

**Technical Report 1197**

**Evaluation of the Effectiveness of Flight School XXI**

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U.S. Army Research Institute

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# EVALUATION OF THE EFFECTIVENESS OF FLIGHT SCHOOL XXI

## EXECUTIVE SUMMARY

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### Research Requirement:

The purpose of this research was to establish a baseline assessment of the Flight School XXI (FSXXI) flight training program. Because this program will be implemented over time, it was necessary to establish a starting point for longitudinal study. The primary focus of the research was whether or not FSXXI produces graduates that are more proficient, and subsequently become fully mission capable pilots, in fewer flight hours than graduates of the previous (legacy) flight training program. The first research question explored was: Do student aviators advance in fewer flight hours to full readiness in FSXXI compared to legacy flight school? The second research question was: What are the perceptions of instructor pilots regarding the extent and manner in which FSXXI is achieving its intended purposes and overarching goals? And the final research question was: Is the FSXXI flight training program more cost effective than the legacy flight school?

### Procedure:

A 2X2 repeated-measures Analysis of Variance (ANOVA) was conducted to compare the readiness level (RL) progression rates of graduates of the FSXXI and the previous flight training program, legacy flight school. These data were supplemented by an instructor pilot survey and a cost comparison. RL data were collected separately for day/night and Night Vision Goggle (NVG) flying scenarios, and separately for UH-60 and CH-47 aircraft. A paired samples t-test was used to analyze the data collected from the instructor pilot survey. These data were used to determine if there was a statistical difference in the perception of the two programs by instructor pilots that have taught and evaluated students under both programs. The final phase of this research examined the cost associated with FSXXI in comparison to the legacy flight training program.

### Findings:

In each of the four analyses of the first research question, there was a statistically significant difference between the FSXXI pilots and the legacy flight school pilots, and in each of these cases the number of hours required for FSXXI students was lower than for legacy flight school students in both the CH-47 and the UH-60 aircraft. That is, the RL progression rates for FSXXI students were more rapid than for the legacy students.

The second research question was: What are the perceptions of instructor pilots regarding the extent and manner in which FSXXI is achieving its intended purposes and overarching goals? The paired samples t-test revealed there was a difference between instructors' perceptions depending on whether they were training pilots on the UH-60 or CH-47 aircraft. Specifically, there was no difference between instructors' perceptions of FSXXI and legacy flight school pilot aptitude for the CH-47 aircraft, but UH-60 instructors rated the FSXXI program more favorably.

The third research question was: Is the FSXXI flight training program more cost effective than the legacy flight school? To address this question, the total cost of pilot training flight hours based on military estimates was integrated with the costs associated with readiness level training from the pilots in the current research. The legacy flight school training was substantially less expensive than FSXXI training for both types of aircraft.

#### Utilization and Dissemination of Findings:

This research will serve as foundational research for a continued effort in refining the Flight School XXI program. Moreover, it establishes a baseline for conducting a longitudinal study that captures improvements in simulation and training techniques. These advances in technology and the body of knowledge in training techniques can be measured against the results of this research to determine their relative effectiveness.

# EVALUATION OF THE EFFECTIVENESS OF FLIGHT SCHOOL XXI

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# EVALUATION OF THE EFFECTIVENESS OF FLIGHT SCHOOL XXI

## Introduction

The U.S. Army has recently embarked on an endeavor that will change the face of its aviator training program. The new training program, Flight School XXI (FSXXI), was established through a needs analysis that identified several shortcomings in the previous flight training program. The primary concern was that aviators were trained in aircraft not currently used in the active Army. Upon completion of flight training aviators began an aircraft qualification course (AQC) in order to receive training in their primary aircraft. This training consisted of 20-30 flight hours in their assigned aircraft.

The FSXXI training program utilizes a training aircraft, the TH-67 Creek, for the first several weeks in order to build basic flying skills. The student is then transitioned to his/her newly assigned primary aircraft in which he/she will receive between 50-70 hours of flight training. As a result of the greater number of hours spent in the primary aircraft at this earlier stage in the training program, it was expected that students would be more proficient in their primary aircraft upon completion of the FSXXI training program. Ultimately, the expected performance outcome was that aviators would transition to a fully mission capable pilot upon arrival to their first duty station in fewer flight hours.

The purpose of this research is to empirically examine the extent to which the FSXXI training program achieves its expected performance outcome of preparing individuals to advance in fewer flight hours to a fully mission capable pilot upon arrival to their first duty station.

### *Flight Training Program Background*

Foundational to this research is the structure of the flight training program in the U.S. Army and the changes that were made per the needs analysis - leading to the development and implementation of the FSXXI training program. This foundational component will be addressed in the section that follows. In particular, it will provide a brief overview of the flight training program in the Army - delineating the key features of FSXXI against the backdrop of the previous training program. Building on this overview, the importance of this research and the corresponding research questions will then be addressed.

*Structure of the Army's Flight School XXI flight training program.* The role of aviation in the U.S. Army has continued to increase since its inception during the American Civil War. The increasing complexity of Army aircraft and high mission demands on aviators throughout the years has called for more effective and innovative training programs. In response to these issues, FSXXI was developed to provide quality training in order to create the most proficient aviators possible.

Recently the U.S. Army restructured its flight training program in an effort to streamline operations and produce more tactically and technically proficient aviators. The new concept has been named Flight School XXI. Under FSXXI, students attend from 34 to 42 weeks of training culminating in the designation of Army aviator (or equivalent for foreign students).

After completing initial officer or warrant officer training, flight students begin flight training by attending two weeks of ground school in which they are taught subjects in aeromedical factors, aircraft systems, and Army doctrine. The next 18 weeks are comprised of contact and instrument training. During this phase, students are taught how to fly a helicopter and the art of navigation by aircraft instruments only. After successful completion of the instrument phase, students move on to a basic navigation phase in which they are taught to navigate using a surface map and a compass during low level flight (10 to 50 feet above the trees). Finally, the students move to the combat skills phase in which they begin flying the aircraft that they have been designated. The students are assigned to one of the four modernized aircraft that the Army operates; the UH-60 Blackhawk (utility/troop transport), the CH-47D Chinook (cargo/troop transport), the OH-58D Kiowa (observation/light attack), or the AH-64D Apache (attack). The newly assigned aircraft will become their primary aircraft. The advanced training lasts from 12 to 14 weeks depending on the aircraft the student was assigned.

*The previous training program (legacy flight school).* Prior to the implementation of FSXXI, the Army trained its aviators in a series of phases that utilized aircraft that are not currently used in the active duty Army. This program was structured very similarly to the FSXXI program; however, students did not transition to advanced aircraft after their initial and instrument training. Instead, they continued to the combat skills training phase in the OH-58A or UH-1H helicopter; Vietnam era helicopters currently used solely for training. Upon completion of combat skills training and night vision goggle qualification in the OH-58A or UH-1H, the student was designated as an Army aviator.

Following flight training and being awarded Army aviator wings, the aviator moved to an advanced Aircraft Qualification Course (AQC). During the AQC, the aviator received flight training in one of the Army's four advanced aircraft referenced above. The AQC lasted from 6 to 12 weeks (depending on aircraft type) and entailed approximately 20-30 flight hours. The goal of the AQC was to qualify an aviator to conduct basic aircraft tasks and to proficiently perform emergency procedures.

Under both programs, once aviators have completed the advanced training, they are assigned to a field unit in which they receive further mission training and begin performing their duties as Army aviators. Upon arrival at a new unit, the aviators are evaluated and must demonstrate proficiency to an instructor pilot. As the aviators demonstrate mastery of all base tasks and unit mission tasks, they will be considered fully mission capable pilots. The process through which an aviator progresses to become a fully mission capable pilot is called readiness level (RL) progression. A more detailed explanation of readiness level progression can be found in Appendix A.

### *Similarities and Differences Between the Programs*

There are a few similarities and many differences between the FSXXI flight training program and the legacy flight training program. The similarities between the two programs can be seen within the program of instruction and aircraft used in the early stages of flight training. The sequence of training in both programs is very similar. Students move from the contact phase (basic flying skills), to the instrument navigation phase, to the combat skills and night vision goggle phases in both programs. Both programs incorporate the TH-67 training helicopter during the initial stages of flight training. This small, cost effective helicopter is used to provide basic flying skills needed in order to advance to more complex aircraft and flying techniques. The basic skills taught in the TH-67 form a foundation upon which future flight training can build.

The primary difference between the programs is in the type of aircraft used to conduct the flight training in the later stages of each program. The legacy flight training program utilized the OH-58A or the UH-1H to train aviators during the combat skills and night vision goggle phases. Once this was complete, the students attended the AQC in which they learned to fly their primary aircraft. The students learned the aircraft systems, emergency procedures, and maneuvers as outlined in the flight training guide and aircrew training manual for that aircraft.

FSXXI students attend the combat skills and night vision goggle phases of training in their primary aircraft, which results in substantially more flight time in their primary aircraft than those attending the AQC. FSXXI students graduate from flight school with fewer overall flight hours than legacy flight school graduates but have more flight hours in their primary aircraft.

### *Desired Performance Outcomes*

The formal desired performance outcomes and objectives of the AQC are to graduate aviators that have met the minimum standards as set forth in the flight training guide and aircrew training manual for that aircraft. These standards are outlined in great detail, to include the task, the conditions under which the maneuver should be performed, and the minimum standards for the execution of the maneuver. The aviator must meet the minimum standards for the designated maneuvers in order to graduate.

The formal desired performance outcomes and objectives of the FSXXI program are to graduate aviators that are at a proficiency level of an aviator that has progressed to RL 2 (Aviation Training Brigade, unpublished slide presentation, February 2005). The aviator should be able to exceed the standards set forth by the flight training guide and aircrew training manual for that particular aircraft. According to the commander of the Aviation Training Brigade the goal is to graduate aviators that are substantially more proficient than graduates of the AQC (Semmens, 2005).

### *Research Questions*

Although the Army has determined the need for an improved flight training program, FSXXI has not been evaluated to determine if it is able to deliver the desired performance

outcomes established for it. This research focused on that need through an empirical examination of the rate at which individuals advance to a fully capable mission pilot – comparing the rate at which individuals advance through the different readiness levels for FSXXI program graduates versus those individuals who were trained via the legacy flight training program. Additionally, with the ultimate goal for this program aimed at providing a more effective and innovative means to prepare aviators for the increasing complexity of Army aircraft and high mission demands, this research examined these differences with respect to (a) perception of instructor pilots regarding the extent and manner in which FSXXI is achieving its intended purposes, and (b) a cost comparison of both programs.

The specific research questions are:

1. Does FSXXI produce more proficient aviators who progress through the readiness levels in fewer flight hours than graduates of the legacy flight training program?
2. What are the perceptions of instructor pilots who have conducted end of course evaluations of FSXXI and legacy flight training program students with regard to the extent and manner in which the FSXXI flight training program is meeting its intended purposes and overarching goals?
3. Is the FSXXI flight training program more cost effective than the legacy flight training program?

#### Review of the Literature

This review of the relevant literature will be developed in three parts. Part one will consist of a brief history of the U.S. Army Aviation Center and Army Flight School. Part two will discuss experiential learning theory as it applies to formal and informal learning. Part three will link experiential learning theory with the FSXXI training program.

##### *History of the Army Flight School*

During the Korean conflict, the Department of Air Training at Fort Sill was the primary training post for aviation personnel. Both aviation and artillery training were being conducted at Fort Sill, leading to its inability to adequately accommodate both schools. In an effort to relieve Fort Sill of the overcrowding, the Army decided to move the Army Aviation School to Camp Rucker in Alabama.

