. *Stress trainer-peculiar safety concerns prior to allowing students access to the equipment.* Administer performance based progress check 3b using the TO as evaluation checklist.

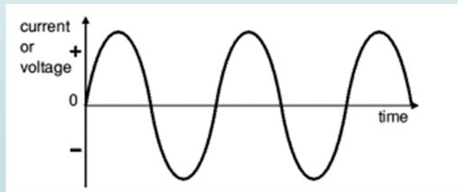
APPENDIX E

BLENDED MODULE

Unit 3
Power systems

Objective 3a:
Using TO, identify AC power system characteristics, with a minimum accuracy of 70 percent.

- For this objective you will use the technical order, along with this module to learn how different sources of alternating current (AC) power are used on the aircraft. You will identify component locations and accessibility problems associated with the system. Afterwards you will take a multiple-choice knowledge based progress check to assess your performance. You will need to score a 70 percent or higher on the progress check to move onto the next objective. Please see your supervisor after you complete this module.



AC Sign Wave

Main Generators

- Provide main power to sync bus
- Two generators per engine (8 total)
  - 115/200 VAC
  - 75 KVA
  - 400 Hz
- Permanent magnet generator
  - Rely on excitation (DC voltage)
  - Synchronous with other generators

Main AC Generator

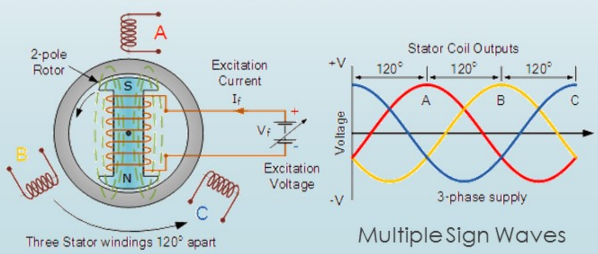
Generator Control Unit (GCU)

- Responsible for exciting the generator
  - Uses DC power for excitation
- Provides reactive load division
- One per generator (eight total)

GCU

Frequency Reference Unit (FRU)

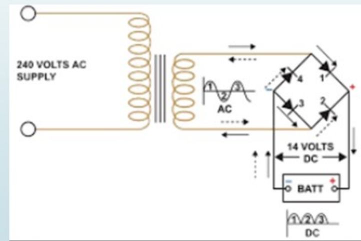
- 4 external power receptacles
  - 90 KVA each
  - Bus Power Control Unit (BPCU) controls power application
  - Always connects to SYNC bus through the external power connector
  - Plug EP1A is the master, other receptacles provide current protection only



Multiple Sign Waves

Transformer Rectifier Unit (TRU)

- Convert 115 VAC to 28 VDC
- Supplies DC power
- All interconnect to each other
- Connected to same circuit as battery

