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In-Depth Analysis of Evaluation Practices and Criteria for Competency-Based Aviation Training Models

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Monterey, California: Naval Postgraduate School

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NPS NRP Executive Summary

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Period of Performance: 10/01/2021 – 12/31/2021

Report Date: 12/31/2021 | Project Number: NPS-21-N109-A

Naval Postgraduate School, Graduate School of Engineering and Applied Sciences (GSEAS)



NAVAL RESEARCH PROGRAM

NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

IN-DEPTH ANALYSIS OF EVALUATION PRACTICES AND CRITERIA FOR COMPETENCY-BASED AVIATION TRAINING MODELS

EXECUTIVE SUMMARY

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Prepared for:

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This research is supported by funding from the
Naval Postgraduate School, Naval Research Program (PE 0605853N/2098).
Approved for public release. Distribution is unlimited.

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Project Summary

This literature review was conducted to find and analyze practices and criteria that can be used to both accelerate the training process for new pilot students in the Navy aviation training pipeline, and potentially improve pilot proficiencies throughout their flying careers. Conducting the initial search for articles on competency-based training (CBT) in a pilot training program using Google Scholar, the Defense Technical Information Center, and the Naval Postgraduate School's Calhoun search engines narrows the list of potentially useful sources from several million to several hundred. CBT has been shown to produce significant improvements in developing training syllabi as well as evaluating progress and effectiveness in many professional fields. Studies have examined the ability of a student to progress rapidly through initial training phases based on demonstrated abilities to perform specific tasks that have been developed prior to the formal training process. Measuring a pilot's experience based only on flight hours flown does not provide a complete evaluation of skill level achievement. CBT processes can provide a more detailed assessment of pilot performance. Follow-on work should examine the details of specific tasks that are likely to be validated in the early training process (ie airmanship and basic communications) to allow the student pilot to more quickly progress to the more demanding evolutions such as formation flights and carrier landings.

Keywords: *pilot training, competence, competency, competency-based training, CBT, competency-based education, CBE, evidence-based training, EBT, performance-based training, PBT, training*

Background

The International Civil Aviation Organization (ICAO) defines *competency* as “a combination of skills, knowledge, and attitudes required to perform a task to the prescribed standard” (ICAO Annex 1, 2013). The Department of Defense describes competency as “an observable measurable pattern of knowledge, abilities, skills, and other characteristics that individuals need to successfully perform their work” (DoDI 1400.25, June 2017). Kearns et al. characterize competence-based education (CBE) as “instructional design, training, and assessment that systematically references written competencies” (Kearns, 2017). The majority of research conducted on CBE within an aviation context is focused on commercial aviation, however many of these studies are applicable to initial phase military flight training.

The current student pilot training pipeline is severely backlogged. As a result, the navy assigns newly commissioned officers to temporary billets before beginning pilot training. If the process can be shortened by reducing the time to learn basic skills, that saving can help reduce the backlog. CBT is a method to reduce the amount of time required to move a student pilot through some of the initial training requirements. As an example, when the skills learned steering a car are applied to some of the motions required to control an aircraft, the time to learn some basic airmanship skills may be reduced. Additionally, some of these skills can be practiced and refined in simulators, which may also reduce demand on instructor pilots and training aircraft.

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Relevant Studies

There have been numerous studies conducted to analyze the benefits of CBT in a variety of occupations, such as doctors, nurses, production managers, and several aviation professions. ICAO developed an outline in their Doc 9995, “Manual of Evidence-based Training” to design training programs and assessment criteria for pilots of different generations of commercial jets and turboprop aircraft. This document is designed “to develop and evaluate the identified competencies required to operate safely, effectively and efficiently in a commercial air transport environment whilst addressing the most relevant threats according to evidence collected in accidents, incidents, flight operations and training.” (ICAO 2013).

A criticism of CBT programs is they only produce a minimum level of performance since the assessments tend to evaluate “met or did not meet” requirements. In some cases, the standards are not clearly delineated, obscuring the assessment process. This is being overcome in programs similar to Mendonca’s study at Purdue, where three learning levels have been defined – *emerging, developing, or proficient* – to differentiate between performance levels (Mendonca et al., 2019). If the “meets requirement” evaluation is considered insufficient to allow the student to progress to the next level, then that requirement needs to be re-evaluated. As they say, if the minimum’s not good enough, then it must be raised.