In September 1954 the first class began at Camp Rucker and by March 1955, the Army Aviation Center was established there. The post was reclassified from a temporary post to permanent status, and the name was changed from Camp Rucker to Fort Rucker in October of that same year.

In 1956, the Army Air Force/U.S. Air Force relinquished control of the training of Army pilots and mechanics. Gary and Wolters Air Force bases in Texas were transferred to the Army and renamed Camp Gary and Fort Wolters respectively. The Army continued primary fixed

wing training at Camp Gary until 1959 and primary rotary-wing training at Fort Wolters until 1973.

In 1973, individual aviator training was consolidated at Fort Rucker. Subsequently, the training programs at Fort Wolters and Fort Gary, Texas, and Fort Stewart/Hunter Army Airfield, Georgia, were discontinued. Following the creation of the Aviation Branch in 1983, further consolidation of aviation-related activities and training under the auspices of the U.S. Army Aviation Center (USAAVNC) and the Aviation Branch chief occurred. Aviation officer courses were implemented at Fort Rucker in 1984 and the U.S. Army Air Traffic Control Activity was transferred from the U.S. Army Information Systems Command to USAAVNC two years later. In 1988, USAAVNC assumed command and control, as well as resource management responsibilities, for the Aviation Logistics School at Fort Eustis, Virginia. In October 2005 the USAAVNC was renamed the U.S. Army Aviation Warfighting Center (USAAVNC).

### *Experiential Learning Theory*

Scholars have tended to use the term experiential learning in two contrasting contexts (Brookfield, 1983). The first deals with the type of learning undertaken by students who are given a chance to acquire and apply knowledge, skills, and aptitudes in an immediate and relevant setting. By this definition, experiential learning involves a "direct encounter with the phenomena being studied rather than merely thinking about the encounter, or only considering the possibility of doing something about it" (Borzak, 1981, p. 9). This type of learning is sponsored by an institution and might be used in training programs for professions such as social work and teaching or in training that requires structured learning as well as physical manipulation training. The second context in which experiential learning is often used reflects learning through life events (Houle, 1980). This type of learning is informal and is a result of involvement with everyday experiences.

*The origins of experiential learning.* The origins of experiential learning can be traced to the early 1900's in the work of John Dewey. Dewey's argument for experiential education was that events are only in existence in an operative way, and the major concern is the meaning of the events. He felt that experiencing events in life is unavoidable; therefore, in order to learn from these events we must make sense of them. Dewey (1925) theorized that experiential education begins with a concrete experience that is then processed through an intentional learning format resulting in useable knowledge.

In the 1940's and 1950's, organizational theorist Kurt Lewin proposed that experience was tied to personal and organizational development. He found such development occurred when individuals or groups set goals, reflected on prior experiences to create a theory, used that theory in their work, and then revised their goals and theories based on the outcome of their new experience (Lewin, 1952).

Jean Piaget's work, from 1952, was rooted in cognitive-structural theories that examine the process of intellectual development with a focus on how people think, reason, and make meaning of their experiences. He believed that cognitive and moral development impact how humans make meaning of experiences. He proposed that any experience could lead to learning (Boeree, 1999).

In the 1970's, David A. Kolb refined Lewin's theory and developed the experiential learning cycle. He suggested that learning is the process in which knowledge is created through a transformational cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb & Fry, 1975). Experiential learning, according to Kolb's model, requires the creation of learning and understanding by the student as a result of engagement in the four stages of the learning cycle (Figure 1). This is an emotional as well as intellectual engagement, leading to reflexivity, self-awareness, critical reflection, theory development, and experimentation. Kolb closely aligned his theory with those of Dewey, Lewin, and Piaget in order to emphasize the role experience plays in learning. However, Coleman (1976) points out that although Kolb closely aligned his theory with others, he also wished to distinguish it from cognitive theories of the learning process.

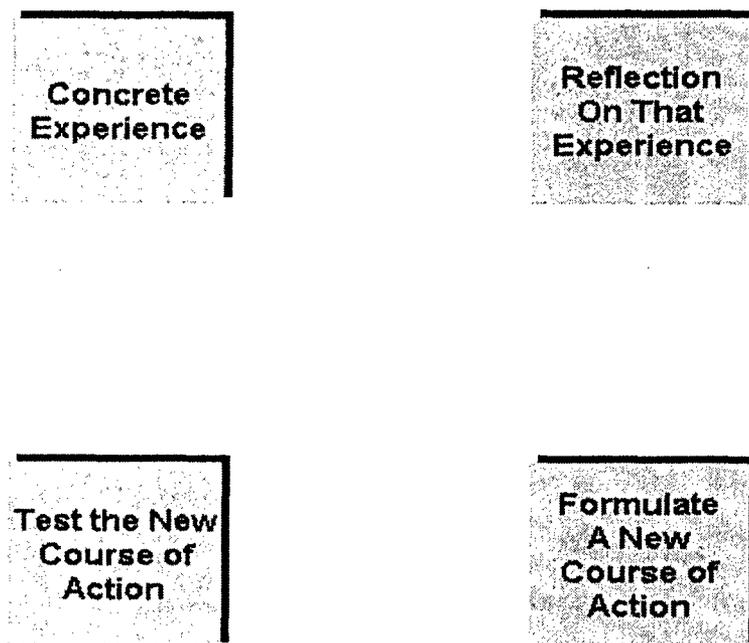


Figure 1. Kolb's experiential learning cycle (adapted from Kolb, 1984).

Kolb and Fry (1975) proposed that the learning cycle can begin at any one of the four points and that it should be approached as a continuous process with no beginning or end. Although the process can begin at any point, the learning often begins with a person carrying out or participating in a particular event or concrete experience. The second step is to understand these effects in the particular instance so that if the same action was taken in the same

circumstances it would be possible to anticipate what would follow from the action. The third step would be to understand what has happened and form an abstract concept. The final step is its application through action in a new circumstance within the range of generalization. Experiential learning can be viewed as a circular process, and in instances where learning has taken place, as a spiral.

*Current adaptations of Kolb's model.* Jarvis (1995) set out to demonstrate that there is a possibility for many more responses to potential learning situations. In his research, he asked several groups of adults to examine Kolb's model and reflect on their own learning through experience. From those responses he developed a model that allowed different experiential routes.

Jarvis' model is more elaborate than that of Kolb; however, he contends that not all experiences result in learning. He classifies situations as non-learning, non-reflective learning, or reflective learning. Non-learning situations are those in which a person responds through a patterned behavior or simply does not respond to a potential learning situation. In non-reflective learning situations individuals may learn through their experiences without reflecting upon the experience. This type of learning is acquired through everyday experiences that are not 'thought about' or through skills learned by physical manipulation. Reflective learning is most closely aligned with Kolb's model. This type of learning is acquired through reflection on experiences.

#### *Adult Education and Experiential Learning*

Research has indicated that adults learn best through experiences that involve the whole person, not just the mind (Fisher-Brillinger, 1990). Linderman (1926, p. 7) stated that "the resource of highest value in adult education is the learner's experience." Boud, Cohen, and Walker (1993) developed a framework that identified a set of basic propositions about adult learning from experience:

1. Experience is the foundation of, and the stimulus for, learning.
2. Learners actively construct their experiences. That is, adult learners play an active role in the learning process.
3. Learning is a holistic process that involves the mind and body.
4. Learning is constructed based on the adult learner's cultural and social environment.
5. Learning is influenced by the social and emotional context in which it occurs.

This framework provides the foundation for understanding the experiential learning process and how it relates to adult learners.

#### *Experiential Learning and Army Flight Training*

Experiential learning is at the core of the Army's FSXXI aviator training program. Kolb's (1984) four stage learning cycle based on experience, reflective observation, abstract conceptualization, and active experimentation can be applied to aviator training. Although his experiential learning theory can be applied to both of the Army's flight training programs, FSXXI enables students to practice flight maneuvers more frequently in their primary aircraft. Legacy flight school students gain general flying proficiency by flying a training aircraft, but

they lack the repetition in their primary aircraft. This is important because although aircraft adhere to the same general aerodynamic principles, flight characteristics vary among aircraft types. Thus, according to Kolb's model, flight students should benefit from both programs. However, FSXXI students should be more proficient in their primary aircraft because of the increased number of flight hours in it.

Concrete experience is essential in flight training in order to begin the learning process. The Aviation Instructor's Handbook (FAA, 1999, p. 1-3) states that, "It seems clear enough that the learning of a physical skill requires actual experience in performing that skill. Student pilots learn to fly aircraft only if their experiences include flying them." Once the students have physically manipulated the controls and experienced a flight maneuver, they can move to the next step in Kolb's experiential learning cycle.

During the second step (observation and reflection) the students reflect on the flight maneuver that was performed. They will evaluate their performance and determine what shortcomings might exist. Once this has been accomplished, they will move to the next step in which abstract concepts will be formed.

The formation of abstract concepts enables the students to devise a course of action that will address the shortcomings that were identified in the previous step. Once these concepts have been developed, the students move to the next step in order to experiment with the newly developed concepts.

The fourth step, testing in new situations, allows the students to test the concepts developed in the third step. This experimentation leads to a concrete experience in which the students begin the entire process over again. This process will continue until the students have mastered the maneuver or the process is intentionally broken.

By continuing the experiential learning process, the students are able to refine their skills through repetition. The Aviation Instructor's handbook underscores this by stating;

The principle of exercise states that those things most often repeated are best remembered...The human memory is fallible. The mind can rarely retain, evaluate, and apply new concepts or practices after a single exposure...Every time practice occurs, learning continues. The instructor must provide opportunities for the student to practice. (FAA, 1999, p. 1-5)

### *Literature Review Summary*

Research indicates that experiential learning programs have the potential to create significant learning (Fisher-Brillinger, 1990; Maxwell, 1997). Army flight training draws from several learning theories, to include experiential learning. However, flight training, and more specifically military flight training, requires unique training methods. The Federal Aviation Administration (FAA) has developed a handbook that incorporates techniques to help guide flight instructors and outlines the role of experiential learning in aviator training. Students are

able to progress through Kolb's experiential learning cycle to refine their flying proficiency. The literature supports these concepts and parallels the Aviation Instructor's Handbook.

### Research Methodology

The purpose of this research was to examine the extent to which the FSXXI training program achieves its expected performance outcome goal of preparing individuals to advance to fully mission capable pilots in fewer flight hours upon arrival to their first duty station. Additionally, with the ultimate goal for this program aimed at providing a more effective and innovative means to prepare aviators for the increasing complexity of Army aircraft and high mission demands, this research examined these differences with respect to the perceptions of instructor pilots regarding the extent and manner in which FSXXI is achieving its intended purposes and overarching goals. Finally, a cost comparison of both programs was performed.

#### *Conceptual and Theoretical Framework of Research*

Flight School XXI was designed around many of the concepts addressed in the FAA's Aviation Instructor's Handbook. Learning as a result of experience, one of the characteristics addressed in the handbook, describes the process in which students learn through reflection on every event they encounter. This concept is supported by Cantor (1995) who states that experiential learning is a process through which people acquire competencies through their experiences, comparing their newly acquired knowledge to their past experiences.

Flight students move through each of Kolb's four stages in a continuous loop while engaged in flight training. For example, aviators will experience a maneuver, process the information that was demonstrated to them, develop and execute a plan, and experiment with refining the maneuver in order to become more proficient. This is a continual process that takes place repeatedly during flight training.