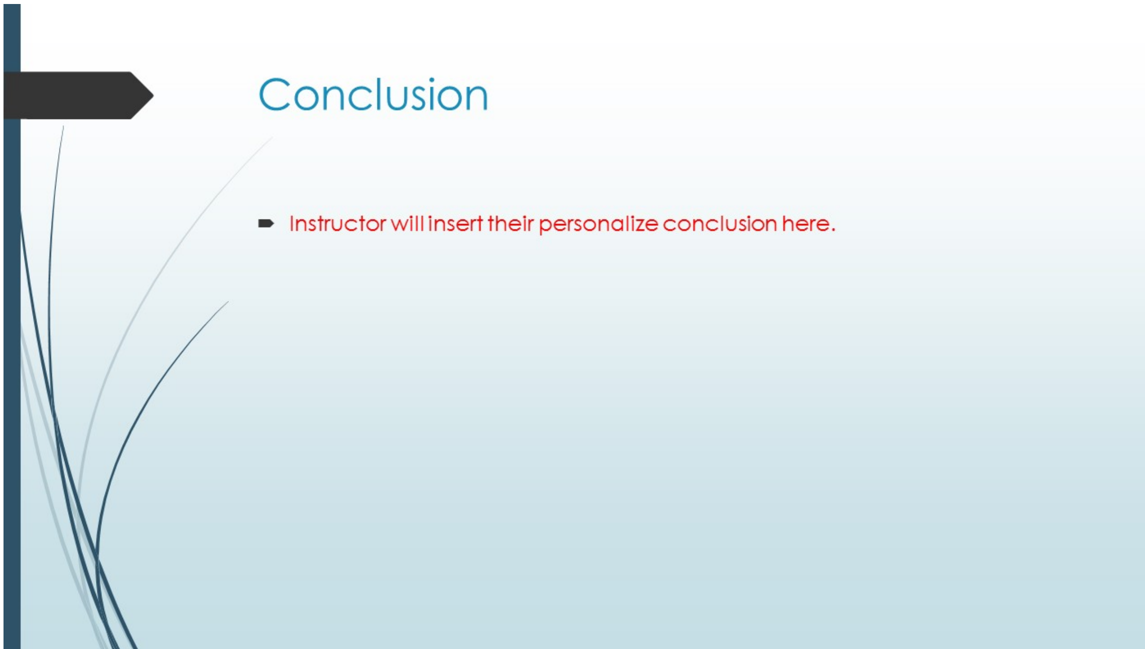


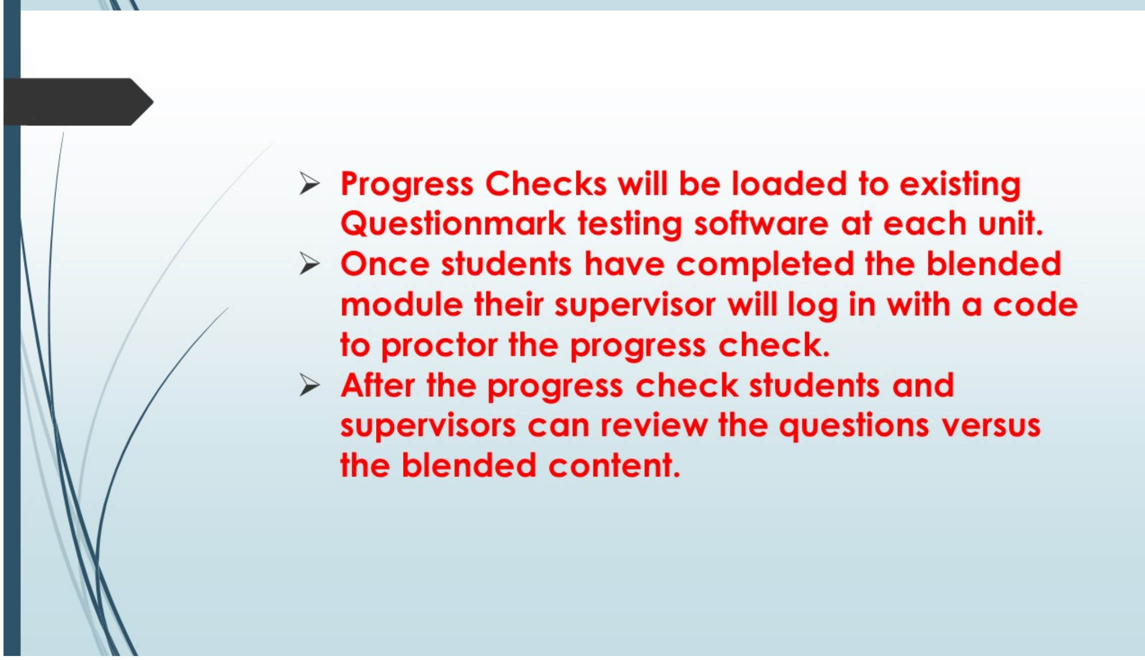
AC to DC / 115 V to DC V

Auxiliary Power Unit (APU) Generator system

- GCU provides voltage control
- Fuel control responsible for frequency
- Always connected to the SYNC bus through the APC
- Operating loads
  - 170 amp continuous load
  - 262 amp 5 minute load
  - 348 amp 5 second load
- Direct Current (DC) system
  - Transformer Rectifier Units (TRU)
  - Batteries
  - Static Inverter
- System controls and instrumentation
  - Flight engineer panel
  - Voltage and frequency monitored from the point of reference

APU w/Generator


Conclusion
Instructor will insert their personalize conclusion here.