Researchers in Norway and the Netherlands investigated the feasibility of competency-oriented, performance-based training for Air Force combat pilots to define continuation training programs (not initial training), used by already trained pilots to maintain skill proficiency. They used a phased approach integrating several training theories starting with CBT, adding performance-based training (PBT), and then supplementing it with evidence-based refinements. They found their approach was well-suited for simulation-based training because scenarios were easier to control than live training. This method is an alternative to the commonly used frequency-based refresher training approach that takes place on a predetermined schedule. Frequency-based refresher training typically generates the same program for everyone and does not reflect individual differences between pilots. Svendsen et al. used PBT to focus on desired proficiencies and used actual pilot performance to determine the training amount and timing (Svendsen et al. 2020). To support this training model, pilot performance needs to be measured as objectively as possible and instructor evaluations need to be discriminative and standardized, not just pass or fail.

Holt and Perry developed a model – Universal Competency Assessment Model (UCAM) – to provide a structured methodology. They specified that any assessment process must be repeatable, transferable, measurable, based on best practices, and tailorable (Holt & Perry, 2011). This provides the skeleton for the Navy aviation pilot training program to design the assessment process.

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Findings and Conclusions

This literature review was conducted to find evidence of successful use of CBT in aviation training programs which, when incorporated into the current pilot training program may allow for a reduction in the overall training program and generate more highly-skilled pilots when they report to the Fleet Replacement Squadrons to join the front line of skilled, capable pilots in the fleet.

Franks states “In aviation, there is debate emerging around the idea that something more than learning and performance of discrete tasks is essential for developing higher order problem solving skills and their application for performing complex tasks of the kind that are routinely encountered by pilots during flight. This indicates that some instructional practitioners see the need for CBT to be used in a more holistic and integrated way than is the current practice in pilot training.” (Franks et al., 2014). This aligns with the challenge of measuring a student pilot’s achievement of specific tasks in assessing whether they are qualified to progress to the next step in the training program. Most CBT programs reviewed applied a binary evaluation to the student’s achievement – either they met the requirement, or they did not.

Assembling a CBT process will require substantial investment of time and energy since it must be tailored to the individual and provide meaningful assessments throughout the process. Providing a fixed training program that everyone must proceed through is simpler to utilize and walk everyone through, but lacks the flexibility to move students through the tasks they have already mastered in a more effective and efficient manner.

Providing a CBT process for the earlier, less complex tasks in the pilot training pipeline can allow quicker progress through those earlier stages, shortening the time required to complete initial pilot training. Utilizing CBT processes for more experienced pilots can also realize improved effectiveness in the training and assessment process, but will require a more involved development process, and more training for those instructors providing the training and performing the assessments.

In summary, there are problems with the binary evaluation process used in many CBT processes. This evaluation process can provide usable results in initial pilot training programs since the tasks being evaluated are less complex, and the time for the instructor to evaluate and provide feedback can be minimal. For more complex task evaluations, the binary issue can be overcome as shown in Mendonca’s study.

Recommendations for Further Research

To enhance the Navy’s student pilot training program, it is recommended that a detailed CBT program be developed, using a structured approach similar to the UCAM developed by Holt and Perry. The tasks outlined in ICAO Doc 9995 could be used as a starting point to develop similar specific tasks that a newly trained Navy pilot would be expected to perform.

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This could be supported by an analysis of current flight training evolutions with consideration for which requirements may be met by other achievements.

Many articles discuss the shortcoming of the CBT process, where the more advanced skill sets such as critical thinking, decision-making, problem-solving and team interactions are lacking or not addressed. Any Navy-oriented CBT process should include these skills since the pilots will be expected to be able to think critically, make decisions, solve problems, and will nearly always be working as part of a team focused on carrying out a mission.

Future research should focus on developing and analyzing use cases to support the training process of upcoming pilots. Additionally, research should investigate methods for accomplishing training objectives with simulator use to reduce impact on aircraft and instructor pilot availability.

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Acronyms

- CBE Competency-based education
CBT Competency-based training
EBT Evidence-based training
ICAO International Civil Aviation Organization
PBT Performance-based training
UCAM Universal Competency Assessment Model