The FSXXI flight training program allows aviators to move through Kolb's learning cycle many more times because of the extended amount of time the students spend in their primary aircraft. The more repetitions learners experience as they move through the different phases of experiential learning, the more proficient they will become. FSXXI gives students many more flight hours in their primary aircraft. The increased experience gained through the extended training program offered by FSXXI should equate to a higher proficiency level and subsequently the aviators should be able to progress to a fully mission capable status in fewer flight hours. For this reason, FSXXI graduates should be more proficient due to the higher number of flight hours spent in their primary aircraft in comparison to legacy flight school graduates.

While experiential learning theory has received considerable attention in the research literature (Galloway & Goldenberg, 2004; Gosen & Washbush, 2004; Henderson, 2004), and continues to be well supported as the basis for curriculum and instructional design in many educational settings (Hornyak & Page, 2004; Ziff & Beamish, 2004), the application of the experiential learning theory has not been empirically examined within the context of military flight training. Given the relatively high cost of aviator training in both civilian and military

flight training programs, it is necessary to empirically examine the effectiveness of this new approach to military flight training.

### *Sample*

Two groups were included in the current research: Army flight training graduates and their instructors. The primary population of interest was individuals who were graduates of the U.S. Army Flight Training Program and had been designated as Army aviators between the years 2000 and 2005. Within this population there were four sub-groups: UH-60 Flight School XXI graduates, UH-60 legacy flight school graduates, CH-47 Flight School XXI graduates, and CH-47 legacy flight school graduates. Each aviator had successfully completed Army flight training, through FSXXI or the legacy flight school, for either the CH-47 or UH-60 aircraft. In addition to completing flight training, each aviator had been assigned to at least one duty station following flight training and had progressed through the readiness levels to achieve fully mission capable pilot status for day/night and night vision goggle flight modes. The entire population consisted of approximately 400 UH-60 FSXXI graduates, 2500 UH-60 legacy flight school graduates, 250 CH-47 FSXXI graduates, and 1600 CH-47 legacy flight school graduates. The sample for the current research consisted of a randomly selected subset of this population. The random selection was accomplished through a random number generator (Randomizer.org, 2005) that produced a set of ten numbers ranging from zero to nine. These numbers were used to select flight records based on the last number of the aviator's Social Security Number. Records were selected based on the first number produced by the random number generator. Once all the records containing the first number in the set produced by the random number generator were exhausted, the process began again using the second number in the set. This process continued until a sample of 260 participants was selected. Of those, 65 were UH-60 FSXXI graduates, 65 were UH-60 legacy flight school graduates, 65 were CH-47 FSXXI graduates, and 65 were CH-47 legacy flight school graduates.

In addition, a group of flight training instructors was surveyed. The population of interest here was the entire group of all U.S. Army aviation instructors who have instructed student aviators on the UH-60 Blackhawk and the CH-47 Chinook helicopters, and who have performed end-of-course evaluations on pilots from both the AQC (legacy) and FSXXI. The sample included in the research consisted of 40 instructor pilots (20 UH-60 and 20 CH-47) assigned to the USAAWC at Fort Rucker, Alabama. The participants were randomly selected from all available instructors present for duty on the day the survey was administered. Twenty instructors from each aircraft (CH-47 and UH-60) completed and returned the survey.

### *Data Collection Tools*

*Readiness levels.* Readiness Level 3 (RL3) is the classification of aviators when they are initially assigned to a unit following flight school. With this classification, the pilot usually trains for day/night flight. The pilot will be evaluated by an instructor pilot (IP) on all base tasks. Base tasks are those tasks that are common to every unit (e.g., normal take-off, normal landing, and emergency procedures). When pilots attain proficiency at these tasks, they are progressed to RL2. RL2 tasks are mission-oriented tasks specific to the unit (e.g., hoist missions, over water flight, and rappelling). When pilots are proficient at those maneuvers, they are progressed to

RL1. RL1 is considered to be a fully mission capable pilot for the designated mode of flight. At that point, the process of progression from RL3 to RL2 to RL1 is repeated for night vision goggle (NVG) flight.

The quantitative data for this research were collected through an archival review of individual aviator flight records. Flight hours required to progress through the readiness levels are annotated in the aviator's individual flight records by the IP conducting the readiness level progression. These hours were extracted from the records of graduates of both flight training programs. A target of at least 64 participants from each category was set in order to obtain an estimated power level of .80.

*Instructor pilot survey.* Additional data for this research were collected via a survey developed by the author (Appendix C). The survey was administered to 20 UH-60 and 20 CH-47 IPs assigned to the USAAVNC at Fort Rucker, Alabama. The IPs were asked to evaluate the quality of training for both FSXXI students and legacy flight school students through a set of three questions using a five point Likert type scale as either "strongly agree," "agree," "neither agree nor disagree," "disagree," or "strongly disagree." The scores on these three items were summed to produce two composite scores: instructor perception of FSXXI and instructor perception of legacy flight training.

The survey instrument was evaluated in a preliminary study. Ten IPs were given the survey instrument to review. Upon the completion of the initial review, the IPs were interviewed individually in an effort to determine whether or not the survey instrument would collect the desired data. During the interviews each question was addressed and the IPs were asked to elaborate on what information they felt the question was attempting to collect. Of the ten IPs questioned during the preliminary study, all ten gave similar responses as to what data they felt the survey instrument was attempting to collect. Their responses were determined to be congruent with the information that the survey instrument was intended to collect. Thus the instrument was judged to be both valid and practical.

*Cost comparison.* A cost comparison, rather than a cost analysis, was chosen to compare the costs of training aviators under each of the flight training programs explored in this research. The purpose of this portion of the research was simply to compare the costs of the training programs rather than to make an assessment of each program based on its cost.

Cost comparison data were collected from the Fort Rucker Budgeting Office. The primary data were the cost per hour of training for the legacy flight school and FSXXI, and the average number of hours required to train a pilot in the two programs. These data were based on Fiscal Year (FY) 2005 costs.

#### *Human Subjects Review*

Permission to obtain the data in the documents specified above was granted by the appropriate military officials. In addition to military approval, the Institutional Review Board of Touro University International reviewed the research proposal for this research and determined that there was minimal risk to human subjects.

### *Limitations*

The survey instrument used to collect data on IP attitudes relied on a subjective evaluation of the student by the instructor. The terms "better" and "regularly exceed" are used in conjunction with the Likert scale in order to quantify the subjectivity of these terms. However, the instructor's opinions of both programs may vary slightly due to the lack of a more objective measure. Additionally, due to the mission requirements of the U. S. Army, data were collected from a limited number of military installations. A sample from every aviation unit was not feasible due to the deployment of many units to a combat zone. The data were collected from aviation units located within the continental United States. No data were collected from overseas units or units based in the U. S. that were deployed to an overseas location. A cost comparison, rather than a cost analysis, was used to examine the cost of training aviators under both programs.

## Results

### *Statistical Analyses*

All inferential analyses were conducted using an  $\alpha$  level of .05 and two-tailed tests. The analytic procedures that were employed were organized around the three research questions, which address (a) the effectiveness of FSXXI and the legacy flight school in advancing student aviators toward full readiness, (b) the perceptions of instructors regarding FSXXI and the legacy flight school, and (c) the cost effectiveness of the two programs.

*Readiness level progression.* The first research question was: Do student aviators advance in fewer flight hours to full readiness in FSXXI compared to the legacy flight school? Initially, descriptive statistics (means and standard deviations) were computed for the number of hours required to advance from RL3 to RL2 (Time 1) and to advance from RL2 to RL1 (Time 2). These means and standard deviations are presented separately for the legacy flight school and FSXXI pilots, for CH-47 Chinook and UH-60 Blackhawk aircraft, and for day/night and NVG training.

In order to determine the sample size required to perform these analyses, a statistical power analysis was conducted using the Sample Power (Version 1.0) computer program (Borenstein, Rothstein, & Cohen, 1997). The analysis was conducted specifying desired power of .80, an  $\alpha$  level of .05, and medium effect size estimates ( $f = .25$ ) for the two main effects and the interaction. With these specifications, 32 subjects per cell would be required to obtain a power of .80, for a total sample size of 128 (i.e., 32 x 4) for each 2 x 2 Analysis of Variance (ANOVA). Because different samples of pilots were employed for the CH-47 Chinook and the UH-60 Blackhawk training programs, a total of 256 subjects were required (i.e., 64 CH-47 legacy flight school pilots, 64 CH-47 FSXXI pilots, 64 UH-60 legacy flight school pilots, and 64 UH-60 FSXXI pilots).

Separate analyses were conducted for the CH-47 Chinook and UH-60 Blackhawk aircraft, and for day/night and NVG training. For each aircraft and program of training, a 2 x 2

repeated-measures ANOVA was conducted. The repeated-measures factor was Time (Time 1 versus Time 2), and the between-group factor was training type (legacy flight school versus FSXXI). Although this method is typically used in a research design that includes a treatment between repeated measurements, which this research does not have, it was required in order to examine the relationship between the different readiness levels within and between groups.

*UH-60 aircraft.* Table 1 provides descriptive statistics for the day/night and NVG scenarios for the UH-60 aircraft. Examining the mean time to progression through Time 1 for the day/night scenario indicates that FSXXI pilots appear to have progressed more quickly, with a mean of 10.11 hours as opposed to 13.73 hours for legacy flight school pilots. The same trend appears to exist for the progression through Time 2, with FSXXI pilots taking an average of 8.27 hours compared to the 9.00 hours for legacy flight school pilots. Examining the means for the NVG scenario similarly indicates that FSXXI pilots appear to have progressed faster than the legacy flight school pilots both through Time 1 (with a mean of 7.62 for FSXXI pilots compared to 8.96 hours for legacy flight school pilots) and through Time 2 (with a mean of 10.48 hours for FSXXI pilots compared to 12.24 for legacy flight school pilots).

Table 1

Descriptive Statistics for Day/Night and Night Vision Goggle (NVG) Readiness Level Progression in the UH-60 Aircraft

	<u>Legacy Flight School</u>		<u>FSXXI</u>	
	Mean*	SD	Mean*	SD
Day/Night				
Time 1	13.73	4.36	10.11	2.39
Time 2	9.00	3.58	8.27	2.50
NVG				
Time 1	8.96	4.43	7.62	1.87
Time 2	12.24	2.54	10.48	1.03

\* *Flight hours required*

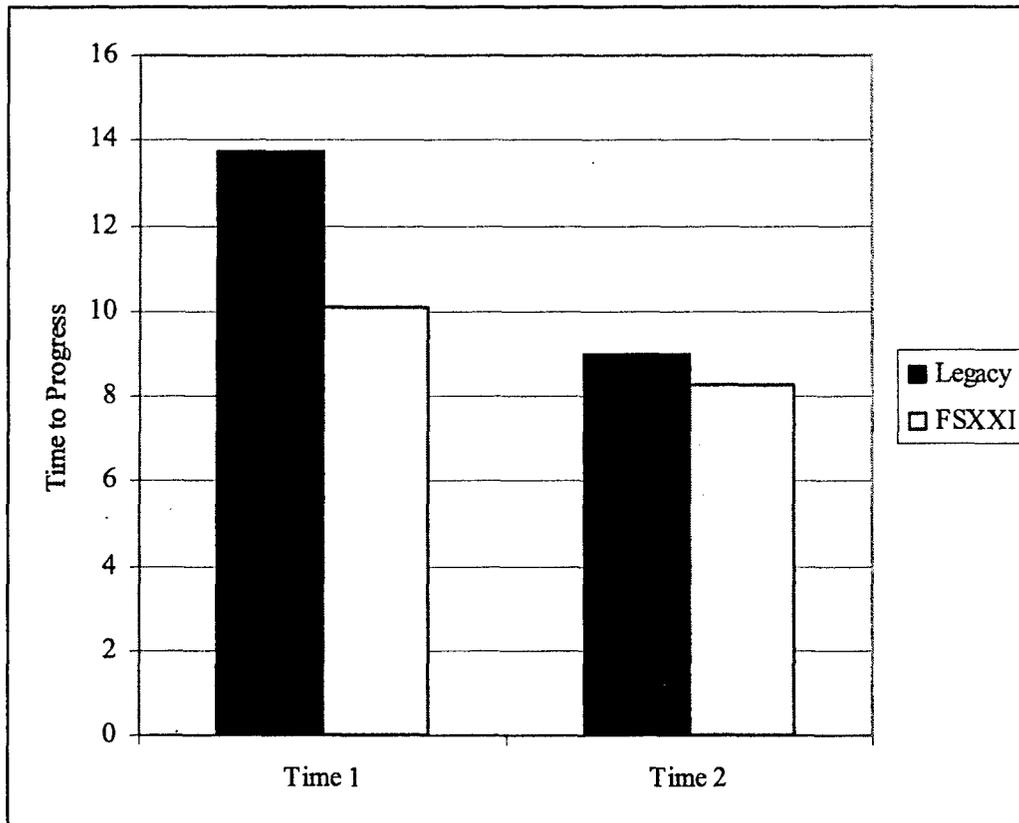
Two ANOVAs were conducted on these means in order to determine the statistical significance of the observed differences for UH-60 aircraft. The first ANOVA examined data from the day/night scenario, and the ANOVA source table for this analysis is shown in the upper portion of Table 2. The main effect for time was statistically significant,  $F(1,128) = 83.46, p <$

.0005, indicating that the progression through Time 1, statistically, was significantly longer than the progression through Time 2. Similarly, the main effect for program (legacy flight school versus FSXXI) was statistically significant,  $F(1,128) = 22.90, p < .0005$ . Examining the means in Table 1 indicates that FSXXI pilots progressed more quickly than legacy flight school pilots. Finally, the interaction between time and program was statistically significant,  $F(1,128) = 16.15, p < .0005$ , indicating that the difference between the two programs was not the same for Time 1 and Time 2. Figure 2 shows this interaction graphically. From this figure, it can be seen that the difference between the two programs was significantly larger for Time 1 than it was for Time 2.

Table 2

ANOVA Source Table for Analysis of Readiness Level Progression on UH-60 Aircraft Comparing Time 1 and Time 2 Between FSXXI and the Legacy Flight School

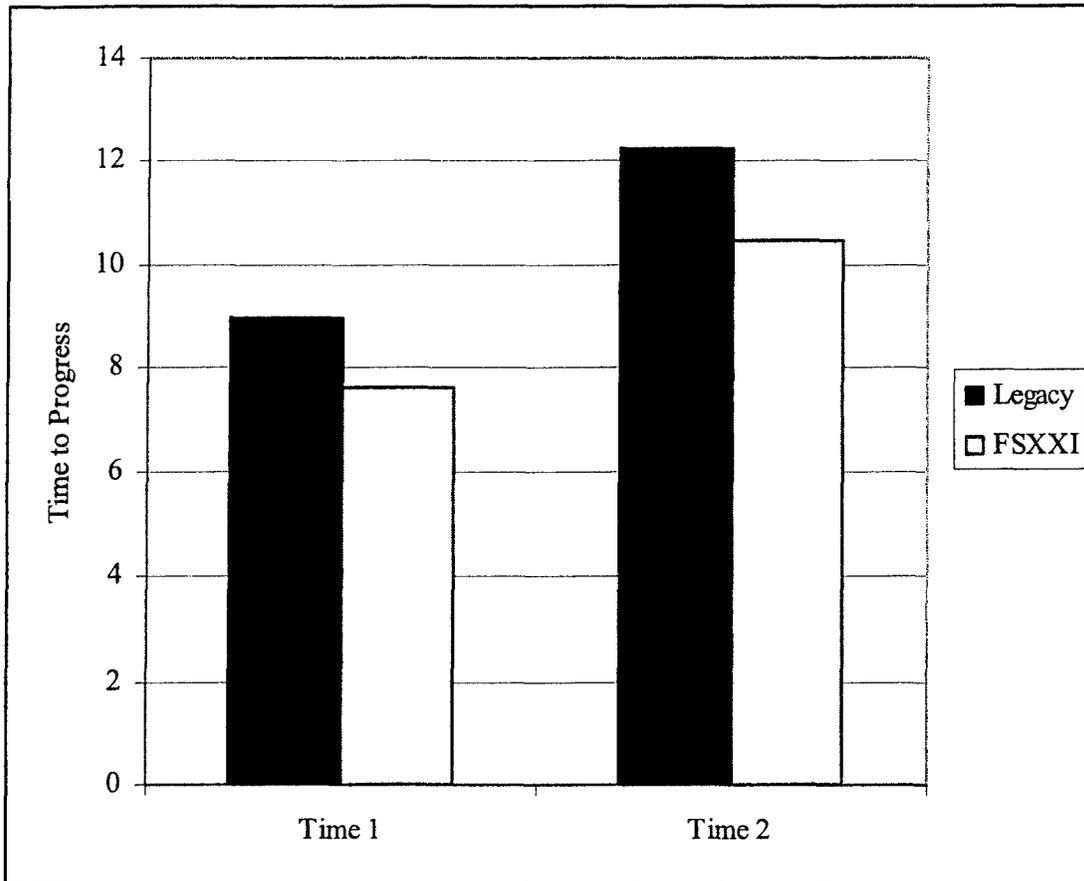
	Sum of Squares	df	Mean Squares	F	p	Power
<b>Day/Night</b>						
Program Effect	308.04	1	308.04	22.90	<.0005	1.00
Error (Program)	1721.99	128	13.45			
Time Effect	702.58	1	702.58	83.46	<.0005	1.00
Program X Time Interaction	135.94	1	135.94	16.15	<.0005	.98
Error (Time)	1077.48	128	8.42			
<b>NVG</b>						
Program Effect	155.53	1	155.53	19.45	<.0005	.99
Error (Program)	1023.32	128	8.00			
Time Effect	611.42	1	611.42	83.61	<.0005	1.00
Program X Time Interaction	2.86	1	2.86	.39	.533	.10
Error (Time)	936.00	128	7.31			



\* Mean number of flight hours required to progress through Time 1 and Time 2.

Figure 2. Time required to progression for UH-60 aircraft in the day/night scenario as a function of program.

The second ANOVA performed on data from the UH-60 aircraft considered the NVG scenario, and the ANOVA source table is shown in the lower portion of Table 2. The main effect for time was statistically significant,  $F(1,128) = 83.61, p < .0005$ , and the means in Table 1 indicate that progression through Time 1 was faster than progression through Time 2. The main effect for program was statistically significant,  $F(1,128) = 19.45, p < .0005$ . Examining the means in Table 1 indicates that FSXXI pilots progressed faster than legacy flight school pilots. However, the interaction between time and program was not statistically significant,  $F(1,128) = .39, p = .533$ . Figure 3 confirms the lack of interaction, as it can be seen that the difference between FSXXI and legacy flight school pilots was essentially the same at Time 1 and Time 2.



\* Mean number of flight hours required to progress through Time 1 and Time 2.

Figure 3. Time required to progression for UH-60 aircraft in the NVG scenario as a function of program.

*CH-47 aircraft.* Table 3 provides descriptive statistics for the progression times on CH-47 aircraft. The same trends observed for UH-60 aircraft are observed for CH-47 aircraft. For day/night flying, FSXXI pilots progressed more quickly through Time 1 (with a mean of 12.14 hours) than legacy flight school pilots (with a mean of 17.68 hours). FSXXI pilots also progressed more quickly through Time 2 (with a mean of 11.70 hours) than legacy flight school pilots (with a mean of 12.97 hours). For NVG flying, FSXXI pilots progressed more quickly through Time 1 (with a mean of 9.18 hours) than legacy flight school pilots (with a mean of 9.97 hours). FSXXI pilots also progressed more quickly through Time 2 (with a mean of 10.08 hours) than legacy flight school pilots (with a mean of 13.70 hours).

Table 3

## Descriptive Statistics for Day/Night and Night Vision Goggle (NVG) Readiness Level Progression in the CH-47 Aircraft

	<u>Legacy Flight School</u>		<u>FSXXI</u>	
	Mean*	SD	Mean*	SD
Day/Night				
Time 1	17.68	3.34	12.14	2.70
Time 2	12.97	3.27	11.70	2.88
NVG				
Time 1	9.97	2.68	9.18	1.90
Time 2	13.70	2.77	10.08	1.57

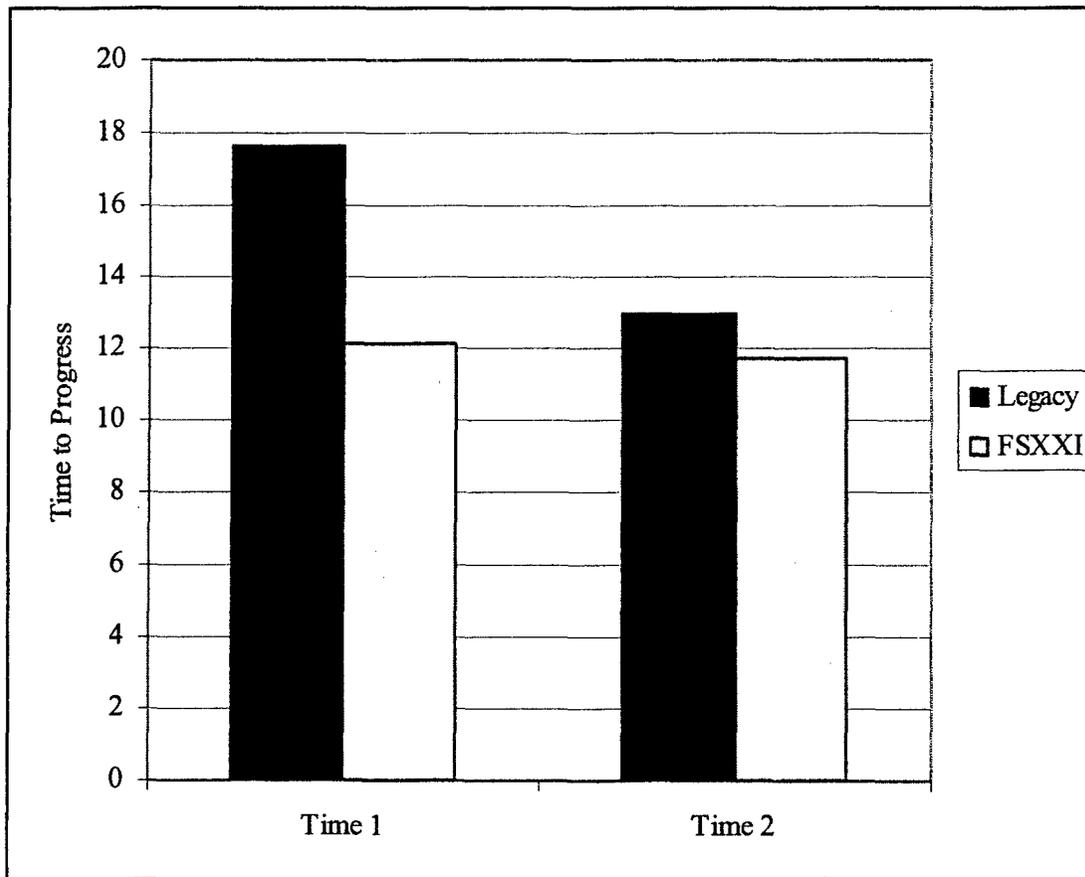
\* Flight hours required

As was the case with the UH-60 aircraft data, two ANOVAs were performed on data from CH-47 aircraft. The first ANOVA performed on data from the CH-47 aircraft considered progression times for the day/night scenario. The ANOVA source table is shown in the upper portion of Table 4. The main effect for time was statistically significant,  $F(1,128) = 54.14, p < .0005$ , and the means in Table 3 indicate that progression from RL3 to RL2 (i.e., Time 1) was slower than progression from RL2 to RL1 (i.e., Time 2). The main effect for program was also statistically significant,  $F(1,128) = 69.93, p < .0005$ , and the means in Table 3 indicate that pilots in FSXXI progressed more quickly than pilots in legacy flight school. The interaction between time and program was also statistically significant,  $F(1,128) = 37.07, p < .0005$ . Figure 4 was created to aid in interpreting this interaction. From this figure, it can be seen that the difference between FSXXI pilots and legacy flight school pilots in time to progress was larger at Time 1 than at Time 2.

Table 4

ANOVA Source Table for Analysis of Readiness Level Progression on CH-47 Aircraft  
Comparing Time 1 and Time 2 Between Programs

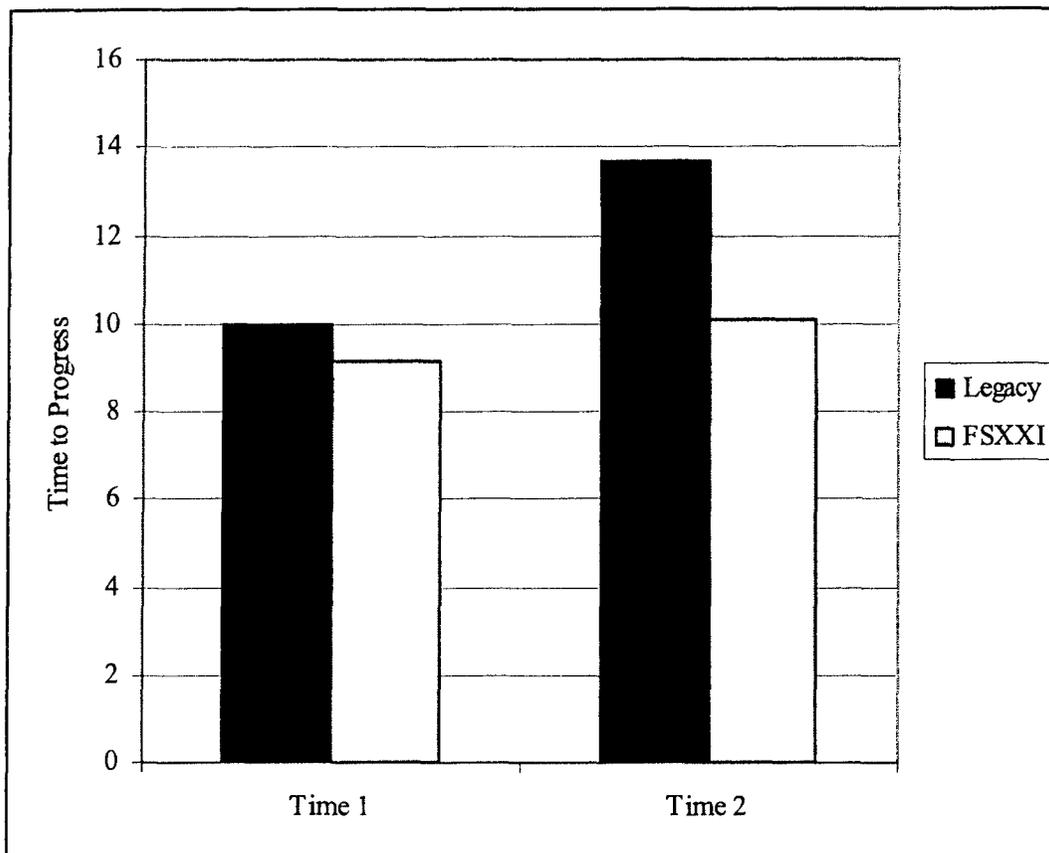
	Sum of Squares	<i>df</i>	Mean Squares	<i>F</i>	<i>p</i>	Power
Day/Night						
Program Effect	753.44	1	753.44	69.93	<.0005	1.00
Error (Program)	1379.08	128	10.77			
Time Effect	431.64	1	431.64	54.14	<.0005	1.00
Program X Time Interaction	295.54	1	295.54	37.07	<.0005	1.00
Error (Time)	1020.43	128	7.92			
NVG						
Program Effect	315.26	1	315.26	55.15	<.0005	1.00
Error (Program)	731.74	128	5.72			
Time Effect	347.77	1	347.77	73.23	<.0005	1.00
Program X Time Interaction	130.07	1	130.07	27.39	<.0005	1.00
Error (Time)	607.85	128	4.75			



\* Mean number of flight hours required to progress through Time 1 and Time 2.

Figure 4. Time to progression for CH-47 aircraft in the day/night scenario as a function of program.

The second ANOVA for CH-47 aircraft data was performed to examine progression times for the NVG scenario, and the ANOVA source table is shown in the lower portion of Table 4. The main effect for time was statistically significant,  $F(1,128) = 73.23, p < .0005$ , and the means in Table 3 indicate that it took longer to progress through Time 2 than Time 1. The main effect for program was also statistically significant,  $F(1,128) = 55.15, p < .0005$ . The means in Table 3 indicate that FSXXI pilots progressed more quickly than legacy flight school pilots. Finally, the interaction between time and program was statistically significant,  $F(1,128) = 27.39, p < .0005$ . Figure 5 shows this interaction, and it can be seen that the difference between legacy flight school and FSXXI pilots in time to progress was larger at Time 2 than it was at Time 1.



\* Mean number of flight hours required to progress through Time 1 and Time 2.

Figure 5. Time to progression for CH-47 aircraft in the NVG scenario as a function of program.

*Instructor survey data.* The second research question was: What are the perceptions of instructor pilots regarding the extent and manner in which FSXXI is achieving its intended purposes and overarching goals? To examine this research question, the two composite scores derived from the IP survey were compared using a paired samples t-test.

In preparation for this research, an assumption of an effect size equal to a difference of one-half standard deviation between the two composite scores, desired power of .80, and a two-tailed test with an  $\alpha$  level of .05 was made, and it was determined that 33 instructors would be required. Forty surveys were distributed to 20 UH-60 and 20 CH-47 instructor pilots in a classroom setting. The instructor pilots were asked to complete the survey voluntarily and return it to a table in the rear of the classroom. All 40 surveys were completed and returned.

Two paired samples t-test were performed, one for UH-60 instructors and one for CH-47 instructors, each of which consisted of a comparison of the reported quality of pilots in the FSXXI and legacy flight school programs. Table 5 shows descriptive statistics for the composite scores for the two types of student pilots (FSXXI and legacy flight school) provided by the instructors of the two types of aircraft (UH-60 and CH-47).

Table 5

## Descriptive Statistics for Instructor Perceptions of the Quality of the Legacy Flight School and FSXXI Pilots

	<u>Legacy Flight School</u>		<u>FSXXI</u>	
	Mean*	SD	Mean*	SD
UH-60 Instructors	9.20	1.64	11.45	1.36
CH-47 Instructors	9.80	1.94	10.75	1.41

\* Composite score derived from Likert scale on author developed survey

For the CH-47, the sample means for the FSXXI pilots were higher (10.75) than for legacy flight school pilots (9.80). Similarly, for the UH-60, the sample means for the FSXXI pilots were higher (11.45) than those for the legacy flight school pilots (9.20). The paired samples t-test conducted for CH-47 instructors, however, was not statistically significant,  $t(19) = 1.81$ ,  $p = .087$ , power = .40, while the t-test conducted on UH-60 instructors was statistically significant,  $t(19) = 5.77$ ,  $p < .0005$ , power = 1.00. This indicates that instructor ratings of pilots in FSXXI and legacy flight school differed only with respect to UH-60 aircraft, but not for the CH-47.

*Cost comparison data.* The third research question of the current research was: Is the FSXXI flight training program more cost effective than the legacy flight school? Cost comparisons between legacy flight school and FSXXI based on official military estimates of training expenditures in the fiscal year 2005 are presented in Table 6. These costs are estimated based on the entire duration of training, as opposed to the readiness level training that was the focus of the first research question. The flight hour costs for each flight training program were calculated using the scheduled number of hours for each program of instruction and the hourly operating cost of each aircraft. Each training program (see Appendix B) has an established number of hours within which an average student should be able to complete the program. These training hours are aggregated by phase of training and by aircraft type for the corresponding phase of training.

The Fort Rucker Budgeting Office has determined an hourly operating cost for each type of aircraft used during flight training. This hourly operating cost is based on scheduled and unscheduled maintenance costs, replacement parts, and fuel costs. The average number of flight hours required to complete each flight training program was multiplied by the hourly operating cost for each aircraft used during flight training. Table 6 presents the total dollar amount of the average cost for a student to attend each of the two flight training programs.

Table 6

## Total Costs of Pilot Training Based on Type of Aircraft and Training Program

	<u>UH-60</u>		<u>CH-47</u>	
	Legacy	FSXXI	Legacy	FSXXI
Initial Entry Core	\$73,920	\$73,920	\$73,920	\$73,920
Basic Navigation	-	\$11,088	-	\$11,088
Qualification and Combat	-	\$180,228	-	\$423,883
Qualification Course	\$63,480	-	\$203,790	-
Combat Skills and NVG	\$64,998	-	\$64,998	-
Total	\$202,398	\$265,236	\$342,708	\$508,891
Savings Associated with Legacy Flight School per pilot	\$62,838		\$166,183	

*Note.* Based on hourly costs of aircraft operation of \$2,760 for UH-60, \$6,793 for CH-47, \$924 for TH-67, and \$942 for OH-58.

As can be seen from Table 6, the total cost of training a pilot on the UH-60 aircraft was \$202,398 for legacy flight school and \$265,236 for FSXXI, for a savings associated with legacy flight school of \$62,838 per pilot. The total cost of training a pilot on the CH-47 aircraft was \$342,708 for legacy flight school and \$508,891 for FSXXI, for a savings associated with legacy flight school of \$166,183 per pilot.

Additionally, the mean number of hours required for graduates of each program to progress through the readiness levels was multiplied by the hourly cost of operating that particular aircraft. This cost was compared to the cost of both aviator training programs to determine which program is more cost effective. These findings are presented in Table 7.

The total number of hours of readiness level training was computed as the sum of Time 1 and Time 2 for day/night flying and Time 1 and Time 2 for NVG flying. These values were then multiplied by the hourly costs associated with operating each aircraft (\$2,760 for the UH-60, \$6,793 for the CH-47, \$924 for the TH-67, and \$942 for the OH-58), which of course are the same for each training program. Due to the smaller number of hours associated with readiness

level training for FSXXI pilots, there is a savings of \$20,562 for the UH-60 and \$76,218 for the CH-47 when compared to legacy flight school pilots.

The final phase of the cost comparison of the two training programs was to integrate the results from Table 6 with those from Table 7. In Table 6, it was shown that for the UH-60, a total savings of \$62,838 was attained by using legacy flight school, but in Table 7 it was shown that legacy flight school was associated with \$20,562 more in readiness level training costs than FSXXI. Therefore, the total savings associated with legacy flight school training for the UH-60 was \$42,276.

A similar picture emerges in an examination of CH-47 costs. In Table 6 it was shown that the use of legacy flight school resulted in a savings of \$166,183 over FSXXI for the entire duration of training. However, in Table 7 it was shown that because of the increased number of flying hours, legacy flight school was associated with \$76,218 more in readiness level training costs than FSXXI. Therefore, the total savings associated with legacy flight school training for the CH-47 was \$89,965.

Table 7.

Costs Associated with Readiness Level Training for the Participants of the Current Research by Aircraft and Program

	<u>UH-60</u>		<u>CH-47</u>	
	Legacy	FSXXI	Legacy	FSXXI
Average Readiness Level Day/Night Hours	\$22.73	\$18.38	\$30.65	\$23.84
Average Readiness Level NVG Hours	\$21.20	\$18.10	\$23.67	\$19.26
Total Readiness Level Hours	\$43.93	\$36.48	\$54.32	\$43.10
Cost per Hour	\$2,760	\$2,760	\$6,793	\$6,793
Total Cost	\$121,247	\$100,685	\$368,996	\$292,778
Savings Associated with FSXXI per pilot		\$20,562		\$76,218

## Discussion

### *Readiness Level Progression*

The first research question was examined separately for day/night and NVG flying scenarios, and for the UH-60 and CH-47 aircraft. In each of the four analyses, there was a statistically significant difference between the FSXXI pilots and the legacy flight school pilots. The results indicate that in each of these cases the number of hours required for FSXXI graduates to progress through Time 1 and Time 2 was lower than that for legacy flight school pilots. Thus, the answer to the first research question is yes, FSXXI pilots require fewer hours to become fully mission capable pilots than legacy flight school pilots. This was true for both the UH-60 and CH-47 aircraft, and was true for both day/night and NVG scenarios.

FSXXI's desired performance outcome of producing aviators that progress to fully mission capable pilots in fewer flight hours has been met for both types of aircraft examined in this research. Although the research question can be answered simply with a "yes," a deeper look at the readiness level progression results gives some insight into the effectiveness of the FSXXI flight training program. The first analysis revealed that the main effect for time for the day/night scenario was statistically significant for the UH-60 and for the CH-47, indicating that progression through Time 1 was significantly longer than Time 2 for both aircraft without regard for program. Additionally, for the NVG scenario, the results indicate a statistically significant difference for both aircraft. However, these data revealed the opposite of the day/night scenario in that graduates of both flight training programs and both aircraft required more flight hours to progress through Time 2 than Time 1.

These findings may give some insight into where training should be focused during flight school. Time 1, which consists of aviator base tasks, requires more flight hours to progress through during RL progression, with the exception of the NVG scenario, than Time 2, which is made up of mission tasks specific to the individual unit. This leads to the question: Should more training time in flight school be focused on areas that require more flight time to progress through during RL progression (i.e., Time 1 tasks for UH-60 and CH-47 day/night scenarios or Time 2 for the UH-60 and CH-47 NVG scenarios) or should the number of flight training hours during flight school for the scenarios requiring more flight hours to progress through during RL progression be increased? By shifting the focus of flight school, aviators may become less proficient in Time 1 tasks (for day/night scenarios) or Time 2 tasks (for NVG scenarios) while becoming more proficient in the tasks that required more flight time to progress through once they arrive at their unit. Essentially, the problem would not be corrected, it would simply shift from one set of tasks to the other and a gap would remain in the proficiency levels of graduates of the two programs. The shift in training focus during flight school would only serve to displace the problem rather than correct it. However, if training hours during flight school remain the same for scenarios that required fewer hours to progress through during RL progression, an increase in the number of training hours during flight school in the scenarios that took more flight hours to progress through during RL progression will generate aviators that are more proficient across the board while closing the gap on the differences in the number of hours required to progress through Time 1 and Time 2 once they arrive at their unit. The focus in training would not be shifted from one set of tasks to the next, but it would provide for an

increase in the number of flight hours during flight school for those tasks that require longer to progress through at the unit. This would allow aviators to maintain their proficiency in the tasks that required fewer hours to progress through at their unit while increasing their proficiency in tasks that required more flight hours to progress through during RL progression.

Research has demonstrated that the increased number of repetitions of an experience serves to increase learning and facilitate a higher proficiency at a task (Pimentel, 1999). As aviators are able to move through Kolb's learning cycle an increased number of times, they will refine their flying skills which will result in better performance of flight maneuvers. An increase in the number of flight hours would result in more repetition of these flight maneuvers.

Although the previous analysis suggests where training resources could be focused, the subsequent analysis comparing readiness level progression rates between the two programs was central to the current research. This analysis revealed a statistically significant difference in the number of flight hours required to progress through Time 1 and Time 2 for both the UH-60 and the CH-47 in the day/night scenario. FSXXI graduates progressed through Time 1 and Time 2 more quickly than did legacy flight school graduates with a mean difference in flight hours for the UH-60 of 3.62 hours for Time 1 and .73 hours for Time 2, while CH-47 aviators had a mean difference of 5.54 hours for Time 1 and 1.27 hours for Time 2.

These findings are consistent with Kolb's experiential learning theory in the sense that the proficiency of an aviator is not solely linked to the performance of specific tasks, but rather a collective aviation experience. Although flight students from each training program received a different number of flight hours in their respective aircraft, and the findings of this research showed a statistically significant difference in the readiness level progression rates, the actual number of flight hours that separated graduates from each program was relatively small. This indicates that students learned from their collective experiences during flight training and developed a certain level of proficiency in both programs.

#### *Instructor Pilot Perceptions*

An analysis of the IP survey data indicated that there was a difference between instructors' perceptions depending on whether they were training pilots on the UH-60 or CH-47 aircraft. Specifically, there was no statistically significant difference between instructors' perceptions of FSXXI and legacy flight school pilot end of course performance for the CH-47 aircraft, but there was a difference for the UH-60 aircraft. For the UH-60 aircraft, instructors rated the end of course performance of the FSXXI pilots to be higher than that of the legacy flight school pilots.

The findings gathered by the IP survey give mixed indications of the quality of the FSXXI program in relation to the legacy flight school. IPs that conduct training in the UH-60 aircraft were of the opinion that the FSXXI flight training program produced aviators that were more proficient during end of training check-rides than students trained in the legacy flight school. However, IPs that conduct training in the CH-47 aircraft were of the opinion that the FSXXI flight training program did not produce aviators that were significantly more proficient than graduates of the legacy flight school. This contradiction could be a result of the program of

instruction for each aircraft, or possibly a result of the ease or difficulty associated with piloting a specific airframe, or both.

Although both helicopters are considered to be state-of-the art, the CH-47 is equipped with features that lower pilot workload while maintaining better aircraft control. The Advanced Flight Control System (AFCS) in the CH-47 “stabilizes the helicopter about all axes and enhances control response. It automatically maintains desired airspeed, altitude, bank angle, and heading” (U.S. Army, 2003, p. 2-5-3). The AFCS allows the pilot to fly “hands-off” while maintaining the desired flight profile. The UH-60 has a similar flight stabilization system that alerts the pilot to make corrections to maintain the desired flight profile. However, unlike in the CH-47, the UH-60 does not perform this automatically. The pilot must make control inputs to maintain or change the flight profile. The automated flight stabilization system of the CH-47 may be, in part, responsible for the perceived equality between the two flight training programs. Several studies (Krueger & Fagg, 1981; Reardon et. al., 1997) conducted by the U. S. Army Aeromedical Research Laboratory at Fort Rucker have concluded that fatigue due to workload can adversely affect an aviator’s proficiency. The automation provided by the CH-47’s AFCS may reduce pilot workload and fatigue.

### *Cost Comparison*

For the third research question, the total cost of flight school pilot training based on military estimates was integrated with the costs associated with readiness level training at the unit for the pilots in the current research. Based on these estimates, legacy flight school training was substantially less expensive than FSXXI training. However, due to the fact that fewer hours of readiness level flight training were required for FSXXI pilots, the cost advantage of the legacy flight school program was diminished, but it remained substantially less expensive. This was true for both UH-60 and CH-47 aircraft. This raises the question, is the cost associated with FSXXI worth the fewer hours required to progress aviators when they arrive at their first duty station?

Although FSXXI has been shown to produce aviators that progress to a fully mission capable status in fewer flight hours, it has also been shown to cost more than the legacy flight school. This increased cost may be acceptable if Army leaders feel that the speed in which aviators are progressed to a fully mission capable status outweighs the increased cost. On the other hand, the cost savings associated with the legacy flight school could allow the Army to train more aviators for the same amount of financial expenditures. For example, the Fort Rucker Master Schools List showed that there were 138 students attending the CH-47 FSXXI training program and 562 students attending the UH-60 FSXXI training program during the 2006 fiscal year (Rucker, 2005). The FSXXI training program will cost \$23.7 million more than the legacy flight school to train the same number of UH-60 pilots: The CH-47 FSXXI training program will cost \$12.4 million more than the legacy flight school. This would result in a total difference of \$36.1 million. If the Army solely utilized the legacy flight school to train its aviators, it would be able to graduate 33 more CH-47 pilots and 117 more UH-60 pilots at the same cost as the FSXXI training program.

## Comparison of Findings with Past Research

The findings of this research support the experiential learning theory that learning can be based on practical experiences. Empirical studies (Harris, 2004; Larson, 2004) have determined that knowledge is gained through “concrete experiences” and that in some instances experiential learning is the most effective way of learning.

The practical experience that aviators gain through hands-on flight training in the cockpit could not be learned through classroom training. Aviation, as with many other fields of study, requires practical training outside the classroom in order to build proficiency. For example, medical practitioners receive a significant amount of their training through supervised clinical experience. Many of these experiences could not be duplicated in a classroom setting or even through simulation. For this reason, many medical, business, and vocational training programs rely heavily on practical training exercises.

Aviation training, and more specifically military aviator training, is a vocational training program that exclusively trains adult learners. Adult education, by nature, seems well suited for experiential learning programs. Research has indicated that adults learn effectively through experiences that involve the whole person (Fisher-Brillinger, 1990). Military flight training fits this mold. Military aviators have a vested interest in succeeding during flight training because it is not only a training program, but a career as well. Army aviators are Soldiers that not only attend flight training as a profession, but also as a way of life. The training they receive while attending flight school may save their lives or the lives of others in combat or emergency situations. In essence, lives could depend on their success as aviators.

## Implications

Although FSXXI appears to produce more proficient aviators than the legacy flight school, the cost associated with it is greater. The increased proficiency, as measured by readiness level progression rates, may not outweigh the cost associated with the program. However, some argue that the increased training received by FSXXI students may have hidden benefits. The students trained under the FSXXI flight training program receive more training in their complex aircraft (i.e., the CH-47 and UH-60) which in turn better adapts them for complex systems currently under design by the Army. The future of Army aviation will rely heavily on sophisticated concepts such as manned-unmanned teaming in which manned aircraft conduct missions while teamed with an unmanned aircraft in a very fluid battlefield requiring intricate networking in order to conduct a mission (DeFrank, 2005). These missions require aviators that are able to grasp and apply very demanding tasks. The deeper understanding of their assigned aircraft may help to facilitate the aviators’ integration into the future fighting force.

However, the increased number of aviators that could be trained using the legacy flight school would enable Army leaders to produce more aviators while maintaining their expenditures. The lower proficiency of legacy flight school graduates could be compensated for over time. As these aviators gain field experience, they close the gap between themselves and the FSXXI graduates. For these reasons, Army leaders will have to weigh the benefits of the FSXXI flight training program and the costs associated with it.

## Recommendations for Future Research

Although this research indicates that FSXXI produces more proficient aviators, more research should be conducted to further establish the effectiveness of the program. Additionally, this research focused on the CH-47 and the UH-60 flight training programs collectively. These programs should be examined individually to further refine the program of instruction and focus training in appropriate areas. By focusing on the individual training programs, the effects of pilot workload and aircraft automation could also be examined.

This research focused on the CH-47 and UH-60 FSXXI training programs. Future research should include the AH-64 and the OH-58 helicopters. By including these aircraft in future studies, a comprehensive evaluation of FSXXI could be conducted.

Another consideration for future research should be the different learning styles associated with adult education. McCarthy (1987) developed the 4MAT system for learning that was designed to accommodate four major learning styles: Innovative Learners, Analytic Learners, Common Sense Learners, and Dynamic Learners. By addressing different learning styles and adjusting the program of instruction for flight training to fit them, aviator performance and retention may increase.

This research utilized a cost comparison in order to outline costs of aviator training for both programs. With military budgets shrinking and the Army being asked to "do more with less," a formal training effectiveness analysis should be conducted to determine the cost effectiveness of each program. In addition to examining the individual flight training programs, future force requirements should be examined to determine the adaptability of each program. FSXXI might better lend itself to adapting to the future requirements of Army aviators.

Finally, research examining the mission requirements of the different field units in the Army should be conducted. The mission of every aviation unit in the Army varies to a certain degree. These mission variances may affect the time required for aviators to progress to fully mission capable status. An examination of the adaptability of each training program to individual unit requirements may assist Army leaders in determining the value of the FSXXI program.

## Conclusion

This research attempted to evaluate the effectiveness of the FSXXI flight training program in comparison to its predecessor, the legacy flight school. The objective of the research was to compare readiness level rates of graduates of each training program to determine which aviators were able to become fully mission capable pilots in fewer flight hours. Although the main objective of this research was to determine the most effective flight training program, it also compared the attitudes that instructor pilots have toward the programs as well as the cost of training an aviator in each program.

The research revealed that the FSXXI training program produced aviators that progressed to fully mission capable pilots in fewer flight hours. However, the cost associated with FSXXI is higher than the legacy flight school, bringing into question its overall value. This was supplemented with a survey that collected data on instructor pilot attitudes toward both training programs. The findings indicated that the instructor pilots' perceptions of the programs differed according to type of aircraft. CH-47 instructors reported that both programs produced aviators of relatively equal proficiency while UH-60 instructors reported that FSXXI graduates were more proficient. This research was the first empirical examination of the FSXXI flight training program. It serves mainly to assist in identifying areas in which further research should be focused.



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## Appendix A

### Aircrew Training Program (TC 1-210)

The Aircrew Training Program (ATP) is managed by the unit commander and is designed to facilitate crew member training within the aviation unit. The U. S. Army has developed a Training Circular (TC-1-210), Aircrew Training Program Commander's Guide to Individual and Crew Standardization, that serves as a guide for the aviation commander. The TC 1-210 outlines all aspects of the program and serves as a reference for developing or maintaining a program. This appendix consists of excerpts from the TC 1-210 (U.S. Army, 1995) that will assist in understanding the ATP.

#### *Flight Activity Categories (FAC)*

All operational aviation positions and other designated flying positions in the ATP are classified as one of three flight activity categories. Unit commanders designate each position FAC 1, FAC 2, or FAC 3. They base these designations on the proficiency required by the unit's mission.

**FAC 1** duty positions require a high degree of flight proficiency in the tactical employment of the assigned aircraft. The higher semiannual flying-hour minimums required of FAC 1 aviators reflects this need for increased flight proficiency.

**FAC 2** duty positions require less tactical flight proficiency than FAC 1 duty positions. For example, executive officers, maintenance officers, and staff officers at battalion or higher levels may be designated FAC 2.

**FAC 3.** Commanders may designate certain positions as FAC 3 based on the unit's mission requirements. Aviators assigned to FAC 3 operational flying positions must be qualified in their primary aircraft. However, they shall not perform crew member duties in Army aircraft. They do not have aircraft flying-hour minimums or currency requirements, and they are not subject to readiness levels. Commanders would not expect to use these aviators in combat operations without providing refresher or mission training. FAC 3 aviators, however, must maintain their basic flying skills using a flight simulator. A compatible simulator must be available for the aviator's use.

#### *Commander's Evaluation*

The purpose of the commander's evaluation is to determine the initial readiness level of newly assigned crew members. This evaluation consists of a records review and possibly a proficiency flight evaluation. The commander or his designated representative will complete the evaluation within 45 calendar days after the crew member signs in to the unit or after the effective date of his flying status orders, whichever occurs last.

*Records review.* Unit commanders or their designated representative will review the crew member's Individual Aircrew Training Folder (IATF). They will compare the individual's

qualifications with the tasks required by the assigned duty position. If the appropriate readiness level can be determined from the review, the commander will document the readiness level in the individual's flight records.

*Proficiency flight evaluation.* If the initial readiness level cannot be determined by the records review or if the commander desires, the crew member will undergo a proficiency flight evaluation. The proficiency flight evaluation should include tasks from each flight mode in which the crew member can expect to perform duties. The results of the proficiency flight evaluation will determine the crew member's readiness level. The commander will document the readiness level in the individual's flight records.

*Additional considerations.* Commanders may not assign an initial readiness level 2 or readiness level 1 to graduates of the Initial Entry Rotary Wing Course (FSXXI) or aircraft qualification courses who are on their first utilization tour solely on the basis of a records review. For initial designations other than readiness level 3, the commander must also consider the results of a proficiency flight evaluation.

If, at the time of initial readiness level designation, one year has passed since the aviator has completed any element of an Annual Proficiency and Readiness Test (APART) (instrument evaluation, standardization evaluation, or aircraft operator's manual examination), he must complete that element before designation as, or progression to readiness level 1. Graduates of the Initial Entry Rotary Wing Course who are on their first utilization tour are exempt from this requirement.

After determining the initial readiness level, the commander will direct qualification, refresher, mission, or continuation training for the crew member as applicable. Time allotted for completion of the required training will start accruing on the date of the readiness level designation. If recommended by the evaluator, crew members may credit the flight tasks satisfactorily completed on the proficiency flight evaluation toward completion of their readiness level training requirements.

### *Readiness Levels (RL)*

Readiness levels identify the training phase in which crew members are participating and measure crew member readiness. They also provide a logical progression of individual and aircrew training based on task and mission proficiency. In some cases, crew members may have more than one readiness level (RL). For example, crew members who are RL 1 in their primary aircraft may be RL 3 or RL 2 in their alternate or additional aircraft while undergoing qualification or mission training in that aircraft. Another example is a crew member who is RL 1 and RL 3 in the same aircraft: RL 1 for aircraft continuation training and RL 3 for NVG refresher training.

### *Readiness Level Progression*

Active Army crew members have 90 consecutive days to progress from one RL to the next. USAR crew members have one year to progress. All Army National Guard crew members, including Active Guard/Reserve crew members and technicians, progress according to NGR (AR) 95-210. These periods also apply when the crew member begins alternate or additional aircraft qualification and refresher training. They exclude days lost because of—

- Temporary duty.
- Leave approved by the unit commander.
- Medical or non-medical suspension from flight.
- Grounding of aircraft by Headquarters, Department of the Army.

If the exclusion period exceeds 45 consecutive days, crew members must restart their current RL progression. However, crew members may progress to the next RL in less time than prescribed.

During RL progression, crew members must demonstrate proficiency in each mode of flight (day, night, and NVD) required by the Aircrew Training Manual (ATM) for their designated aircraft and the Commander's Task List (CTL) in their flight records for each task. RL progression evaluations may be continuous.

*Readiness Level 3 (RL 3).* Crew members are designated RL 3 while undergoing qualification or refresher training in their primary, alternate, or additional aircraft. They progress from RL 3 by demonstrating proficiency in all base tasks to an Instructor Pilot, Standardization Pilot, or Instrument Examiner as appropriate.

An aviator returning to an operational flying position after not having flown within the previous 180 days must be designated RL 3 for refresher training. If an aviator entering the unit's ATP has flown within the past 180 days, the commander may still require the crew member to undergo refresher training. The commander will base his decision on either a records check or a proficiency flight evaluation.

During refresher training, crew members do not have minimum hour, task, iteration, or APART requirements in the aircraft in which the training is being conducted. The only requirements they have are those designated by the commander. Crew members undergoing RL 3 training in the aircraft must fly with an Instructor Pilot, Standardization Pilot, or Instrument Examiner as appropriate. The Instructor Pilot, Standardization Pilot, or Instrument Examiner must be at a station with access to the flight controls.

*Readiness Level 2 (RL 2).* Crew members who have completed RL 3 training or have been designated RL 2 initially based on the commander's evaluation will begin training in the mission/additional tasks designated by the unit commander. They will complete this training in their primary, alternate, or additional aircraft. Crew members progress from RL 2 to RL 1 by

demonstrating proficiency in all selected mission/additional tasks to an Instructor Pilot, Standardization Pilot, or Instrument Examiner.

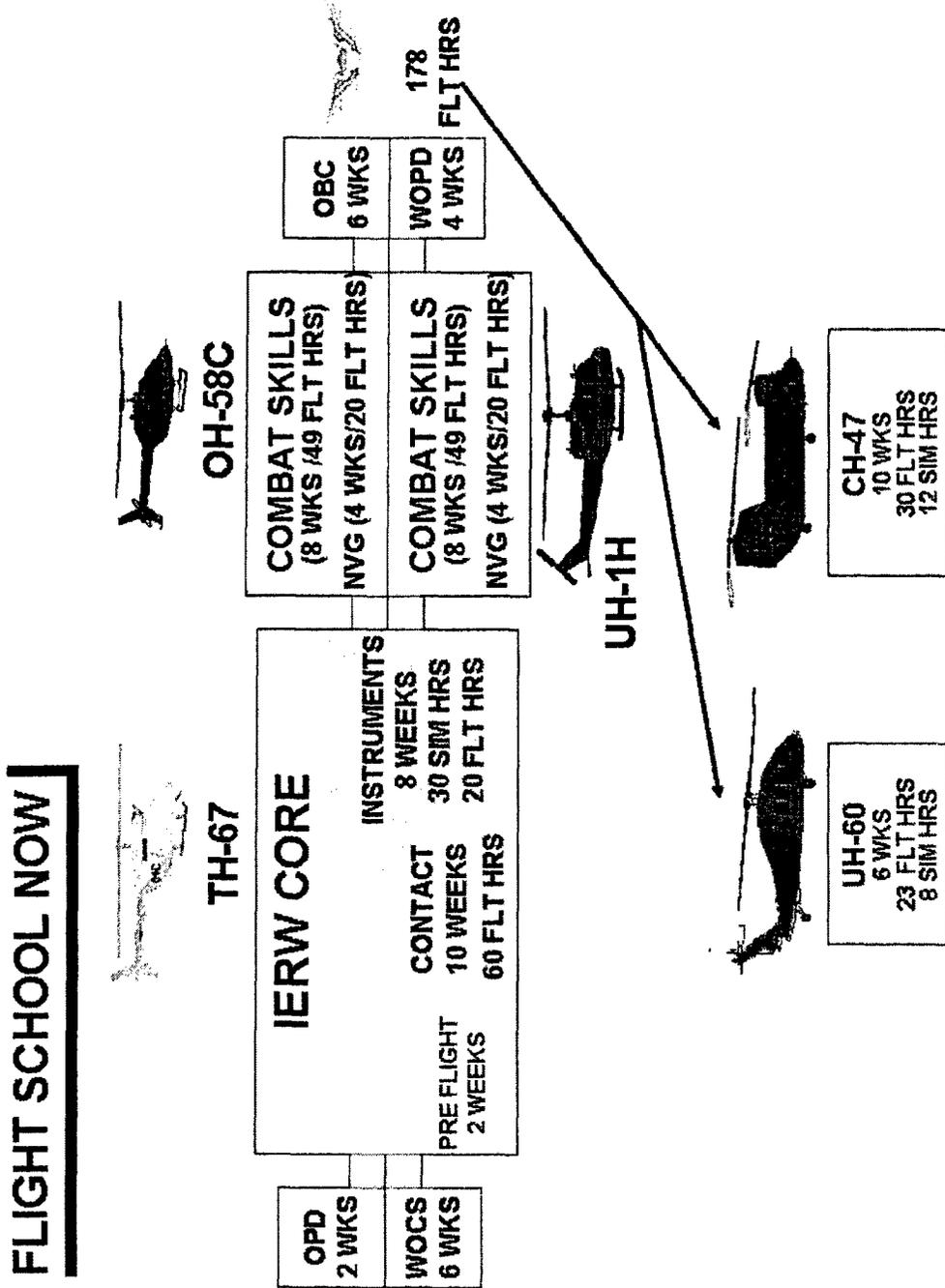
Mission training programs help RL 2 crew members develop the ability to perform specific tasks selected by the commander to support the unit's mission. Because the goal is proficiency in mission-related tasks, commanders should tailor their task list to meet specific unit needs. RL 2 crew members may not perform mission tasks in which they have not demonstrated proficiency unless they are performing duties with an Instructor Pilot, Standardization Pilot, or Instrument Examiner.

*Readiness Level 1 (RL 1).* Crew members who have completed RL 2 training or have been designated RL 1 initially based on the commander's evaluation are considered mission-ready. They are designated RL 1 while undergoing continuation training in their primary, alternate, or additional aircraft. Aviators assigned to maintenance officer or maintenance technician positions or are designated as Maintenance Pilots or Maintenance Evaluators must pass a maintenance test pilot evaluation before being designated RL 1. All aviators must complete a local area flight orientation before progressing to RL 1. Once designated RL 1, crew members must maintain RL 1 training minimums. The exceptions are when their minimums are prorated or reprogrammed or they are being processed for failing to complete task and flying-hour requirements.

Appendix B

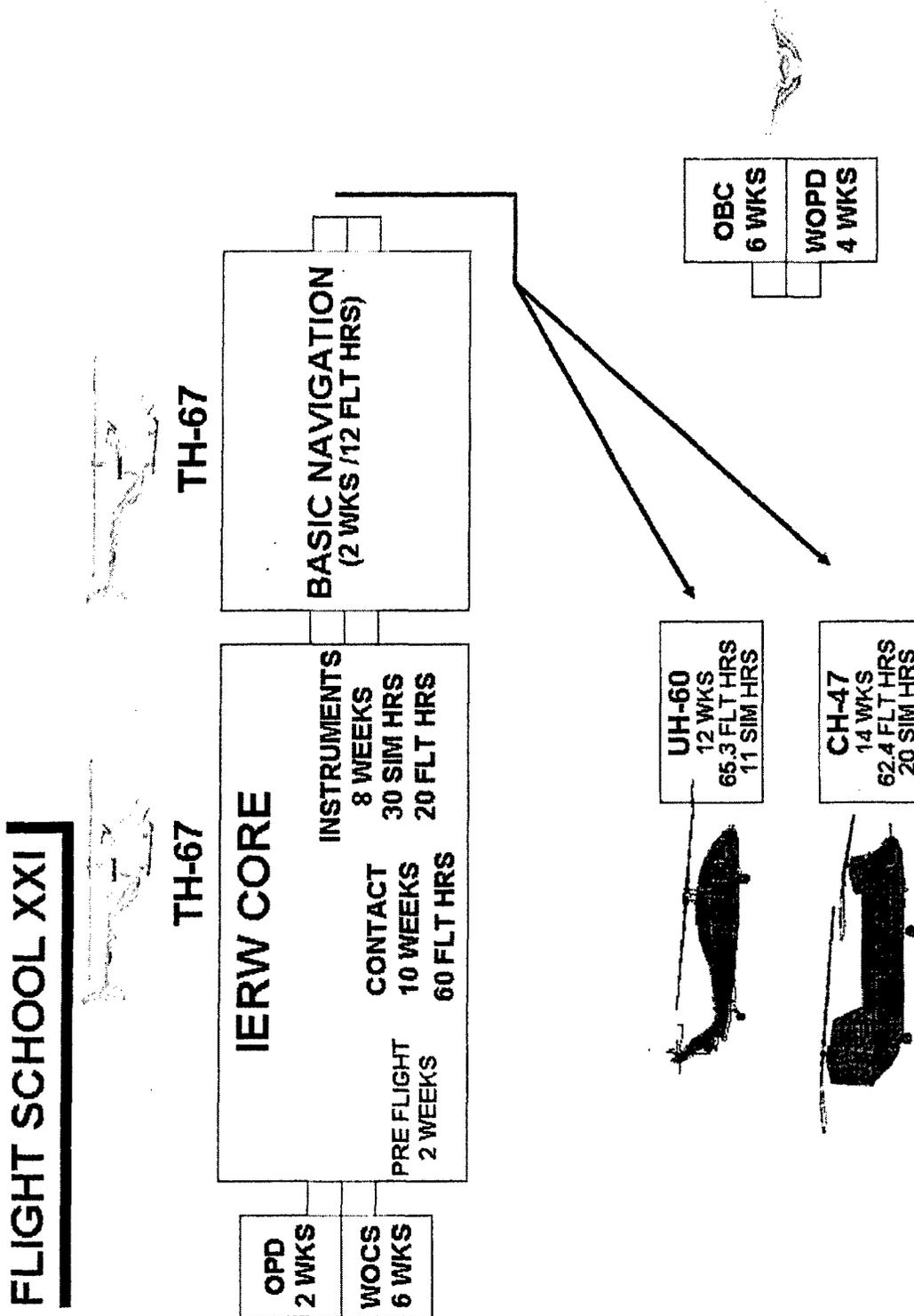
Structure of Army Flight Training

Flight Training Program with the Initial Entry Rotary Wing Course (IERW) and Aircraft Qualification Course. This diagram was adapted from USMA (2005).



Interim Flight School XXI Flight Training Program

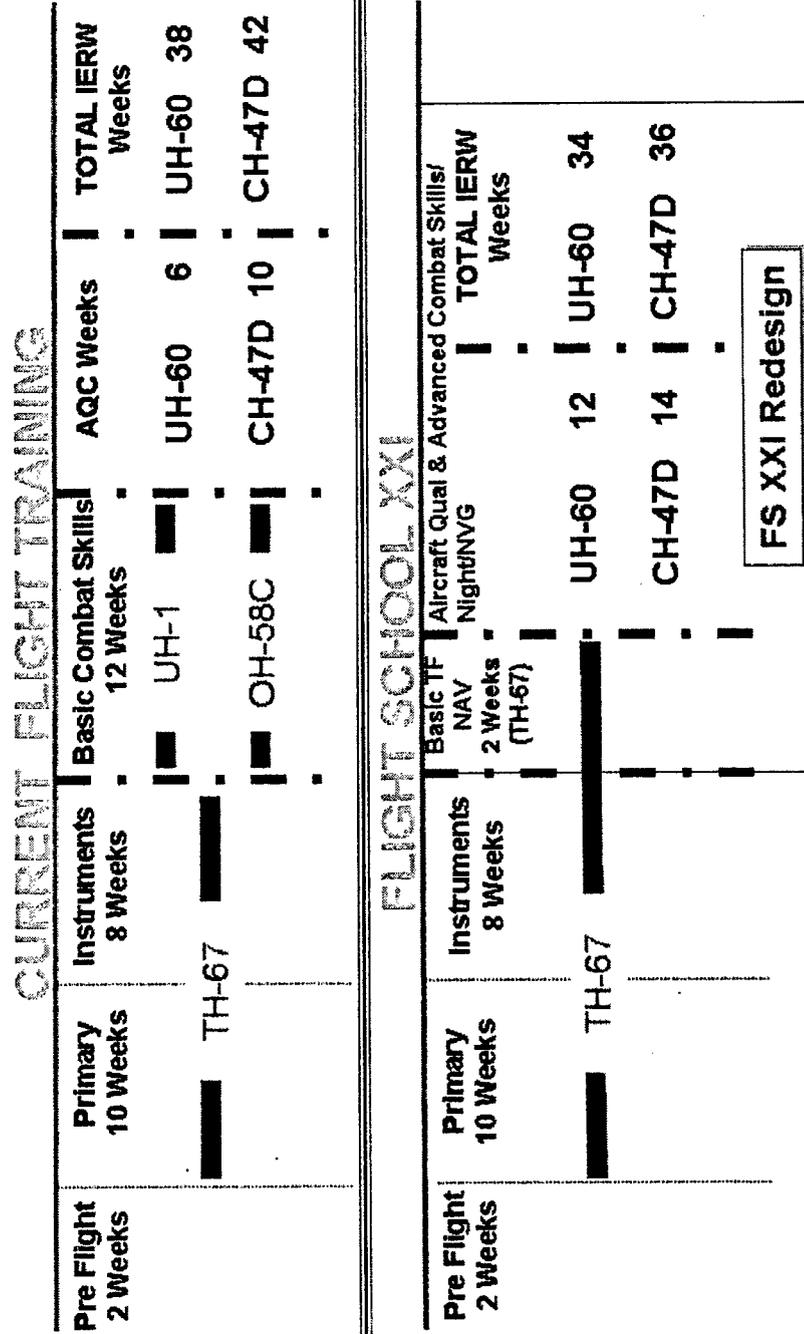
Diagram adapted from USMA (2005).



Comparison of Flight School XXI to the IERW and Aircraft Qualification Course

Diagram adapted from USMA (2005).

**FLIGHT SCHOOL XXI COMPARISON**







7. Overall, the FSXXI flight training program prepares flight students for integration into an aviation unit.

1      2      3      4      5

#### Legacy Flight School

8. Legacy flight school students regularly exceed the evaluation standards during end of course evaluations.

1      2      3      4      5

9. The legacy flight school program of instruction prepares students for integration into an aviation unit upon graduation.

1      2      3      4      5

10. Overall, the legacy flight training program prepares flight students for integration into an aviation unit.

1      2      3      4      5