Progress Checks will be loaded to existing Questionmark testing software at each unit.
Once students have completed the blended module their supervisor will log in with a code to proctor the progress check.
After the progress check students and supervisors can review the questions versus the blended content.

Progress Check
AC Power Systems

- **OBJECTIVE**: Using TO, identify power system characteristics, with a minimum accuracy of 70 percent.
- **INSTRUCTIONS FOR SUPERVISOR:** Once the student has completed the blended module you may log them in to complete the progress check. Once complete, please review all progress check questions to clarify any questions.
- **INSTRUCTIONS FOR STUDENT**: Read each questions/statement carefully. Circle the letter of the response that BEST answers the question or completes the statement. A minimum 7 of 10 items must be answered correctly for satisfactory completion.

Question 1

The Main AC power system consists of how many components?

a. 6 generators

b. 8 generators

c. 4 legs of external power

d. 8 IDGS and related Buses

Question 2

Each engine driven generator has its own ___________ to control voltage and frequency.

a. FLCU

b CSD

c. GCU and FLCU

d. GCU and GCR

Question 3

The APU generator is connected to the SYNC BUS by the EPC.

a. True

b. False

Question 4

The SYNC bus will always be powered with ________________ power on the aircraft.

a. main generator
b. APU and external
c. battery
d. static

Question 5

DC power for both mission and air vehicle loads is provided by

a. batteries.
b. inverters.
c. internal power TRU.
d. Transformer-Rectifier units.

Question 6

The outputs of the main TRUs are interconnected with each other.

a. True

b. False

Question 7

The APU Generator provides power to any of the load buses via their

a. EPCs.

b. GCUs.

c. individual GCBs.

d. individual BTBs.

Question 8

Protection from a faulty ground power source is provided for external power through receptacle

a. EP2B.
b. EP1B.
c. EP1A.
d. EP2A.

Question 9

The total KVA for all engine-driven generators is 600 KVA, with each generator providing____ KVA.

a. 60
b. 90
c. 75
d. 70

Question 10

The AC buses are protected from large loads by

a. circuit breakers.

b. ELCUs.

c. fuses.

d. diodes.

This objective will be conducted face-to-face in the classroom portion of the course. This is just a place holder for continuity.

Objective 3b:

Using TO and the TAU-197/E Electrical Systems Trainer, perform main AC power system operational check, with no more than two instructor assists.

APPENDIX F

VERBAL RECRUITMENT SCRIPT

Participant Verbal Recruitment Script

Transfer of Training Aircraft Maintenance:
Perceptions of Blended Learning Impact

My name is Scott Dawes, a doctoral candidate under the direction of Professor Elisabeth Gee at the Mary Lou Fulton Teacher College at Arizona State University. I would like to invite you to participate in my research study to examine the how blended learning can influence the transfer of training in aircraft maintenance technical training courses from the classroom to the workplace.

As a voluntary participant, you will be asked to be observed during class and work center activities, take place in a brief 45-minute interview about your thoughts on the training, and complete a brief 15-mintue pre and post survey where I will quantify your experiences before and after the innovation.

There are no foreseeable risks or discomforts to your participation and your responses are completely anonymous. The results of this study may be used in reports, presentations, or publications, but your name will not be used.

If you would like to participate in this research study I will provide you with a consent form to review, sign, and date.

Do you have any questions now? If you have questions later, please contact me at scott.dawes@asu.edu or you may contact my advisor, Dr. Elisabeth Gee, at elisabeth.gee@asu.edu.

Thank you for your time and consideration for this exciting study!

Scott

APPENDIX G

PARTICIPANT CONSENT FORM

Participant Consent Form
Transfer of Training Aircraft Maintenance:
Perceptions of Blended Learning Impact

I am Scott Dawes, a doctoral candidate under the direction of Professor Elisabeth Gee at the Mary Lou Fulton Teacher College at Arizona State University. I am conducting a research study to examine the how blended learning can influence the transfer of training in aircraft maintenance technical training courses from the classroom to the workplace.

I am inviting your voluntary participation, which will include an observation period, interview, and pre/post surveys. The observation period will be conducted during class time and within the workplace, it will last about an hour and will not require your direct input. The interview will be a brief 45-minute interview where I will collect your thoughts on the study. Lastly, the brief 15-minute pre/post surveys will be used to quantify your experiences before and after the innovation. You have the right to not answer any question in the above format that you do not feel comfortable with and to stop participation at any time.

As a reminder, your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty or negative consequence. Your input from the above consented formats will be used to shape future innovations in aircraft maintenance technical training and could enhance student learning outcomes. There are no foreseeable risks or discomforts to your participation and your responses are completely anonymous. The results of this study may be used in reports, presentations, or publications, but your name will not be used.

I may ask to audio record the observations and interviews. Neither the observations nor the interviews will be recorded without your express permission. Please let me know if you do not want the observations or interviews to be recorded; you can also change your mind after any of the above formats begin, just let me know.

Participants must be 18 years or older to participate, please initial the following:

I am at least 18 year's old _____

If you have any questions concerning the research study, please contact the research team at: Dr. Elisabeth Gee at Elisabeth.gee@asu.edu. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788. By signing below, you are agreeing to be part of the study. Thank you very much for your participation!

Printed Name: Signature: Date:

APPENDIX H

OBSERVATION SCRIPT

Observation Script

Course Content

1. What types of questions are instructor/student asking?
2. What are the levels of questions being asked, both directions?
    - Literal: primary, explicit meaning. (as intended)
    - Interpretive: read between the lines. (inferences, generalizations, relationships)
    - Critical: reading beyond the lines (quality, value, significance, accuracy, truthfulness)
    - Creative: reading outside the lines (new ideas, insight through creative analysis, interpreting, applying info)

    Adapted for observation from: http://olms.cte.jhu.edu/olms2/10750
3. How well does the instructor's presentation and course content align?

Student Performance

4. Is the course content relevant to students job in the workplace?
5. Do the instructor's questions challenge students to think critically?
6. Do the objectives in the course relate to students workplace?

Job Application

7. Does the instructor/course content make connections to other career fields?
8. Are students challenged to solve realistic workplace problems in the course?
9. How often does the instructor tie the course content to the workplace mission?

APPENDIX I

INTERVIEW GUIDE

Interview Guide

Transfer of Training Aircraft Maintenance:
Perceptions of Blended Learning Impact

Students/Instructors

1. Describe the difference between the traditional technical training course and the blended training course use of classroom time.
2. In the blended training portion, explain how the modules enhanced your knowledge for the face-to-face part of the course.
3. What did you find most effective with the blended modules?
4. Compare the balance of blended to face-to-face learning, how was the ratio, was it appropriate?
5. How much of the learning you incurred in the traditional versus the blended training course do you believe would transfer to the workplace? Think content related.
6. Which method of training, traditional or blended, would you prefer in future courses, why?

Supervisors

1. How was your experience guiding the students through the blended modules prior to them attending the face-to-face portion of the class?
2. How do you feel the blended modules fit into 21st century learning for aircraft maintainers?
3. What did the graduate say about the innovated course after they returned to the workplace?
4. How did the graduates relate the course content to the workplace?

APPENDIX J

PRE-SURVEY: TRANSFER OF TRAINING AIRCRAFT MAINTENANCE

Pre-Intervention Survey
Transfer of Training: Aircraft Maintenance

Demographics

1. What is your gender?

☐	☐
Male	Female

2. What is your age (in years)?

____

3. What is your time in service (in years)?

____

4. What is your AFSC (i.e. 2AXXX)?

____

5. How long have you been in your AFSC (in years)?

____

Course Content

6. The course content was relevant to the face-to-face instruction?

☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

7. The content of the course was relevant to my Air Force Specialty Code.

☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

8. The content of the course flowed well with the face-to-face instruction.

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

9. The overall content of this course improved my knowledge of my current position.

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

10. This course further enhanced my ability to do my job.

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

Student Performance

11. The course content allowed me to think more critically in the performance objectives in the course.

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

12. The performance objectives in the course were realistic to those in my workplace.

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

13. The performance objectives required me to think critically to solve problems.

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

14. The performance objectives were relevant to my AFSC.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

15. The performance objectives enhanced my ability to do my job.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

Job Application

16. The objectives in the course challenged me to think critically about my job.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

17. The course enhanced my troubleshooting/problem solving capabilities?

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

18. The course made connections to the mission in the field.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

19. The course enhanced my understanding of how I impact sortie generation.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

20. This course better prepared me to collaboratively work with other AFSCs?

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

I appreciate your time in taking this survey. Please return this survey to sdawes@asu.edu as soon as possible.

Sincerely,
Scott Dawes, SMSgt (ret), USAF

APPENDIX K

POST-SURVEY: TRANSFER OF TRAINING AIRCRAFT MAINTENANCE

Post-Intervention Survey
Transfer of Training: Aircraft Maintenance

Demographics

1. What is your gender?

☐ Male	☐ Female

2. What is your age (in years)?

____

3. What is your time in service (in years)?

____

4. What is your AFSC (i.e. 2AXXX)?

____

5. How long have you been in your AFSC (in years)?

____

Course Content

6. The blended course content was relevant to the face-to-face instruction?

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

7. The blended course content of the course was relevant to my Air Force Specialty Code.

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

8. The blended component of the course flowed well into the face-to-face instruction.

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

9. The overall (blended and face-to-face) content of this course improved my knowledge of my current position.

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

10. I perceive that the course content could further enhanced my ability to do my job.

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

Student Performance

11. The blended modules allowed me to think more critically during the performance objectives in the course.

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

12. The performance objectives in the course were realistic to those in my workplace.

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

13. The performance objectives required me to think critically to solve problems.

☐ Strongly Agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly Disagree

14. The performance objectives were relevant to my AFSC.

☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

15. The performance objectives enhanced my ability to do my job.

☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Job Application

16. The objectives in the course challenged me to think critically about my job.

☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

17. The course enhanced my troubleshooting/problem solving capabilities?

☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

18. The course made connections to the mission in the field.

☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

19. The course enhanced my understanding of how I impact sortie generation.

☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

20. This course better prepared me to collaboratively work with other AFSCs?

☐	☐	☐	☐	☐
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

I appreciate your time in taking this survey. Please return this survey to sdawes@asu.edu as soon as possible.

Sincerely,
Scott Dawes, SMSgt (ret), USAF

APPENDIX L

INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL

EXEMPTION GRANTED

Elisabeth Gee
Division of Educational Leadership and Innovation - Tempe
480/965-4284
Elisabeth.Gee@asu.edu

Dear Elisabeth Gee:

On 12/3/2018 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Transfer of Training Aircraft Maintenance: The Perceived Impact of Blended Learning
Investigator:	Elisabeth Gee
IRB ID:	STUDY00008728
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• Verbal Recruitment Script, Category: Consent Form; • IRB Wizard Screen Shot, Category: Other (to reflect anything not captured above); • IRB Wizard , Category: IRB Protocol; • Interview Questions, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Post-Survey Questionnaire, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Protocol Template, Category: IRB Protocol; • Consent Form, Category: Consent Form; • Pre-Survey Questionnaire, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Memo from supporting agency, Category: Off-site authorizations (school permission, other IRB approvals, Tribal permission etc);

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (1) Educational settings, (2) Tests, surveys, interviews, or observation on 12/3/2018.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator