NPS-GSBPP-09-025

NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

An Assessment of the Effectiveness of Computer-based Training for Newly Commissioned Surface Warfare Division Officers

24 August 2009

by

Dr. William R. Bowman, Professor

Alice M. Crawford, Senior Lecturer

Dr. Stephen Mehay, Professor

With the assistance of Carol Stoker and Robert Paynter

Naval Postgraduate School

Approved for public release, distribution is unlimited.

Prepared for: Naval Postgraduate School, Monterey, California 93943

Naval Postgraduate School
Monterey, California

The Acquisition Chair, Graduate School of Business & Public Policy, Naval Postgraduate School supported the funding of the research presented herein.

The report was prepared by:

____
Stephen Mehay, Professor
Graduate School of Business & Public Policy

____
Elda Pema, Assistant Professor
Graduate School of Business & Public Policy

Reviewed by:

____
William R. Gates, Ph.D.
Dean, Graduate School of Business & Public Policy

Released by:

____
Karl van Bibber, Ph.D.
Vice President and
Dean of Research

REPORT DOCUMENTATION PAGE			Form approved OMB No 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.			
1. AGENCY USE ONLY (Leave blank)	**2. REPORT DATE** 24 August 2009	**3. REPORT TYPE AND DATES COVERED** 1 October 2007 through 30 September 2008	
4. TITLE AND SUBTITLE An Assessment of the Effectiveness of Computer-based Training for Newly Commissioned Surface Warfare Division Officers			**5. FUNDING**
6. AUTHOR (S) William R. Bowman, Alice M. Crawford, and Stephen Mehay, with the assistance of Carol Stoker and Robert Paynter			
7. PERFORMING ORGANIZATION NAME (S) AND ADDRESS (ES) NAVAL POSTGRADUATE SCHOOL GRADUATE SCHOOL OF BUSINESS AND PUBLIC POLICY 555 DYER ROAD MONTEREY, CA 93943-5103			**8. PERFORMING ORGANIZATION REPORT NUMBER** **NPS-GSBPP-09-025**
9. SPONSORING/MONITORING AGENCY NAME (S) AND ADDRESS (ES)			**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited			**12b. DISTRIBUTION CODE**

13. ABSTRACT (Maximum 200 words.)

The goal of this study was to analyze the effectiveness of the new SWOS-at-Sea training for newly commissioned surface warfare officers that was introduced in 2003. The new regime combined self-paced computer-based training (CBT) with on-the-job training (OJT) on-board an officer's ship. The study relied on a variety of analytical techniques, including a literature review of CBT and OJT training, interviews and focus groups with junior and senior surface warfare officers, and statistical analysis of test scores at the Surface Officer Division Officer Course (SWOSDOC). The literature review pointed out that no previous studies had analyzed a learning course that involved CBT when the student was also performing a full-time job. Nonetheless, the literature review noted that structured OJT is preferred to unstructured OJT, as in SWOS-at-Sea. Interviews also indicated that division officers prefer face-to-face learning and they felt they were trying to perform as division officers without the requisite skills. The statistical analysis of test scores at the SWOSDOC 'leveling' course found significant differences in performance between ship type, ship home port location, commissioning source, undergraduate major, and gender. The results highlighted significant differences in the learning environments aboard ships and suggested the need for additional research on training opportunities offered aboard ships.

14. SUBJECT TERMS Surface Warfare, Officers, training			**15. NUMBER OF PAGES** 121
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT: UNCLASSIFIED	**18. SECURITY CLASSIFICATION OF THIS PAGE:** UNCLASSIFIED	**19. SECURITY CLASSIFICATION OF ABSTRACT:** UNCLASSIFIED	**20. LIMITATION OF ABSTRACT:** UU

NSN 7540-01-280-5800

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std 239-18

THIS PAGE INTENTIONALLY LEFT BLANK

Abstract

The goal of this study was to analyze the effectiveness of the new SWOS-at-Sea training for newly commissioned surface warfare officers that was introduced in 2003. The new regime combined self-paced computer-based training (CBT) with on-the-job training (OJT) on-board an officer's ship. The study relied on a variety of analytical techniques, including a literature review of CBT and OJT training, interviews and focus groups with junior and senior surface warfare officers, and statistical analysis of test scores at the Surface Officer Division Officer Course (SWOSDOC). The literature review pointed out that no previous studies had analyzed a learning course that involved CBT when the student was also performing a full-time job. Nonetheless, the literature review noted that structured OJT is preferred to unstructured OJT, as in SWOS-at-Sea. Interviews also indicated that division officers prefer face-to-face learning and they felt they were trying to perform as division officers without the requisite skills. The statistical analysis of test scores at the SWOSDOC 'leveling' course found significant differences in performance between ship type, ship home port location, commissioning source, undergraduate major, and gender. The results highlighted significant differences in the learning environments aboard ships and suggested the need for additional research on training opportunities offered aboard ships.

Keywords: Surface Warfare, Officers, training

THIS PAGE INTENTIONALLY LEFT BLANK

NPS-GSBPP-09-025

NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

An Assessment of the Effectiveness of Computer-based Training for Newly Commissioned Surface Warfare Division Officers

24 August 2009

by

Dr. William R. Bowman, Professor

Alice M. Crawford, Senior Lecturer

Dr. Stephen Mehay, Professor

With the assistance of Carol Stoker and Robert Paynter

Naval Postgraduate School

THIS PAGE INTENTIONALLY LEFT BLANK

Table of Contents

Executive Summary

For many years, newly commissioned Surface Warfare Officers (SWOs) in the Navy were trained at the Surface Warfare Officer School Division Officer Course (SWOSDOC), after which they reported to their first ship assignment. In January 2003, that training was replaced by what is called SWOS-at-Sea Training, which combines computer-based training (CBT) with on-the-job training (OJT) conducted onboard an officer's first ship. Once the Officer of the Deck Underway (OOD-U/W) qualification is achieved, officers report to SWOSDOC for a 3-week course of instruction for "leveling" (i.e., to bring everyone to the same level of knowledge). Feedback suggests that the new program may not be working as well as intended.

The purpose of this research was to identify: (1) the parameters of effective CBT and OJT and how those compare to the implementation of the SWOS-at-Sea training; (2) how stakeholders perceive the effectiveness of the SWOS-at-Sea training; (3) how effectively junior officers are learning from CBT; (4) what measurable factors (e.g., gender, commissioning source, and ship type) are predictors of training effectiveness; and (5) the extent to which leveling actually occurs by the end of the 3-week SWOSDOC course of instruction. The study uses several methods of analysis: literature was reviewed; interviews and focus groups were conducted; and data on performance on a pretest (administered by SWOSDOC to 12 classes, a total of 733 students) was analyzed.

The literature review shows that the Navy, like other organizations, has a history of converting traditional classroom training to various forms of mediated instruction, including CBT, to reduce costs and provide learning at any time and any place. Yet, many prior studies have questioned whether using CBT is associated with a reduction in the quality of instruction. The multitude of factors that affect quality and, in many cases, inadequate metrics make it difficult for analysts to make definitive statements about the transfer of learning that one can expect from CBT.

For the most part, students prefer face-to-face learning to mediated instruction, with "blended solutions" (a combination of the two) as a second choice. The parameters of effective CBT, as identified in the literature, were not present consistently in the SWOS-at-Sea training. For example, interactivity, collaboration, and a supportive learning community are related to higher satisfaction and achievement, but interviews with SWOs showed that they did not find the CBT engaging, interactive, or interesting. "Death by PowerPoint" was a common complaint.

Many of the elements in the original design of the SWOS-at-Sea training were not implemented as intended. For example, there was inconsistency in mentoring and in accountability for those completing the CBT. Where ships' personnel were involved in the training through mentoring and other programs (e.g., weekly meetings at "SWO University" with the Commanding Officer), there was greater satisfaction. An interesting finding was that, contrary to expectations based on what the researchers know about Generation Y, the group interviewed did not like learning from a computer. They told us that computers are for work and games but not learning—they still want human contact.

It is particularly noteworthy that no studies were found that describe the effects of a distance learning course like the SWOS CBT that is mandated in addition to a student's full-time job, as opposed to during work hours or in a full-time learning mode.

The review of literature on OJT shows that many organizations depend on OJT for training to acquire or maintain skills, to reduce costs, and to effectively transfer training to job performance. The literature is quite clear on what constitutes effective OJT. In particular, structured (planned and systematic) OJT is preferred to unstructured OJT because it produces consistent training that ensures that training objectives are achieved. The SWOS at-Sea training represents unstructured OJT.

A last, but key, complaint heard in interviews was that the students felt frustrated, if not embarrassed, to be put in the position of running a division without the requisite skills and knowledge to do the job. Many felt that the training sends the message that they are not valued to the same extent as other unrestricted line officers, and this may affect their decision to stay in the Navy. Findings from the interviews for background and with six post-command Navy Captains confirmed what we heard from the students at SWOSDOC.

With respect to the analysis of the quantitative data on test scores at SWOSDOC, the general success of self-directed CBT paired with OJT (as measured by the pre-test administered at SWOSDOC) is found to vary significantly with respect to ship type and home port assignment. In addition, test scores varied with pre-commissioning factors such as commissioning source, quality of undergraduate college, and academic majors, as well as demographic characteristics—especially gender. The findings of the statistical analysis of test scores are summarized as follows:

1. Officers assigned to the primary line ships (cruisers, destroyers, and frigates, called CRUDES) are significantly less likely to pass the CBT module tests.
2. Those assigned to home ports on the Atlantic coast have significantly lower passing rates on the CBT tests than do others.
3. Naval Academy graduates had significantly lower passing rates than otherwise similar officers commissioned by NROTC and OCS.
4. The quality of one's undergraduate college—used to approximate academic ability—is directly related to performance on the CBT modules.
5. Graduates with technical majors have higher passing rates on the CBT tests than those with non-technical skills. However, it is important to keep in mind that the CBT modules do not capture all of the skills needed by junior officers to become successful Division Officers (DIVOs).
6. Women have significantly lower pass rates than men.
7. Few differences are found by ethnicity—with the exception of the scores on the Conning Officer Virtual Environment exam given toward the end of SWOSDOC; all minorities are less likely to pass this exam as compared to their majority counterparts.
8. Most, if not all, of the test score differences disappear when junior officers are given introductory training in a traditional classroom

environment. In other words, leveling occurs by the end of SWOSDOC.

In summary, the quantitative analysis in this study addresses personal achievement on initial junior officer tests and exams, which are related to the technical skill competency of Division Officers. The researchers uncovered achievement differences on the tests at SWOSDOC that are related to pre-commissioning factors as well as to the environments aboard ships and home ports. Such variations may possibly be indicative of a larger issue related to the early training opportunities of junior officers in the surface navy. To the extent this is true, it is in the best interest of the community to investigate in more depth why training environments for junior officers differ to the degree that has been found in this study.

The study recommends that future studies investigate the source of differences in test score performance at SWOSDOC based on ship type and home port. In addition, test score differences based on academic background (technical degree) and commissioning source are worthy of further analysis. Finally, it is especially important that future research be directed at determining why females and minorities appear to perform worse on the initial tests at SWOSDOC leveling school. It is highly recommended that additional resources be devoted to a better understanding of learning and training opportunities aboard ships before decisions are made regarding how training will be divided between classroom and self-paced CBT aboard ships.

I. Introduction

In January 2003, the Navy implemented a new training program for the Surface Warfare Officer's School Division Officer Course (SWOSDOC). Prior to January 2003, newly commissioned officers reported to the Surface Warfare Officer School (SWOS) in Newport, Rhode Island, to complete SWOSDOC. The initial training course equipped junior officers with the fundamental knowledge necessary to function as a division officer (DIVO) and to qualify as a Surface Warfare Officer (SWO). The format consisted of six months of classroom-style training. Upon graduation, the officer reported to his or her ship to complete the initial SWO qualification process through further on-the-job training. The entire qualification process took approximately 24 months from the beginning of SWOSDOC to final qualification by the ship's Commanding Officer (CO).

Under the new training process, newly commissioned officers report directly to their ships and individually complete the training onboard the ship.[1] The new training program consists of two distinct curricula. The Navy repackaged the classroom-style training of SWOSDOC into a computer-based training (CBT) format (SWOS-at-Sea 2.0), combined with on-the-job training (OJT) collectively referred to as SWOS-at-Sea training. Upon completion of the SWOS-at-Sea training and of qualifying as Officer-of-the-Deck Underway (OOD U/W), junior officers report to the Surface Warfare Officer's School (SWOS), where they complete the second curriculum—a 3-week resident course that provides advanced proficiency training designed to complement the at-sea program of study.

---

[1] The literature uses the following terms synonymously: Computer-based Training (CBT), Computer-based Instruction (CBI), Computer-assisted-Training (CAT) and Computer-assisted Instruction (CAI). This study uses CBT unless quoting from a study that uses one of the synonymous terms. In that case, the appropriate term is used. Further, there is a distinction between CBT and E-learning (sometimes called Web-learning), as the latter specifically takes place over a network or internet connection. Nevertheless, E-learning and CBT are both computer-based.

The Navy's reasons for changing the training program were to speed the time necessary to achieve the Surface Warfare Qualification and to reduce overall training costs of surface warfare officers. As predicted, the time to qualify as a surface officer has fallen from roughly 24 to 16 months (Rowden, 2008; Surface Warfare Enterprise, 2007). Nonetheless, some observers began to doubt the efficacy of sending all newly commissioned officers to sea without first giving them better training in the fundamentals of being a division officer. This concern was summarized by the comments of a junior officer in a US Naval Institute on-line publication:

> What NETC may fail to recognize, however, is the quality of the division officer they're now producing—one who lacks baseline knowledge when first reporting onboard and must struggle to qualify through a process of trial, error and failure, while being forced to sit in front of a computer for hours on end. The fact is, the current training program is ineffective and wasteful. Shipboard life is not conducive to completing a program like the "SWOS-in-a-Box," and the follow-on 3-week finishing school is, quite simply, a paid vacation. (Shovlin, 2008, p. 1)

The primary goal of this research is to investigate how well the re-engineered SWOS-at-Sea training is preparing junior officers for Surface Warfare Officer (SWO) Qualification and their jobs as division officers. The research will examine how well junior officer SWO candidates are learning from the computer-based approach. The research is grounded on the overall goal of Navy SWO division officer training, namely to effectively prepare prospective junior officers for SWO qualification.

The study attempts to answer several questions:

1. What does a review of the literature tell us about the parameters of effective CBT and OJT, and how the actual implementation of the SWOS-at-Sea training compare to the ideal program?

2. How do stakeholders perceive the effectiveness of the SWOS-at-Sea training?

3. How effectively are junior officers learning from CBT? SWOS administers a pretest derived from the SWOS-at-Sea training to students arriving at the SWOSDOC. The purpose of this test is to establish a baseline for a student's comprehension level, as well as to

indicate the effectiveness of the at-sea curriculum (Rowden, 2008). This study evaluates students' performance on this test.

4. What measurable factors affect training effectiveness, as measured by student performance on the pretest administered by SWOS? The study investigates the effect of several factors (e.g., ship type and commissioning source) on student performance. This information is valuable as it provides a broader picture of the SWOS-at-Sea training beyond time-to-qualify and costs. SWOS provided the researchers with the dataset that contains information for 12 SWOSDOC classes, comprised of 733 students. Analysis of the data includes descriptive and inferential statistical methods. Descriptive statistics present a detailed analysis of the variables included in the dataset, while the multivariate models identify important determinants of test score performance.

5. To what extent does leveling occur by the end of the 3-week SWOSDOC course of instruction?

THIS PAGE INTENTIONALLY LEFT BLANK

II. Background

A. Surface Warfare Officer (SWO) Qualification and Designation

OPNAV Instruction 1412.2H, updated in May 2002, standardized requirements and standards for the SWO qualification process. The instruction states that all officers must meet the following requirements:

- Be assigned to permanent duty aboard a surface ship as a commissioned officer for a minimum of nine months;
- Complete the applicable *PQS*;
- Qualify and "serve successfully" as:
    - In-port Officer of the Deck
    - Combat Information Center Watch Officer or Surface Watch Officer
    - Underway Officer of the Deck
- Demonstrate effective leadership skills and proficiency in performing division officer duties;
- Complete all of the above within the first 18 months of shipboard service unless granted an extension of time authorized for up to 6 months, unless special circumstances dictate otherwise. (Balisle, 2002, p. 3)

The instruction was amended in December 2002, which added that all SWO candidates must complete the two-part SWOSDOC curriculum, including the SWOS-at-Sea component and the SWOSDOC 3-week resident course (LaFleur, 2002, December 29). The Surface Warfare Directorate (N76), Commander Naval Surface Force, US Atlantic Fleet, sent another message on December 16, 2003, to reemphasize the importance for junior officers to achieve their initial SWO qualification: "Completion of Surface Warfare Qualification is the critical component of the first division officer tour" (Surface Warfare Directorate, 2003, December 16, para. 3).

B. *Personnel Qualification Standard (PQS)*

The *PQS* defines the minimum level of competency that an individual must demonstrate to attain a particular position or duty qualification. It is based on a collection of knowledge that demonstrates skills required to ensure “safety, security and proper operation of a ship, aircraft or support system” (Naval Education and Training Command, 2004, p. 7). The SWO *PQS* consists of three sections: fundamentals, systems and watch stations. The CBT helps SWO candidates understand the fundamentals and ship systems, while their service on watch stations represents the application of acquired knowledge. While the *PQS* outlines the specific areas in which a SWO candidate requires competency, the ultimate approving authority is the ship’s CO; thus, a SWO candidate must demonstrate a proficiency that satisfies the CO (Naval Education and Training Command, 2004).

C. Ship Instruction

Each ship issues its own instruction to detail the SWO qualification process for that specific ship. The ship instruction more precisely defines the duties and responsibilities of both supervisors and SWO candidates. For example, SWOS recommends that each new junior officer be assigned both a Department Head and a technical mentor. SWOS also recommends that a ship utilize the instruction to provide specific accountability on the part of the junior officer for CBT completion. Lastly, the instruction is designed to aid in ensuring a process for consistent communication between JOs and their supervisors. However, the ship’s CO ultimately decides what particular instructions to promulgate.

D. *Training Requirements Document* (*TRD*)

The Surface Warfare Director publishes the *Training Requirements Document (TRD),* which defines the core competencies necessary to be an officer at sea. This document encompasses both Navy requirements and International Maritime requirements as specified in the *Standards of Training, Certification and Watchkeeping* (STCW) published by the International Convention of STWC in July 1995. This document outlines minimum qualifications necessary to safely operate a vessel at sea. The focus of the *TRD* is navigation, seamanship and shiphandling. Specifically, it places the SWOSDOC in the context of the Navy SWO training continuum, which is shown below in Figure 1.

COURSE / CAPABILITY / CERTIFICATION	LOCATION/DESCRIPTION	SPECIFICALLY REQUIRED BY STCW?
	Primary NSS COIs	
SWOS Division Officer (A-4H-0154)	Shipboard & Newport, RI	N
SWOS Department Head (A-4H-0107)	Newport, RI	N
PXO (A-4H-0112)	Newport, RI	N
PCO (A-4H-0111)	Newport, RI	N
Navigator Course (CIN - TBD)	Newport, RI & designated Fleet Concentration Areas (FCA)	N
ECDIS-N (A-061-0030)	Shipboard, Newport, RI & designated Fleet Concentration Areas (FCA)	N
	NSS Modules in Primary COIs	
Radar Navigation / Advanced Radar Plotting Aid (ARPA)	Shipboard, Newport, RI & designated Fleet Concentration Areas (FCA)	Y
Basic Safety Training (BST)	Shipboard & Newport, RI	Y
	NSS Trainer Capabilities	
Bridge Resource Management (BRM)	Shipboard, Newport, RI & designated Fleet Concentration Areas (FCA)	Y
VR Shiphandling Trainer	Shipboard, Newport, RI & designated Fleet Concentration Areas (FCA)	N
	Certifications / Endorsements	
Platform Endorsement (P.E.)	Shipboard - PQS Based	N
Rules of the Road Examination	Shipboard & Newport, RI	Y

LEGEND

	NEW COURSE/ PQS or MAJOR COURSE REVISION
	EXISTING COURSE / MINOR REVISION NECESSARY
	EXISTING COURSE OR TRAINER
	EXPANDED TRAINER/TRAINING CAPABILITY REQUIRED
	NEW TRAINER / TRAINING CAPABILITY REQUIRED

Figure 1. SWO Training and Course Requirements
(Surface Warfare Directorate, 2002, June 15, pp. 3-4)

The Navy identified two drawbacks to the old training regime. First, it was inefficient in that, with a 24-month qualification process, junior officers earned their qualification at the end of their initial sea tour. As a result, the ship received very little productive work from the officer (in terms of contributions to the ship's mission). It was estimated that officers completing the revised curriculum would receive their qualification about 12 months earlier than under the previous qualification process

(Goodwin, 2003, February 14, p. 2-2-2). A shorter time-to-qualify meant that a junior officer could begin to be productive sooner and that the Navy could begin to earn a return on its training investment earlier.

An additional drawback to the previous training approach was the cost. The Navy incurred two moving costs for a new Ensign: the first was the move from his or her commissioning source to the SWOSDOC; the second was the move from SWOSDOC to his or her first duty station. According to the DoN FY2009 Budget, the Navy spent over $809 million for officer permanent-change-of-station (PCS) travel in FY2007 (Office of the Secretary of Defense, 2007, p. 113). The cost per officer was approximately $4,616 (based on 175,270 officer moves for FY 2007). SWOSDOC had an annual throughput of 902 officers in FY 2007. Under the old training regime, there would have been a second PCS move for 902 officers—costing the Navy an additional $4.1 million annually.[2]

Moreover, the cost of operating the SWOSDOC schoolhouse was a consideration. Gavino (2002) indicates that, based on Naval Education and Training Professional Development and Technology Center (NETPDTC) data, operations and personnel costs were $28,634 per graduate in FY2001 (p. 20). Thus, the cost of operating the schoolhouse under the traditional training method was in excess of $24 million for FY 2001. Accounting for inflation, the cost of operating the SWOSDOC schoolhouse in 2007 would have been $28.75 million (using inflation rate of 15% (US Bureau of Labor Statistics, 2008) under the old training regime. The actual cost of SWOSDOC for the “leveling school” in FY 2007 was $3,260 per graduate, or about $2.9 million. While it is beyond the scope of this study to perform a full cost-effectiveness analysis, these preliminary estimates indicate that the Navy is saving about $29 million annually in PCS and direct SWOSDOC operation costs under the new training regime. However, these cost savings must be balanced

[2] This amount is based on a calculation of an annual throughput of 902 SWOSDOC students multiplied by a per officer PCS move cost of $4,616.

against the true learning curve of Junior Officers (JOs), their on-the-job productivity, the cost of the CBT and the true cost of shipboard on-the-job training.

1. The New Curriculum

By design, the CBT equips the student with a strong foundation in shipboard operations. It consists of six compact discs (CDs) comprised of 20 modules under four main sections: division officer fundamentals; navigation, seamanship and ship handling; combat systems/maritime warfare; and engineering. Each section begins with an overview and related *PQS* items. The student reads the appropriate material within each module, and then must accomplish a practicum and practical problem that applies systems theory to the individual's ship. The student completes a module test and receives a percentage score; 80% is required to pass. If the student does not pass, further review is required, followed by a retake of the exam. Once he or she has passed the module test, the trainee learns to apply the learned principles in a "real world" context with a case study. The process is repeated for each module. Figure 2 describes the training sequence of the SWOS-at-Sea training.

It is important to note that the SWOS-at-Sea training was designed to be completed by new Ensigns working outside of their other duties onboard their ships, but within a structured training time during the work day. The design also relied on mentorship as a key element of the success of the program, with goal setting for program progression and regular meetings to assess progress and make adjustments to the Individual Training Program. This aspect, along with an assumption that the CBT would be paired with unstructured/unplanned but adequate on-the-job training, represented a reasonable design for the training. By definition, learning in one's place of work, with access to the equipment and systems that will actually be used on the job, should lead to good transfer of learning between training and job performance. However, the present research shows that the design was not fully implemented as intended—which, in turn, led to inadequate preparation of the Ensigns for their duties as Division Officers, frustration for the Ensigns and others in their chain of command, and less knowledge than intended when they reported to SWOSDOC. These findings are discussed further in Chapters IV and V.

One other element of the program that impacts the results found in this study is the quality of the CBT. A review of the modules shows the following:

- The descriptive sections are very dry with no video or opportunity for user interaction to keep students engaged. They are very much like reading a handbook; definitions are provided, visuals are static and include organizational charts, pictures of equipment, equipment labels, etc.

- Practical problems may include case studies, which offer the opportunity to see learning applications. However, the real value of case studies is their use in a collaborative setting where students can work together (and ideally with instructor collaboration) to jointly solve problems and create new knowledge. The extent to which individual ships created opportunities for collaborative learning is not known but is discussed further in Chapter IV.

- Practicums direct students to perform some activity or make some observation. The extent to which there is this correspondence between the CBT and OJT is not known (but is also discussed in Chapter IV), and forms of interactivity that are necessary to keep students engaged—other than multiple choice questions at the end of modules—are not part of the program.

As will be shown in Chapter III, a large body of literature in the area of CBT demonstrates that these characteristics of the CBT are predictive of less-than-optimal learning.

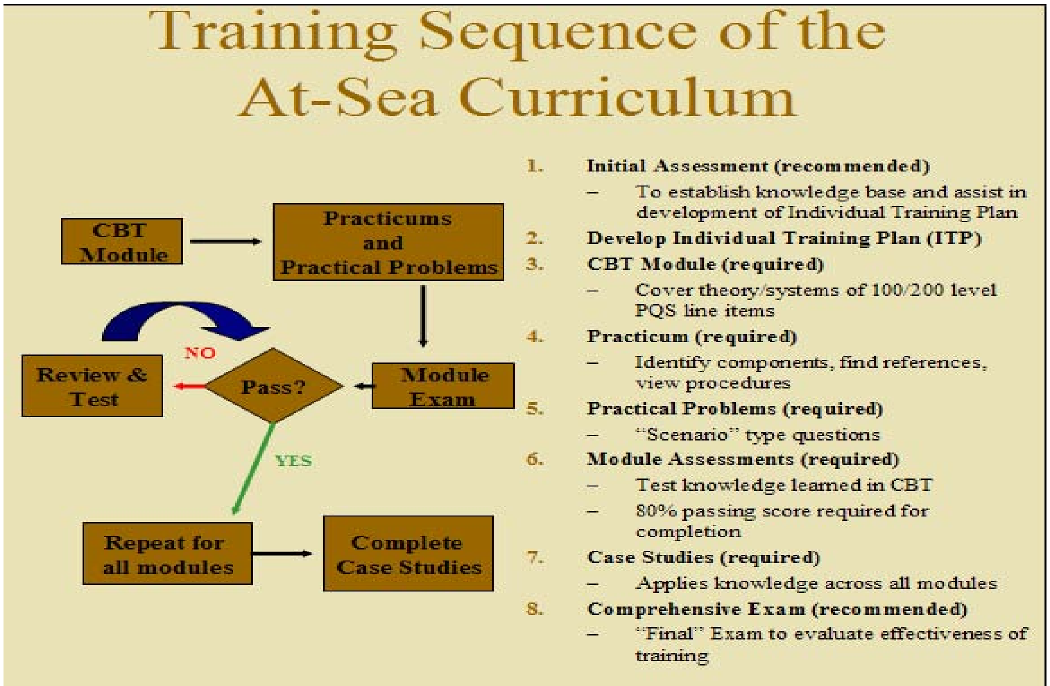


Figure 2. Training Sequence of the SWOS-at-Sea Training
(Division Officer Training Department, 2005a, May 12)

Upon completion of all modules and satisfactory completion of the applicable *PQS*, the CO grants the junior officer qualification as OOD U/W. Unlike the previous curriculum, the junior officer is not granted full SWO qualification; the JO must still complete the 3-week resident course at SWOSDOC before achieving full qualification.

The Navy based the 3-week SWOSDOC course on the ship's wardroom concept. It brings together a cadre of officers to interact and learn from one another. SWOS groups students into wardrooms of 10 to 12 officers based on strengths and weaknesses to "level the field." The curriculum is based on six modules: damage control, force protection, maritime warfare, leadership, navigation, seamanship and engineering. The material is presented in a variety of formats, including classroom presentations, "hands-on" enactments, scenario training and simulators.

SWOS administers four formal exams to students. The initial exam is a four-part pretest derived from the four main sections of the SWOS-at-sea CBT that assesses students' knowledge. The second test encompasses Coast Guard navigational rules—referred to as the "rules of the road." These rules cover inland and international navigational requirements as enforced by law. The third test the SWOS administers covers tactical thought in areas of maritime warfare. Lastly, SWOS instructors observe and rate each student's ship handling ability in the Conning Officer Virtual Environment (COVE) simulator. The SWOS records these scores and sends a copy to the CO of a student's ship.

After completing SWOSDOC, the student returns to his or her ship, where training concludes with an appearance before a SWO qualification board. Usually, the board convenes within one to two months after the officer's return to the ship. Like the previous training program, senior, qualified SWOs—as well as the ship's CO—comprise the board. The board reviews the student's qualifications and tests his or her knowledge. As in the previous SWO qualification process, if the board finds the junior officer satisfactory, the CO grants qualification as a SWO, and the officer dons the coveted SWO "pin."

Two years into the new training régime, concerns began to surface that the self-directed training may not be working as expected when the DIVOs were formally tested at the beginning of a 3-week SWOSDOC "leveling" school in Newport. It was discovered that less than 3/4 of reporting DIVOs scored a passing grade on the self-directed tests (i.e., based on at least 75% correct on selected questions from the DIVO Fundamentals Modular Tests). Since that time, all scores on these tests are reported back to the CO of the junior officer's ship to raise accountability for these self-directed training modules.

The purpose of this research is to analyze how well the reengineered SWOS-at-Sea training is preparing junior officers for Surface Warfare Officer (SWO) Qualification and their jobs as division officers. The research examines how well junior officer SWO candidates are learning from the CBT and OJT. We adopted several methods for the assessment, including interviews, focus groups, and statistical analyses of test scores of junior officers at SWOSDOC.

III. Literature Review

A large body of research literature exists for both computer-based training (CBT) and on-the-job training (OJT), which are the key components of the SWOS-at-Sea training program. A review of some of the most relevant studies is presented here as a foundation for the results of the analysis of the present research.

A. Kirkpatrick's Evaluation Model

The standard technique used to evaluate training programs has been based on Kirkpatrick's classic, four-level evaluation taxonomy (Kirkpatrick, 1998). The taxonomy proposes four levels, or steps, in evaluating a training initiative: (1) reaction; (2) learning; (3) behavior; and (4) business results (job applications). Phillips (1997) added a fifth level of evaluation: return on training investment. These five levels involve the following elements and evaluation instruments:

1. **Reaction**—How do the participants feel about the training program? Did they like it? This element is often measured via surveys.
2. **Learning**—What did the training participants learn? Did they acquire new knowledge, skills, or attitudes? This element is often measured via tests.
3. **Behavior**—Did the participants change their behavior on-the-job? Did they transfer the learning to the job?
4. **Results**—Are there any impacts on the individual's or organization's performance? For example, have sales or productivity improved?
5. **Return on Investment**—Do the financial benefits of the improved productivity (or sales, for example) exceed the costs of the training program?

This scheme will be used below to assess the literature on CBT and on-the-job training programs.

B. Computer-based Training

A review of the literature shows that studies of CBT are found under the category of Distance Education (DE), which has evolved significantly in the past twenty years. The literature differentiates between synchronous learning (generally defined as two-way, simultaneous, "live" communication) and asynchronous learning, with which there is no direct, "live" communication between the student and instructor. DE can include any learning with separation of learner and instructor (place and/or time) during learning events, which may include a range of media from correspondence courses to highly interactive web-based applications. In fact, CBT is now an older technology as the most current generation of DE includes more interactive courses due to technological advances and more blended approaches that capture the advantages of both mediated instruction and traditional face-to-face instruction.

Computer-based training and other forms of mediated instruction have been used by the military and other organizations for many years. The Navy, for example, received multi-year funding from the Defense Advanced Research Projects Agency to evaluate the use of CBT for Navy training (Hurlock & Slough, 1976) over 30 years ago. Then and now, the military and others continue to seek opportunities to convert traditional classroom education to mediated instruction in order to save costs. Many of these applications, if not most, use mediated instruction away from schools—either at centralized locations or on the job. These applications allow the organization to avoid travel costs (Corporate Leadership Council, 2004; 2005) or even, in the case of some military applications, to avoid permanent change of station costs as with the SWOS-at-Sea Training.

Another frequently-cited advantage of CBT is standardization of training materials, although one study from the Army Research Institute finds that when a population is diverse and people may lack common knowledge (as in the military), training needs to be more tailored. Giving the same training to all students is not the most effective approach (Dyer, Singh, Harnam & Clark, 2005).

Yet another advantage of CBT mentioned in the literature is the ability to learn around the clock. However, Mackay & Stockport (2006) point out that high operational tempo makes finding time to train and educate difficult.

Research on Navy CBT has historically focused primarily on enlisted personnel and A-School applications. The Center for Naval Analysis (CNA) recently evaluated CBT modules for Electronics Technicians, Fire Controlmen, and Yeomen and found reductions in training time, no impact on later success at C-School, and that self-paced instruction can increase student failures. In this configuration, the CBT was conducted in school with instructors available to answer questions and monitor progress. CNA concluded that CBT may not be appropriate for high-risk-of-mission-failure jobs (Carey, Reese, Lopez, Shuford & Wills, 2007).

In spite of potential cost savings and many successful applications, the results of learning from CBT have been mixed. Over the years, many researchers have questioned the balance of costs saved versus the concern for a decrement in the quality of the instruction as compared to traditional face-to-face learning.

The literature generally reflects measures of knowledge outcomes based on test scores and measures of student satisfaction from surveys taken by students immediately after completing the course. However, little is revealed in the literature concerning changes in actual work behavior/job performance or about subsequent student evaluation of the actual training results after a longer period of time has passed (Strother, 2002; Hui, Hu, Clark, Tam & Milton, 2007), likely because these things are much more difficult to measure.

A study of Marine Corps training shows a typical finding: DE students may do as well on grades and test scores as their traditional classroom counterparts; some learners may like DE, but prefer face-to-face contact; and transfer of student knowledge into behavior and impact on the organization is not always supported (Blevins, Jones & Monroe, 2003). However, the results are mixed, as noted, and this inconsistency of data is often due to a large number of factors that can vary in CBT applications (Strother, 2002).

A study of a DE application of Professional Military Education that sums up some of the critical issues was conducted by the Government Accountability Office (GAO, 2004). The study concludes that the DoD has not developed a way to properly evaluate the effectiveness of the conversion of school-house materials to DE applications; the Department's belief that its results have been positive are anecdotal versus metrics-based; it has not used systematic criteria to decide which courses to convert to DE—this is done subjectively; processes for conversion of materials are non-standard; and, finally, that these problems are seen in the private sector as well.

Factors such as those described above confound conclusions that can be drawn about the effectiveness of DE and make it difficult to predict the success of a given CBT application. However, those themes that show consistency across many studies are described here to provide a context to help explain the results of this analysis of the SWOS-at-Sea training program.

1. Student Satisfaction

Studies of satisfaction with CBT typically address two things: whether or not students like it in comparison to traditional classroom instruction, and their impressions of the quality of CBT.

In a review of e-learning in the corporate sector, Strother (2002) finds mixed results, but concludes that a majority of e-learners preferred classroom training over e-learning. Anderson (2003) sites data from a meta-analysis that also shows that distance learners like DE but prefer face-to-face contact.

O'Malley (1999), in his study of undergraduate business students, found that they did not perceive that DL is as effective as traditional learning and did not want to take more DL courses. They also did not believe they learn more in online courses and have concerns about being able to contribute to class discussions. They perceive online advantages to be time savings, scheduling flexibility, and ability to take more courses. Students generally prefer traditional courses to online courses.

Similarly, a GAO survey in 2004 found that nearly half of distance learning students in a Professional Military Education course believe they are not as well prepared as the resident student counterparts; they were are concerned about the quality of their courses as compared to those taken in residence.

Many reasons are recorded in the literature as to why students are less satisfied with CBT than with traditional classroom instruction, but they seem to center on less engagement with CBT (often due to less interactivity and collaboration, which are discussed below) and, therefore, less motivation. Holden and Westfall (2006)—in their guide for medial selection for distance learning—discuss the strengths and weaknesses of each form of instructional delivery media. For example, weaknesses of CBT include students' inability to interact with the instructor by asking questions and, "Research has shown that reading large amounts of text on a computer screen results in a reduction of comprehension and speed when compared to print. Often used as a self-study medium, students may feel isolated and unmotivated to complete training" (2006, p. 23)

One factor shown to moderate this general lack of satisfaction with CBT as compared to classroom instruction is self-selection for CBT. Yatrakis and Simon (2002) showed that students who chose to take an online course were more satisfied, and they perceived that they retained more information than did the students who were not given the choice. However, there was little difference in the grades of the two groups. This implies that student choice increases student satisfaction and perception of information retention, but seems to make no difference on actual learning outcomes (based on grades). What is not addressed here is the list of other consequences of low satisfaction such as dissatisfaction with the organization sponsoring the CBT and subsequent attrition. Bernard et al. (2004), for example, in their analysis of 232 studies, found a higher dropout rate among students who worked in asynchronous CBT (individually) as compared to students working synchronously and linked to a classroom via videoteleconfrencing. While their studies lacked attitude data from the attrites, the authors concluded that the lower retention rate might be a result of the group affiliation and social pressure of the classroom-linked environment. The effects of collaboration are discussed later in this chapter.

There are other factors, too, that may affect satisfaction with CBT. Results of a meta-analysis by Allen et al. (2004) suggest that learning style plays a role here, too. These authors note that some students may learn better in a social mode, but other students learn better in a solitary setting; in addition, changing from face-to-face learning to computer-mediated communication can affect the group outcomes. A related characteristic of some learners is introversion, which Abell (2002), in her study of Army DE, suggests is more compatible with CBT than extroversion. This researcher also finds that soldiers perform better with CBT when they know why learning is necessary, can direct their own learning, and can apply what they have learned to real-world problems (Abell, 2002).

One individual characteristic that has been discussed formally and informally by many in Navy leadership is the generational variable. Because Generation Y—those born between approximately 1982 and 1994—grew up with computers, many assume that students from this generation will be very comfortable with e-learning. Further, Abell (2000), states that students from both Generation X (born between 1965 and 1981) and Generation Y are inclined to learn independently but adds that they like fast-paced, frequent feedback and visually intensive interaction. Interactivity in CBT is discussed next.

2. Interactivity

Interactivity in learning—any kind of learning, synchronous or asynchronous—is perhaps the most frequently mentioned factor in research on effectiveness of DE. CBT applications range from rigid text combined with drill and practice to highly interactive programs with tailored feedback, video and audio components, ability to e-mail the instructor with questions, etc. The latter are, of course most costly. Ultimately, the highest level of interactivity can only be found in “blended solutions,” in which CBT is accompanied by the presence of an instructor or mentor and built-in opportunities for teamwork, collaboration among peers and instructors, problem-solving discussions, and hypothesis testing.

From an instructional point of view in CBT, there is no possibility for adapting teaching strategies to students who are having difficulties. From the student's point of view, non- or minimally-interactive CBT may simply be passive and boring (MacKay & Stockpart, 2006).

The work of Bernard et al. (2004)—based on a meta-analysis of 232 studies of both synchronous and asynchnchronous DE using weighted multiple regressions to identify strength of predictors with respect to achievement, attitudes, and retention—concluded that DE should incorporate problem-based learning (learning material that fosters student engagement, deep processing and understanding) and communication/interactivity (among learners and/or with instructors; either face-to-face or through mediation). The need for student-teacher, student-student, and student-content interaction in DE courses is discussed in detail by Anderson (2003).

3. Not All Content is Appropriate for CBT

An issue discussed by critics for many years with little resolution is the question of whether certain types of learning are more suited for different types of instruction. For example, Gagne's classic model of "Principals of Instructional Design" (Gagne, Briggs & Wagner, 1992) categorizes different types of learning and shows that different types of learning events are required for each. For example, the events/instruction required for learning a new attitude are very different from learning a procedural skill. Similarly, Hui et al. (2007) examined this issue with respect to DE language learning and concluded that there were types of learning better suited for DE than for traditional classroom instruction and visa versa.

This fact has long been recognized by members of the training and education community. Attempts have been made for many years by organizations, including the Navy, to develop media-selection algorithms. Two recent efforts were conducted by Lee and Owens (2008) and by Holden and Westfall (2006). Such devices require experts to consider various aspects of instruction (e.g., content, the need for interactivity, students, cost, etc.) and to rate the importance of various factors to come up with a recommendation as to which medium is most appropriate. It is interesting to note that Holden and Westfall (2006) conclude that “finding the right medium-to-objective match will likely result in a blended media approach” (p. 29).

While there has been little resolution on exactly which types of skills are most appropriate for CBT and other forms of DE, there is general agreement that “soft” skills such as leadership training are not appropriately taught via DE (GAO, 2004; Hui et al., 2007; Anderson, 2003).

This aspect of the literature is mentioned to underscore the complexity of moving traditional classroom instruction to DE, and the depth of analysis—beyond cost factors—required before an organization implements CBT. Anderson (2003, p. 140) discusses how DE instruction choices are made without adequate knowledge. “For example, despite years of study, it is still unclear which students studying under what types of content under what conditions and using which instructional design benefit most from synchronous as opposed to asynchronous interaction.” He further notes that, “The search for single-faceted solutions that generalize to the many diverse contexts of distance education is likely a quixotic quest” (2003, p. 141).

4. Collaboration

Collaboration, also mentioned in the literature as a “learning community” is certainly related to interactivity and also frequently mentioned as important for effective DE. Hui et al. (2007), for example, define “learning community support as the extent to which a learning environment creates an active, strongly bonded community that encourages and facilitates knowledge exchanges among peers and their instructors” (p. 248). These researchers cite quantitative research that reports the positive effects of collaboration on learning experiences. (The research of Allen et al. (2004) discussed earlier implies that some students—introverts—may not require all of the benefits of a learning community. For example, they may require student-instructor but not student-student collaboration.)

In a survey of MBA students taking online courses, Peltier, Schibrowsky and Drago (2007) conclude that there are interdependent factors in online education. Student-to-student and student-to-instructor communication is critical to creating an effective learning environment. In addition, these researchers find that the instructor should create a learning community rather than a course in which each student operates independently of each other. And, in a study of e-learning in higher education, MacDonald and Thompson (2005) stress the importance in DE of collaboration, interactivity, and the concept of a supportive learning community.

Similarly, the Marine Corps is concerned with maintaining cohesion in a DE environment and sees that one way to meet that challenge is to provide mentoring. It feels that the shift from an instructor-centered to student-centered learning approach "must be balanced with a team training approach that is mentored and proctored by senior leaders" (Anderson, 2003, p. 651). This aspect of the literature review can be nicely summed up by a quote from Bernard et al. (2004, p. 38): "DE should not be a solitary experience as it was in the era of correspondence courses."

5. Blended Learning

The concept of blended learning has existed at least as long as two classic meta-analyses of CBT research (Kulik, 1991; Kulik, 1994). Both analyses support combining mediated instruction with classroom instruction. Kulik found that students typically learn more when classes are supplemented with computer-based tutoring. Usually conceived as online tools with live instructors (e.g., Zimmerman, 2001), blended learning is seen by a majority of critics as superior to CBT. Mackay and Stockport (2006) point out that e-learning and classroom instruction each have advantages and disadvantages, that no one method can directly replace the other, and that blended learning may offer benefits beyond what the other two methods alone can provide.

Sitzmann, Kraiger, Steward and Wisher (2006), in their meta-analysis of web-based learning studies (generally considered superior to CBT because of the greater capacity for interactivity), concluded that blended learning outperforms either web-based learning or classroom instruction alone with respect to learning, but trainees seem to prefer classroom instruction alone to blended learning.

6. A Final Consideration

An issue not addressed in this literature review should also be considered. Not surprisingly, no study described the effects of a distance learning course being mandated in addition to a student's full-time job/work hours, as compared to a distance learning course in which students are dedicated full-time to school during working hours. The time spent by students in the SWOS-at-Sea program, while concurrently performing jobs for which they had inadequate knowledge, may carry the most weight in explaining the results of the present study.

C. On-the-Job Training (OJT)—Estimating Return on Investment

While this study is concerned with CBT, OJT is another major component of the SWOSDOC curriculum and is conducted concurrently with CBT. Unlike CBT, OJT is not a new development for the SWOSDOC. In fact, OJT is one of the oldest recognized training processes. Thus, it is important to examine the characteristics of OJT as well as its cost, benefits, and challenges.

1. Return on Investments in OJT

Gay (1974) approached OJT from a labor economics perspective as an investment in human capital. He calculated the returns to OJT as a function of the value of marginal product over time. Figure 3 graphically illustrates this relationship, where "P" represents the end of training (i.e., the end of the investment period). The shaded area to the left of "P" is the undiscounted cost of OJT—consisting of the opportunity cost of lost production plus direct training costs. The shaded area to the right of "P" corresponds to the undiscounted returns to OJT ending at "Q" (the end of employment). For the organization to at least breakeven financially on its investment in training, the area of returns (undiscounted in this example) from time P to Q must equal or exceed the area of costs from time 0 to time P.

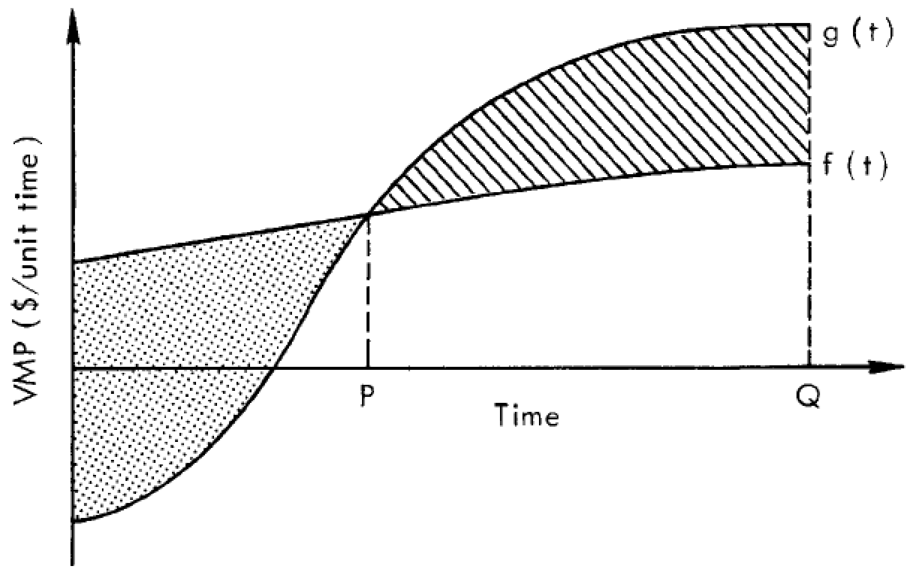


Figure 3. Returns to OJT
(Gay, 1974, p. 9)

One of the most challenging aspects to estimating return on investment (ROI) is estimating training costs. Numerous studies have examined the costs associated with OJT (Arzigian, 1967; Gay, 1974; Manacapilli, Bailey, Beighley, Bennett & Bower, 2007; Weiher & Horowitz, 1971). While the studies differ in their cost-estimation methodology, they all note the importance of foregone productivity of both supervisors and trainees. Since OJT takes place in the work environment, and since experienced workers conduct the training, their work productivity is reduced while they are engaged in training. Arzigian (1967) assumes that supervisors spend 5% of their time in OJT, thus calculating foregone production as pay multiplied by 5%. While one can argue the logic of this assumption, it does serve as an example of a method for including foregone production in OJT costs.

a. Total Costs Related to OJT

A more recent study by the RAND Corporation augmented Gay's model to include initial skill training (IST) costs in addition to OJT costs based on lost productivity (Manacapilli et al., 2007). The expanded model gives a broader picture of the total costs as a function of IST and OJT costs. The authors refer to the combined costs as total human capital development (HCD) costs (2007).

The researchers employed a four-step methodology. First, they collected relevant training data. Second, they conducted interviews and surveys with technical specialty supervisors to develop learning curves for each specialty. Third, the authors estimated the costs of manpower, instruments, facilities, and time. Last, the researchers developed cost-versus-productivity curves for each of the specialties.

The researchers developed the productivity curves from answers on a questionnaire distributed to E-6s and above in the Air Force. The answers provided information of how supervisors perceive the skill level of new workers when they complete IST and how their productivity increases with OJT. They further assessed how changing IST course length would affect overall training time and associated productivity. The authors combined their data to examine the impact of IST course length changes on total HCD costs. Specifically, the researchers examined the implications of shifting the combination of IST and OJT for specific Air Force enlisted occupations.

In particular, Manacapilli et al. were concerned with defining a fully productive airman. They used the survey questions to construct the definition of “fully productive.” They specifically asked supervisors to define a fully productive (i.e., mission capable) airman in each specialty. This information provided the baseline for measuring each airman’s productivity. Supervisors were also asked to define the time it took to reach full productivity.

The researchers used a composite pay function to derive the costs. They included basic pay, plus benefits. The authors did not consider PCS-related costs. The costs were divided into two categories: the cost of productive activity and the cost of HCD. OJT costs were derived from a simple calculation, “composite pay times 1 minus the productivity level[…] OJT cost is based on the cost of paying an individual’s salary for non-productive time” (Manacapilli et al., 2007, p. 53). The authors emphasized the importance of including all of the costs of OJT. During OJT, both the trainer and the trainee necessarily forego productivity. Trainees make mistakes as they learn, which can result in increased costs to fix those mistakes (e.g., additional training time, repairing of equipment).

The researchers constructed the learning curves based on the productivity index for each specialty. In other words, they measured the number of journeymen who could produce the same output as a given specialty's mix of journeymen and fully qualified airman (Manacapilli et al., 2007, p. 58). The total costs are divided by the total productivity to generate the cost of one unit of productivity. This is used to measure how a change in the length of IST would affect total HCD costs through productivity units.

The researchers concluded that shortening IST results in: increased OJT costs, reduced productivity, longer overall training time, a lower experience ratio, and decreased standardization (2007, p. 7). Seventy-one percent of the specialties tested would significantly increase productivity with a 10-day increase in IST time. Increased productivity results in decreased costs. For example, the researchers estimated that an increase in IST for the vehicle maintenance specialty would decrease the overall HCD cost by $12 million annually (p. 70). In addition, the authors found that OJT produces substantial costs: "An important implication is that future assessments of course length adjustments should explicitly consider effects on the extent and cost of OJT" (p. 71). Figure 4 graphically illustrates these conclusions.

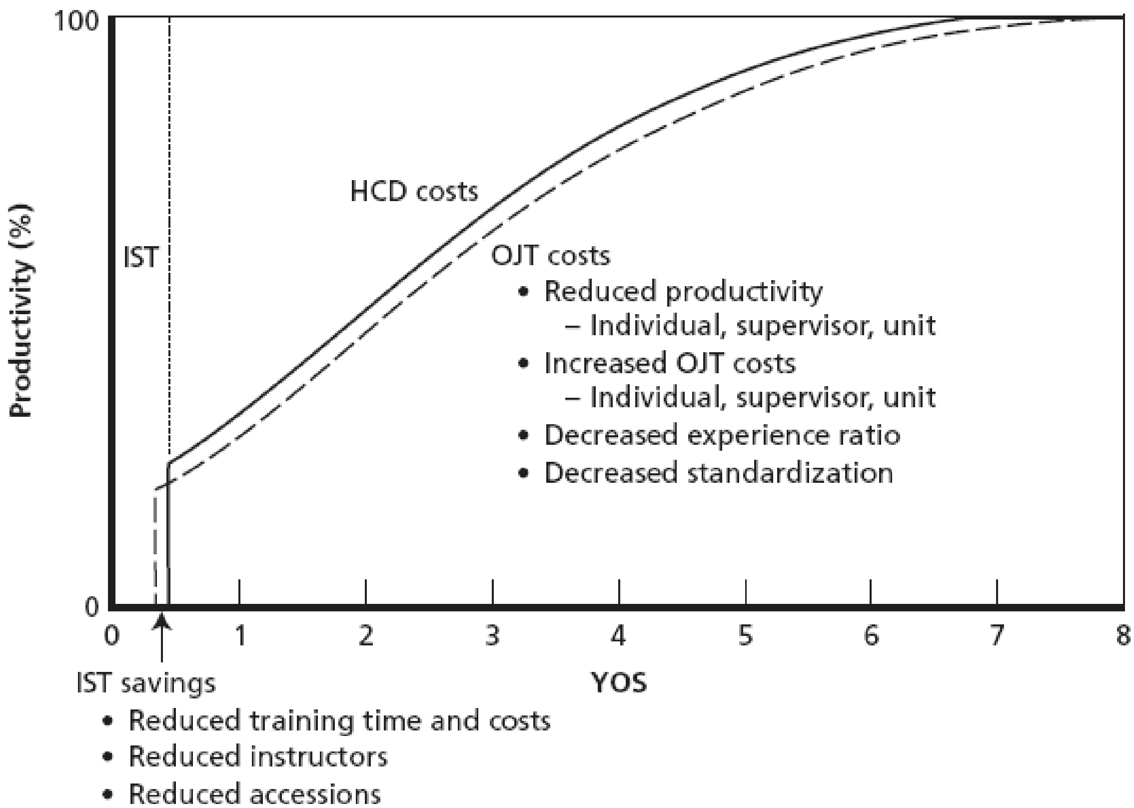


Figure 4. Effect of IST & OJT Costs on HCD Costs
(Manacapilli et al., 2007, p. 7)

The graph depicts a nominal HCD cost curve for a typical airman who first completes IST, then enters the workforce. In this example, the worker is 20% productive at the point of entry into the workplace. As the airman participates in OJT, he or she increases in productivity until eventually reaching 100% productivity (at about 6.5 years of service (YOS). In this case, the authors reduce the amount of time for IST, which results in a lower productivity upon entering the work force. The result is a longer required period of OJT to compensate for the shorter IST training period. In the example, OJT time is extended by approximately six months (to a total of 7 YOS). The longer training time results in increased OJT costs. Since OJT costs are a function of total HCD costs, the total cost of training increases. Conversely, lengthening the amount of time in IST results in an upward shift of the curve and less OJT time to reach 100% productivity; thus,total HCD costs are decreased.

This study is relevant to the SWOS training situation. The SWOSDOC combines IST and OJT such that they occur simultaneously. The results of this combination are uncertain. It requires more research to calculate the productivity lost during OJT, as well as during CBT study time. Early reports indicate that since the combination of IST (i.e., *Division Officer At-Sea Curriculum*) with OJT, total training time has decreased (Rowden, 2008; Surface Warfare Enterprise, 2007). However, the cost implications for OJT have not been fully understood or analyzed.

2. Challenges of OJT

On-the-job training (OJT) is defined as job-specific training conducted at the work site by a supervisor or an experienced employee using the equipment, tools, and processes of the job (Steinbach, 2004). It is considered the most common form of training, certainly in part because it offers good potential for achieving "transfer of training"—that is, applying knowledge, skills, and attitudes learned to the job (Kim, Lee & Jacobs, 2001). It is perceived as low-cost, high-return training (Sisson, 2001).

The literature differentiates between structured and unstructured OJT. Structured OJT is training that has been sufficiently thought-out and planned. (Jacobs, 2003). It is formal, not informal training. It is planned and delivered in a systematic manner, and outcomes and procedures are prescribed *(*DeJong, Thijssen & Versloot, 2001).

Vernon (1999) describes the key advantages of structured OJT as its ability to reliably and predictably achieve training objectives and its ability to help build team members.. Jacobs (2005) also finds that learners receive consistent training from structured OJT because of the actions taken before (preparation/planning), during (standard delivery), and after (ensuring learning has occurred) training.

Unstructured (unplanned) OJT is the traditional and most common form of OJT. A problem with this form of OJT is that the trainer may focus on completing the work at hand over conducting the training. Work provides the structure for the training. Hence, tasks might occur out of logical sequence, or unusual events might occur that impact training. Further, the instructor must rely on his/her job experience to do the training (Sisson, 2001).

In unstructured OJT, training content can be inaccurate, incomplete, or may represent an accumulation of bad habits or unsafe shortcuts on which workers have come to rely over time (Jacobs, 2005). Training can be inconsistent. Even experienced workers may use different and unequally effective methods each time they conduct the training, and trainers are typically selected for their technical knowledge, without consideration of their effectiveness as an instructor (Steinbach, 2004). For example, is the trainer a good communicator? Does the trainer know at what point to start the training? Does he break the job into appropriate processes/tasks? Does he establish quality standards? Does he have poor work habits? Does he select and schedule adequate time? Does he provide appropriate feedback? Instruction may not be a priority for the trainer in the context of his own work, and learners rarely, if ever, achieve the same training outcome (Jacobs, 2005).

Sisson (2001) concludes that traditional, unstructured OJT, overall, is inconsistent, inefficient and ineffective. He states that industry has learned that if organizations do not make a sufficient investment to ensure their OJT is planned and executed properly, it often may take on the form of unstructured OJT, which according to Sisson, may be the single most expensive training method available. And Jacobs (2005) takes the criticism further when he claims that "Studies have shown that unstructured OJT leads to increased error rates, lower productivity, and decreased training efficiency, compared to structured on-the-job training". He further states that "most uses of unstructured OJT are ineffective in achieving the training objectives, which inhibits the achievement of important organizational outcomes".

Another interesting aspect of the literature on OJT—because of its relevance to the SWOS-at-Sea training is a recommendation for integrating OJT with developing a Community of Learners or Community of Practice (CoP). The research stems from a body of knowledge on "Situated learning," which deals with the concept that”physical and social contexts in which an activity takes place are an integral part of the activity, and that the activity in turn is an integral part of the learning” (Stein, 2001). That is, social interaction between trainees and others are part of the learning experience. Stein adds, “Acquiring knowledge becomes a collaborative rather than an individual process with trainees and a work community contributing to the dialogue about the meaning of work situations. Through dialogue, learning is created” (p. 416). He implies that situated learning can enhance planned OJT. “Planned on-the-job training may come to mean planning opportunities on the job for trainees in a community to reflect on their job performance and, through discourse with others, construct specific and situational workplace knowledge” (p. 422).

Like any training program, OJT presents challenges. The biggest challenges are lack of formalization and feedback. If not carefully monitored, OJT can become “following Joe around” (Dertouzos, Lester & Sokow, 1989). This can be a challenge for SWOs. The operational tempo aboard ship is high. There are a number of activities and tasks to perform, and only so much can be accomplished in a 24-hour period. The ship’s CO places heavy demands on the ship’s leaders to sustain superior performance—the same leaders who are responsible for mentoring young SWOs. Under the pressure of these demands, OJT can quickly become a “just follow me,” or “just do what I do” exercise. Plainly, the quality of OJT can degrade to a mimicking exercise instead of a true learning experience. However, the ship’s senior leadership can combat this tendency with clear objectives and measures of effectiveness to ensure that training goals are accomplished.

Another challenge for OJT involves variability, which is evident in several facets of training. First, most of the supervisors tasked to provide the training have no formal training in instruction or adult learning. They must rely on their own individual experience. Secondly, certain supervisors may have very little motivation to train junior officers. Inexperience and low motivation can result in uneven training that can cause great variance in competency levels and performance (Mathis & Jackson, 2006). With OJT, leadership also runs the risk of assigning a sub-par performer or worker with bad habits to instruct trainees. In the case of the SWOSDOC, relatively inexperienced second-tour division officers often train SWO candidates. Potentially, this might affect the depth of training. In addition, low motivation of the supervisor may leave a junior officer to learn on his or her own.

One researcher (Jacobs, 2003) provides this illustrative example:

> When I first reported to the ship, a second tour DIVO lieutenant trained me. We became friends. I relied upon her to tell me what to do since I had very little training. She told me, “Just do this or do not do that. This is how I do this.” Eventually I learned what she wanted me to learn, but I soon discovered that I could learn just as well on my own. I am still not sure if I really learned what I am supposed to learn. Anyway, after a while, I just started figuring things out on my own. (p. 22)

It is incumbent on the ship’s leadership to emphasize the necessity of training and to monitor the training environment.

D. Summary of Literature Review

The Navy, like other organizations, has a history of converting traditional classroom training to various forms of mediated instruction, including CBT, to reduce and provide learning at any time and any place. Yet, many researchers have questioned whether using CBT decreases the quality of instruction. This question is difficult to answer because of the many variables that can impact outcomes and the difficulty in collecting measures of actual transfer of training to job performance. In fact, a GAO report criticizes the DoD for not developing adequate measures of effectiveness of distance education applications. Nonetheless, the literature review consistently reflects several themes that are relevant to the SWOS-at Sea training.

- Students are less satisfied and feel less prepared by CBT than face-to-face learning (except for those who self-select to take CBT).
- Interactivity, collaboration, and a supportive learning community in CBT are related to higher satisfaction and achievement. Students who must read large amounts of text on the screen are not motivated to complete training.

  - Successful CBT, in the Navy and elsewhere, pairs CBT with the availability of an instructor to answer questions.
  - A higher level of interactivity is found in "blended solutions," with which the CBT is accompanied by an instructor or mentor, opportunities for collaboration among peers and instructors, problem-solving discussions, and hypothesis testing.
  - Generation Y students generally like visually intensive interaction and fast-paced instruction with frequent feedback.
  - Attrition is higher for students in asynchronous (individual, not real-time) learning as compared to synchronous learning that combines CBT with access to instructors through videoteleconferencing.

- Not all instruction is equal and, therefore, it is not all equally applicable to conversion to CBT. The literature reflects a lack of systematic analysis and criteria for deciding which courses should be converted to CBT.
- Although standardization is an advantage of CBT, when a population is diverse, such as in the military, the training must be tailored.
- An advantage of CBT mentioned in the literature is the ability to learn around the clock. However, when learning on the job, high operational tempo makes finding time to train and educate difficult.
- Students perform better with CBT when they know why learning is necessary, can direct their own learning, and apply what they have learned to real-world problems.
- No studies were found describing the effects of a distance learning course that is mandated in addition to a student's full-time job—as opposed to during work hours or in a full-time learning mode—as is the case with the SWOS-at Sea training.

The Navy and most other organizations depend on OJT for training to acquire or maintain skills, to decrease costs, and because it presents the opportunity for good transfer of training to job performance. The literature is quite clear on what constitutes effective OJT:

- Structured (planned and systematic) OJT is preferred to unstructured OJT.

- Planned OJT produces consistent training that ensures training objectives are achieved.
- Unstructured OJT, the more common form, may be conducted by someone who is technically competent but not a good instructor.
- Opportunities for collaboration are an important aspect of OJT effectiveness.

These finding are related to the results of interviews conducted for this study described in Chapter IV and to the analysis of the quantitative data described in Chapter V.

IV. Interviews with SWOs

To assess the perceived effectiveness of the SWOS-at-Sea training, Interviews were conducted first to collect background information from four SWOs at NPS, six post-command SWOs (all Captains), and with officers on staff at SWOS. Subsequently, interviews were conducted with students attending SWOSDOC in May 2008. The goal of the interviews was to question as many students as possible in the time allotted about their experiences with the SWOSDOC training. A total of 17 students were interviewed (either one at a time or in groups of 2-3) for 60 to 90 minutes. Results were not only consistent across all officers interviewed, but also with several articles that have recently appeared in Navy publications (Davis, 2008; Ewing, 2008; Shovlin, 2008).

A. Results of Interviews with Captains

First, it is worth summarizing the themes from the comments made by the Captains who had been commanding officers to show the similarity of their comments to those made by the Ensigns at SWOSDOC. Themes from their interviews were:

- There is inconsistency across Commanding Officers with respect to how much time they put into supporting SWOS-at-Sea training. For example, some hold a “SWO-U”; others don’t.
- Second-tour DIVOs don’t know as much as they should about the day-to-day skills of running a division. They are weak in leadership skills.
- The SWOS-at-Sea program sends a bad message about the value of junior officers in the Surface Community as compared to other unrestricted line officers.
- The CBT is not a good product.
- In many cases, if there is anyone helping the Ensigns with their training, it’s others with not much more experience, e.g., second-tour DIVOs.

B. Results of Interviews with Students at SWOSDOC

The student demographics represented were:

- All of the students except two Limited Duty Officers (LDO) and one Lieutenant Junior Grade were Ensigns (ENS).
- Two of the ENS had prior enlisted experience.
- Accession sources represented were Naval Academy (6), Naval Reserve Officer Training Corps (7), Officer Candidate School (1), and Seaman to Admiral Program (1).
- The students' ship types represented were DDG (12), LPH (1), CV (1), CG (1), CGN (1), and FFG (1).
- All of the students except two were men.

Content analysis was performed on the interview data. The themes from the analysis are described in the context of the questions asked.

The results presented below will include statistical representation of the student responses. They will then quote actual responses from the survey. By highlighting these aspects of the data, the researchers hope to describe officers' attitudes toward the CBT training approach.

How did you feel about the SWOS-at-Sea computer-based training (CBT)?

Fourteen of the 17 students interviewed did not like the CBT; three said that it was "OK." Complaints mentioned and comments made most often converged on the following:

- Not engaging, interactive, or interesting
  - CDs are a cop out for better training.
  - The instructors here [at SWOSDOC] are very involved and engaging. A computer can't give you that…it can't know when you're bored and make it better. You can't ask it questions.
  - Am I going to do death by Power Point? No, I'm going to do some work that matters.

    - The CBT does not make use of available technology that would make it more interesting.

- Can easily be gamed (cheated)

    - It was a worthless waste of time. I cheated to get through.

    - Have “they” gone through the CDs? Our XO looked at some and said, “What’s this teaching you?” It’s so easy just to click through to get the answers.

- Lack of time to complete because of ship duties

    - I didn’t make it through the CBT; there’s no time.

    - If you make time to go do the CBT, you are viewed as hiding in your stateroom.

    - CBT just adds to the burden of all the hours required of us.

- There are accessibility problems

    - There are lots of problems with shared computers.

- They don’t address leading enlisted personnel

    - The CDs don’t prepare us to lead. I learned more by being a resident assistant in college.

- They are easier for some than others because of accession source.

    - The lack of preparation for being a Division Officer isn’t as bad (so the CBT isn’t as frustrating) for Naval Academy guys. In NROTC, we don’t get anything. I didn’t even know standard commands when I came onboard.

- Inconsistency in accountability for completing the CBT

    - It’s not standard. On some ships you are held accountable for completing the CBT; on other’s you aren’t.

How do you feel about learning from a Computer?

All 17 students said they did not like learning from a computer. Three quotes sum up their feelings:

- People still want human contact. We may love computers for enjoyment, but not for learning. There’s a reason why people still go to college where there are professors as opposed to Phoenix on Line.
- I grew up with computers as a resource and for entertainment but not to learn from. I was a computer science major and still hated it.
- We need a hybrid approach where a human is involved.

This finding was fascinating in light of the generally held assumption that this generation is comfortable with *anything* that involves interacting with computers.

Did you get support from your ship to complete the CBT?

This line of questioning addresses the OJT that was designed to be part of the SWOS-at-Sea training. All students cited the CO’s attitude toward the training as the primary factor that determined whether or not they got support for the training. Several of the students had seen a change in support for the training with a turnover of COs, training officers, or Department Heads. Regarding any help they personally obtained, six students of the total 17 were on a ship where the CO held a “SWO-U.” The SWO-U may have been implemented differently on different ships, but in all cases, the students found it to be very helpful. Some comments follow:

- Once a week we had SWO-U. It’s all about good COs.

Other students were more negative or at least neutral in their responses about the support they got. The following comments are examples of inconsistency in the implementation of the OJT:

- The TrainO is not involved. TrainOs are too busy with course management of all the new systems. [In one case, a student said he was on a ship that had no Training Officer for 1.5 years.]
- The Department Head was sort of supportive in that he said, ”Get it done.”
- There are people onboard who will help when you ask, but not about the CBT.

Others commented on the lack of collaboration among students and between students and senior officers:

- Everyone was just too busy, and we were just sort of left to figure things out by ourselves.

In a related question, 15 students were asked if they had a **mentor** onboard the ship. Twelve did not have mentors; three did. Of those who did not, the follow comment was typical:

- When I went onboard I was given a mentor. He showed me around the ship and that was it. He was too busy with INSURVE, ATG, etc.

- I was asked if I wanted a mentor. I said yes, but they never got back to me. I asked the DCA if he would be my mentor, and he really helped. Maybe there is a policy; I don't know.

What, if anything, would you change in the training to make it more effective?

Thirteen of 14 students who were asked this question said that newly commissioned officers should attend SWOSDOC *before* reporting to their first ship assignments. Their reasons centered primarily on their frustrations of not feeling prepared to function as Division Officers. One student said:

- We start not knowing anything; the CO yells at us, and we look dumb in front of our guys.

- I went into a division with no chief, and I needed 1-2 months on the job [to feel prepared to lead a division] but did not get that.

- It would be good not to feel clueless and useless on day-one on your ship.

- Help the fleet by getting rid of the CBT and having a school upfront…the trick is to make it good enough to where people want to go and learn because they've heard about it from their buddies...it wouldn't just be a one-month party in Newport like some people seem to think the old one was.

Eight of the 14 said that the CBT could serve as a good reference if separate from some other primary training vehicle such as SWOSDOC.

It was clear to the researchers that there had been talk among the cohort on the two above suggestions, which may have influenced the answers.

How long do you intend to stay in the Navy past your Minimum Service Requirement (MSR)?

While not necessarily related to the SWOS-at Sea program, the researchers were curious as to the answer to this question. Three said they would stay to some point past the MSR; six said they would definitely not stay; the two LDOs said they would stay until 20 years, and six did not know how long they would stay.

One of the SWOSDOC staff instructors said that he had observed that the Naval Academy officers were particularly negative—that they are burnt out when they leave The Academy and almost hate the Navy. Few want to be COs. This sentiment has been heard from others with whom the researchers discussed this topic.

- The CBT sends me the message that the Navy doesn't care about our development, so I will probably get out as soon as I can.

C. Summary and Discussion of the Interview Results

Based on the background information collected from SWOSDOC before the interviews commenced, the findings from the interviews are not surprising. Further, based on the literature reviewed in Chapter III, the findings offer few surprises. In other words, a large body of research findings reveals several elements of CBT and OJT that are critical for student satisfaction and transfer of learning. If these elements are missing, as in the case of the SWOS-at-Sea training, then negative outcomes for student satisfaction and achievement are predictable. And in fact, negative feelings about the training are evident in the interview results described above, and poor transfer of learning to tests administered at SWOSDOC are described in Chapter V.

A summary of the interview results follows:

- **The majority of the Ensigns did not like the CBT.**

  The literature indicates that interactivity is positively related to satisfaction, and that this may be more pronounced for members of Generation Y.

  The research also shows that where populations are diverse, such as in the military, CBT needs to be tailored. For the SWOS-at-Sea program, Ensigns came to the training with different levels of experience based on their accession sources, and this added to the general level of dissatisfaction for many.

  Accountability for completion of the CBT was inconsistent across ships and senior officers, and the system could be easily "gamed." These factors, too, played a role in students' negative perceptions of the training.

- **Students did not like learning from a computer.**

  The literature shows that, in most cases, students prefer face-to-face learning over CBT; this was the case with the SWOS-at-Sea CBT. A hybrid learning solution that blends CBT with face-to-face learning is preferred over CBT, but this sort of program was not available to the SWOs. There was not even a capability for e-mailing questions to an instructor. This shortcoming is related to the next finding.

- **SWOS-at-Sea training was not well supported.**

  The OJT component of the training appears to have fallen short in implementation as compared to the original design of the program. The OJT can be classified as unstructured, which the research literature shows is less likely to produce consistent training and to achieve learning objectives.

  Collaboration, also, has been shown to be an important component of OJT. The SWOS-at-Sea training provided some opportunities for support and collaboration through the efforts of some ship COs who conducted a SWOU and who pushed their concerns for junior officer development down the chain of command. For the most part, however, there were few opportunities for students to interact to share knowledge, experience, and insight. Collaborative opportunities, which can help build commitment and satisfaction, were a function of the efforts of individual Commanding Officers rather than a planned/structured part of the training. Additionally, few students had mentors.

Time was also an element that detracted from consistent OJT and good support of learning. The Ensigns had Division Officer duties that cut into the time available for the CBT and OJT, and many senior officers were too busy to help. To summarize, we have heard many times during the course of this project that “the SWOS-at-Sea training puts too much of a burden on the ship.”

- **Ensigns would like training before going onboard their first ships.**

  Ensigns feel frustrated, and in many cases embarrassed, to be put in the position of running a division without the requisite knowledge and skills to do the job. They feel (and some senior officers agree) that the SWOS-at-Sea training sends a message to them they are not valued the same as other unrestricted line officers. There was considerable negativity surrounding this topic with some of the Ensigns; they indicated this was just “one more reason” not to stay in the Navy.

- **Not all of the SWOS-at-Sea content may be suitable for CBT.**

  The results described in Chapter V show poor transfer of learning from the CBT to tests administered at SWOSDOC. Many of the possible reasons for this have been discussed here, but one other may be the suitability of the content for CBT. The literature shows that not all skills, knowledge, and abilities can be trained through mediated instruction. Further, decisions to convert classroom instruction to CBT are often made subjectively as opposed to analytically.

  The extent of analysis done before converting the SWO training to CBT is not known, but this suitability factor should certainly be addressed in any future conversions conducted by the Navy.

V. Statistical Analysis of Student Performance on Test Scores and Passing Rates on DIVO Tests

The Surface Warfare Officers School provided data for the following statistical analyses. Data were also collected from the Officer Personnel Information Systems (OPINS) to check for consistency and to obtain additional demographic information on each officer. The data set consists of individual-level performance information for junior officers participating in the SWOSDOC training program who completed the 3-week course at SWOS between June 2007 and March 2008. The total number of records included in the data set is 733 and includes SWOSDOC classes #213 through #224.

We model the determinants of the CBT test scores as well as later exams administered at SWOSDOC. Multivariate regression models are specified (based on the literature) and estimated. Separate models are estimated for all four CBT modules and for the overall weighted CBT score. The determinants of test score performance included the following general factors: education, ability, motivation, demographics, ship-related factors, military rank, officer qualifications, and commissioning source.

A. Computer-based Training Test Scores

SWOS administers a test to students upon their arrival for the 3-week training course. The test consists of four modules: maritime warfare, navigation and seamanship, division officer fundamentals, and engineering. A student receives a score for each module, as well as a cumulative average score for all four modules. The minimum score is zero, and the maximum score is 100. The test is derived from the CBT SWOS-at-Sea training and measures the effectiveness of the CBT. Kulik and Kulik (1991) emphasized in their meta-analysis of computer-assisted instruction that the instructional outcome most often measured was student learning—determined by performance on achievement examinations.

The metric adopted here for student learning is student performance on the CBT modules examination. Thus, in the analysis below, CBT test scores are used as the dependent variable. Table 1 describes each variable for each test module and for the overall CBT test. The dependent variable adopted is the pass rate on each individual exam.

Table 1. Computer-based Training Dependent Variables

Variable Name	Description	Variable Type
Cbt	Average score on the CBT four modules	continuous
cbt_mw	Maritime Warfare CBT score	continuous
cbt_nss	Navigation, seamanship, & ship handling CBT score	continuous
cbt_dof	Division Officer Fundamentals CBT score	continuous
cbt_eng	Engineering CBT score	continuous

B. Demographics

The study combines the two categories under the heading “Ethnicity,” due to a small number of observations for minority (non-Caucasian) groups, which is shown in Figure 5. Therefore, this research uses either race or ethnicity to identify members of a minority (non-Caucasian) group. Furthermore, this study recodes ethnicity to a binary variable due to its distribution. Members are classified as Caucasian or “Other.”

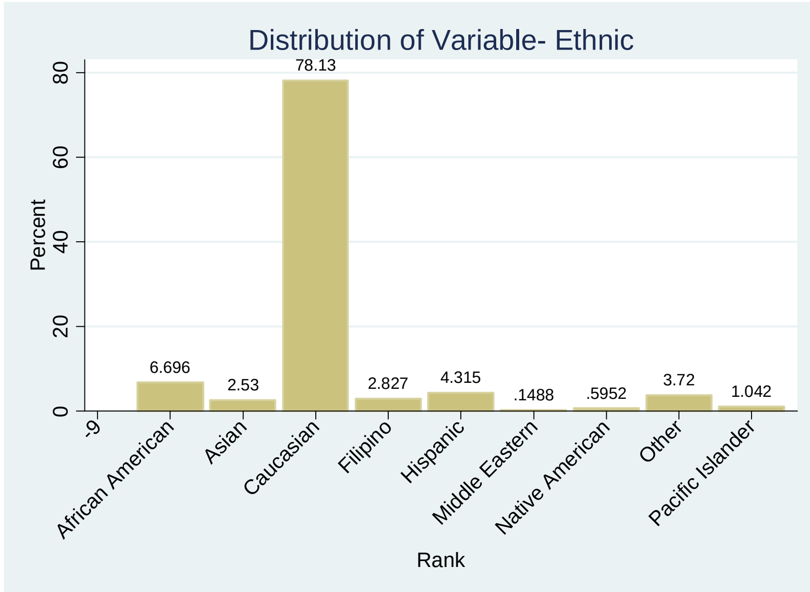


Figure 5. Race/Ethnic Distribution

Gender is another important demographic factor that may affect academic performance (Schram, 1996). Schram's (1996) meta-analysis of 18 quantitative performance studies found that women slightly outperformed men in post-secondary psychology, education, and business courses.

C. Military Factors

Military factors capture the officer's military service prior to arriving at SWOS. The data include commissioning source, rank, prior enlisted service and SWOSDOC class. Since CBT takes place on each officer's ship, and the environment on each ship type differs, it is likely that performance on the CBT will differ across ship type. The selected variables will reflect the learning environment and work-related conditions that will affect the officer's ability to study onboard the ship. These variables include time-onboard (in months), ship name, ship type and homeport. Other important variables that we use capture an officer's shipboard qualifications. These variables indicate whether the officer qualified as EOOW and the time in months that an officer has been qualified OOD U/W. Time-onboard describes the total time that an officer has been assigned to his or her ship. It is measured in months, begins from report date and ends with the month the officer reports to

SWOSDOC. Since CBT is self-paced, it is assumed that less time-onboard equates to a higher motivation level. Thus, time-onboard is used as a proxy for motivation.

The ship name, ship type and homeport characterize the specific ship to which an officer is assigned. The original data included observations for 13 ship types. The study combines the ships according to major category of ship. For example, the two different types of amphibious assault ships (LHD & LHA) are combined into the category, “amphibious.” However, the study combines the auxiliary ship category with the mining ship category (i.e., ships whose mission is mining and mine sweeping) due to a low number of observations (less than 3% of the sample). The two graphs in Figure 6 show the distribution of officers by ship type before and after the ship categories were combined into 5 groups.

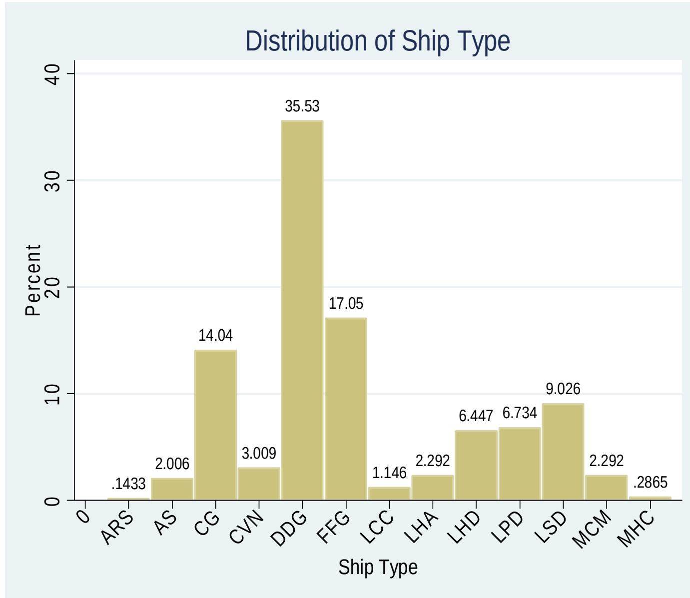


Figure 6. Ship Type Distribution Before and After Variable Conversion

The final two ship-related variables reflect the qualifications obtained by an officer before attending SWOSDOC. Since each officer must be OOD-qualified before reporting to SWOSDOC, OOD is a continuous variable measured as the number of months required to achieve the OOD qualification. Lastly, some officers have qualified for engineering officer of the watch (EOOW) in addition to OOD. A binary variable is created to indicate whether the officer qualified EOOW. The study measures the impact of this additional qualification on CBT performance. Table 2 describes the variables of the shipboard environment and their hypothesized effects on test scores.

Table 2. Modified Ship Factors

Variable Name	Description	Variable Type	Code for Categorical Variables	Hypothesized Effect on CBT Test Score
Ship/Qualifications				
tobmonth	Months onboard ship	continuous	---------------	+
oodmonth	Months qualified OOD U/W	continuous	---------------	-
ship_cat	The Category of Ship	*categorical*		
auxmine	Combination of Auxiliary & Mining ships	dummy	Other=0 auxmine=1	-
cruiser	All types of Cruisers	dummy	Other=0 cruiser=1	+
destroyer	All types of Destroyers	dummy	Other=0 destroyer=1	+
frigate	All types of Frigates	dummy	Other=0 frigates=1	+
amphib	All types of Amphibious Assault ships	dummy	Other=0 amphib=1	-
eoow	Engineering Officer of the Watch Qualified (Y/N)	dummy	No=0 Yes=1	+

D. Education Variables

Studies of student performance normally include educational background information. The correlation between previous academic performance and future performance is well documented (Anderson & Benjamin, 1994; Butcher & Muth, 1985; Chisholm, Cobb & Kotzan, 1995). Eskew and Faley (1988) found a statistically significant effect of previous college grades on a specific college accounting course.

Kulik and Kulik (1991) found that all of the 254 studies they reviewed included previous academic achievement variables to control for academic ability and motivation. The data for this study contained information on an officer's undergraduate education, major, and college attended. However, the data did not include information on undergraduate grade point average (GPA). We obtained data from OPINS on individual officer undergraduate GPA, but information was available for only 5% of the sample. As a result, we created the following variables to control for academic ability: undergraduate classification, type of undergraduate school, and undergraduate major. Following Bowman and Mehay (2002), we constructed undergraduate classification from Barron's *Profiles of American Colleges,* which classifies colleges and universities according to their admissions competiveness. Barron's (2006) uses averages of the factors of entrance criteria (i.e., SAT scores, class ranking, and percentage of freshman admitted). Each university is ranked along a competiveness scale ranging from "Noncompetitive" to "Most Competitive" (2006). For example, Harvard University is ranked "Most Competitive" since it has very strict entrance criteria, while Norfolk State University is ranked as "Less Competitive" since it accepts the majority of students that apply. A plus (+) is added to a ranking, with the exception of the "Most Competitive" ranking. The latter indicates schools that fall within a certain category but that also limit the amount of students accepted. Barron's also includes a "special" classification for colleges with specialized fields of study (e.g., art schools). Figure 7 shows how the observations in this data set are categorized using the Barron's classification system.

"Special"' colleges are dropped since they comprise less than 2% of the sample (only four observations) and they represent certain talents (e.g., artistic ability) along with academic ability, which may confound their affects on CBT score. Similar to Bowman and Mehay (2002), the competitive categories are grouped into three classifications: (1) *Least Competitive* (combines Noncompetitive, Less Competitive, and Competitive); (2) *Competitive* (combines Competitive +, Very Competitive, and Very Competitive+); and (3) *Most Competitive* (combines Highly Competitive, Highly Competitive+, and Most Competitive).

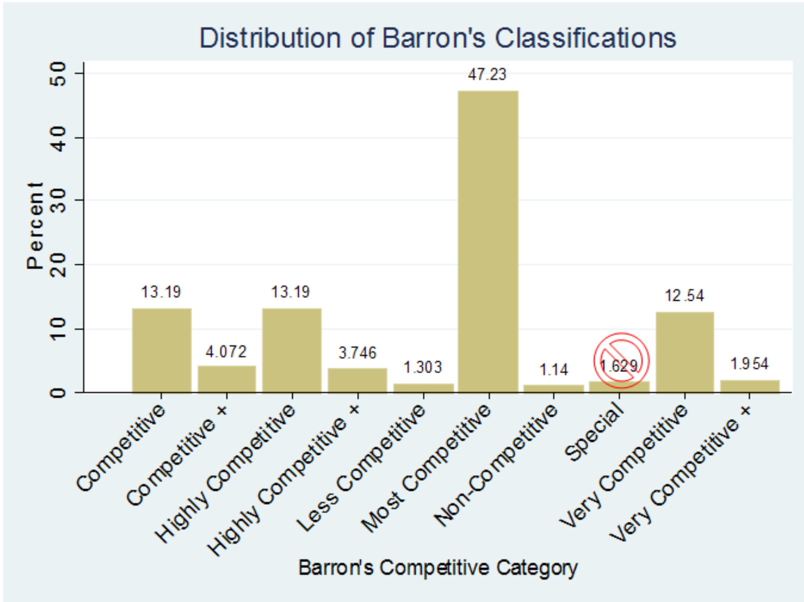


Figure 7. Barron's Competitive Categories

In addition, we distinguish between the type of undergraduate school attended: public, private, or USNA. Bowman and Mehay (2002) found that officers from private schools received better performance reviews from superiors. Brewer, Eide, and Ehrenberg (1999) also concluded that there are significant economic returns to attending a private college. While this information does not reflect differences in student academic performance between public and private universities, it may be useful to see if there are differences associated with school ownership. For example, private universities may have more resources and, therefore, yield improved cognitive skills of their graduates.

Moreover, there is likely to be a difference between students educated at the USNA and students educated at other universities. Naval Academy students receive specialized training that includes professional development coursework and OJT during summer cruises, and they are also exposed to a full-time military environment during college (Bowman & Mehay, 2002). In addition, students receive this education in a Navy-centric environment. Thus, this study controls for these differences. Figure 8 shows the distribution of USNA students compared to those educated at other private or public universities.

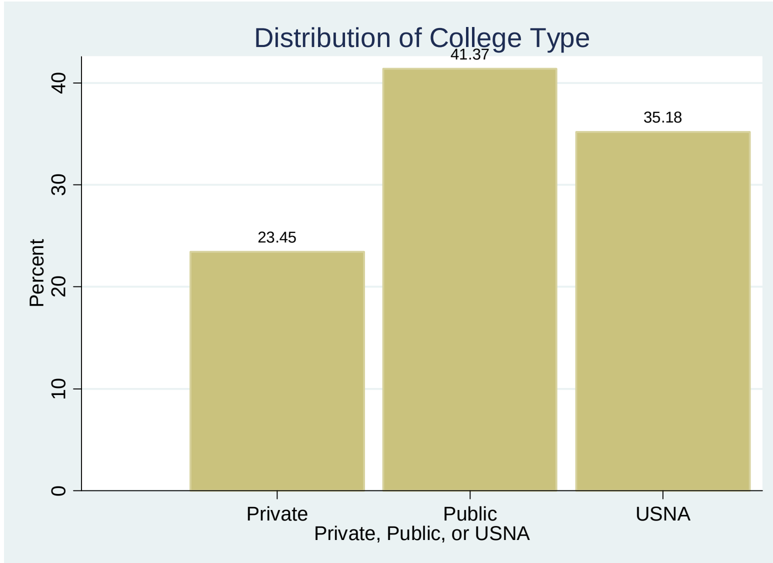


Figure 8. Distribution of College Type

In summary, Barron's classification and type of university serve as proxies for student ability and cognitive skills.

We also classify an officer's undergraduate major into one of five categories: natural science, social science, mathematics concentration, arts, and business. Natural science includes the physical sciences (i.e., chemistry, biology, mathematics, etc.), while social science encompasses the study of human individuals and groups (i.e., economics, education, sociology, etc.). Mathematics concentration is based on degree programs such as engineering, computer science, and mathematics that emphasize calculations, measurements, and problem solving. Humanities, general liberal art degrees, and fine art degrees comprise the arts category. Lastly, business includes those majors with a focus on business administration or business-related subjects such as accounting or marketing. Figure 9 displays the distribution of officer's undergraduate education in the data set.

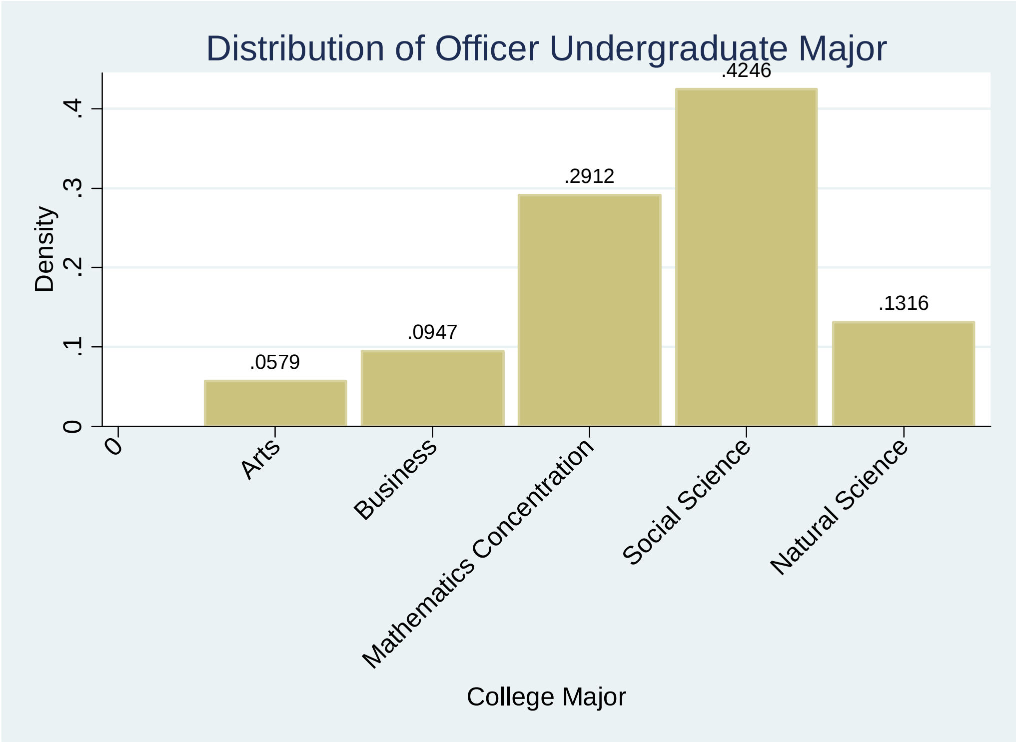


Figure 9. Distribution of Undergraduate Major

Once DIVOs pass their first warfare qualification, OOD-U/W (Officer-of-the-Deck-Underway), and achieve a pass rate of 80% correct on each of the four self-directed tests, they are sent to the 3-week classroom training program at SWOS, called the "leveling" school. The goal of this 3-week program is to assure that all DIVOs reach the same competency level in the knowledge base contained in the self-directed training modules. During the first day of training, all DIVOs are administered selected questions from the self-directed training package. The scores on this exam are weighted to arrive at a total score of DIVO Fundamentals, with Maritime Warfare and Engineering modules receiving the highest weights and the Division Officer Fundamentals module receiving the lowest weight.[3] In addition to the weighted total score, SWOSDOC also assigns a passing rate of 75% correct, which

[3] These weights are based on a linear regression model that regresses the combined score on the scores reported for the four modules. The results of this statistical estimation technique produced the the following weights, which are attached to each score: Maritime Warfare = 0.303; Engineering = 0.278; Navigation-Seamanship = 0.238; and Division Officer Fundamentals = 0.172.

is somewhat lower than the 80% passing rate that is required during execution of the self-directed tests (CBT) taken aboard ship. The lower pass rate of 75% allows for some depreciation of knowledge that may have occurred since the junior officers studied the modules aboard their ships many months earlier.

E. Descriptive Statistics

We analyzed data on 12 classes that entered the “leveling” school between July 2007 and March 2008. The data was provided by SWOSDOC and covered class numbers 213 through 224. The average total test score and the average percent of officers who achieved a “passing” score for the twelve classes are shown below in Figure 10.

Two trends are noticeable in Figure 10. First, the average weighted total score for DIVOs has risen over time—peaking at almost 80% for Class 218 (see Graph A). More important, however, is the continuous rising trend in the percent of students achieving a passing grade over this period, which rose from 75% to 84%. The reason these two trends differ is evident if we compare the distribution of the weighted total scores for early compared to later classes. We first notice the class sizes are similar (56 versus 58), but the standard deviation for the earliest Class 214 (7.494) exceeds that for the most recent Class 222 (6.692) (See Graph B). Far more individuals from Class 214 scored “below passing,” while more enrollees of Class 222 scored at or above passing. Both of these characteristics result in far higher pass rates than in higher average test scores between the two classes. In essence, SWOSDOC appears to be directed at raising the level of common knowledge required for successful surface warfare qualification—that is, in achieving the “leveling effect,” which is the goal of the 3-week classroom training program. All analysis reported in this study will, therefore, focus on the “passing rates” on the DIVO tests as a measure of achievement in both self-directed learning as well as in classroom learning environments.

While much of the analysis in this study focuses on the weighted total test scores, secondary analyses are carried out on the passing rates of the four modular tests administered on the first day of SWOSDOC. These rates for the classes are shown below in Figure 10. The highest passing rates are on Navigation-Seamanship and Engineering, which both average around 80%. In contrast, only 40% to 60% pass the Division Officer Fundamentals Module, and only 40% pass the Maritime Warfare module.[4]

(A)
AVERAGE SCORE AND AVERAGE PASSING RATE ON DIVISION OFFICER FUNDAMENTALS EXAM

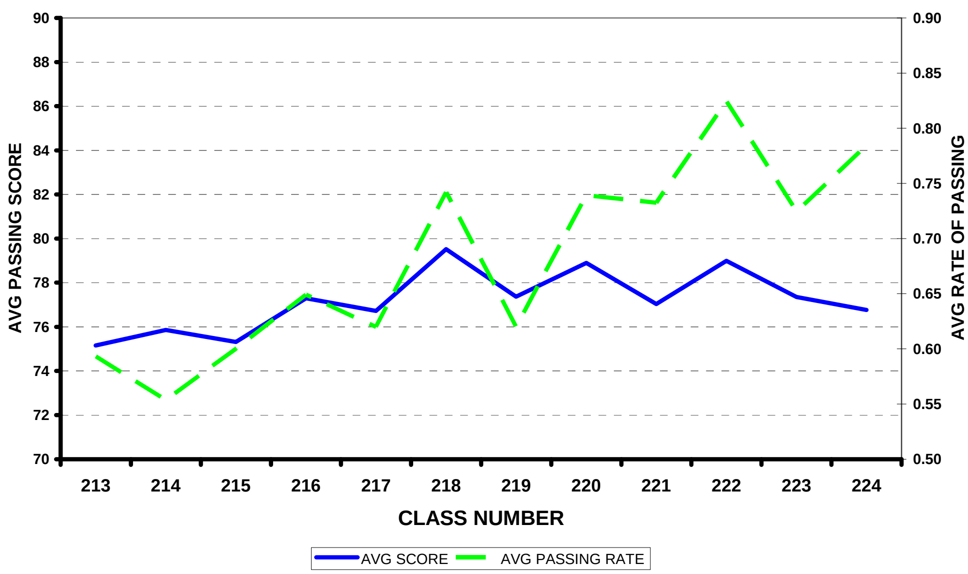


Figure 10(A). Total DIVO Fundamentals Exam Scores and Selected Class Distributions

(B)
DISTRIBUTION OF PASSING RATES ON DIVO FUNDAMENTALS EXAM

CLASS 214 **CLASS 222**

---

[4] It may be noted that SWOSDOC has chosen the latter two modular scores to be central to the index score used to identify high-achieving DIVO test scores. They are combined with the score on the Rules-of-the Road exam administered at SWOSDOC to create the index score. Clearly, SWOSDOC views relatively high scores on Maritime Warfare and Division Officer Fundamentals as indicators that distinguish DIVOs from their fellow classmates. This is not to say that doing well on Engineering and Navigation-Seamanship is not important. On the contrary, these are extremely important competencies for all DIVOs. Perhaps so much effort is put forth toward these two competencies, that

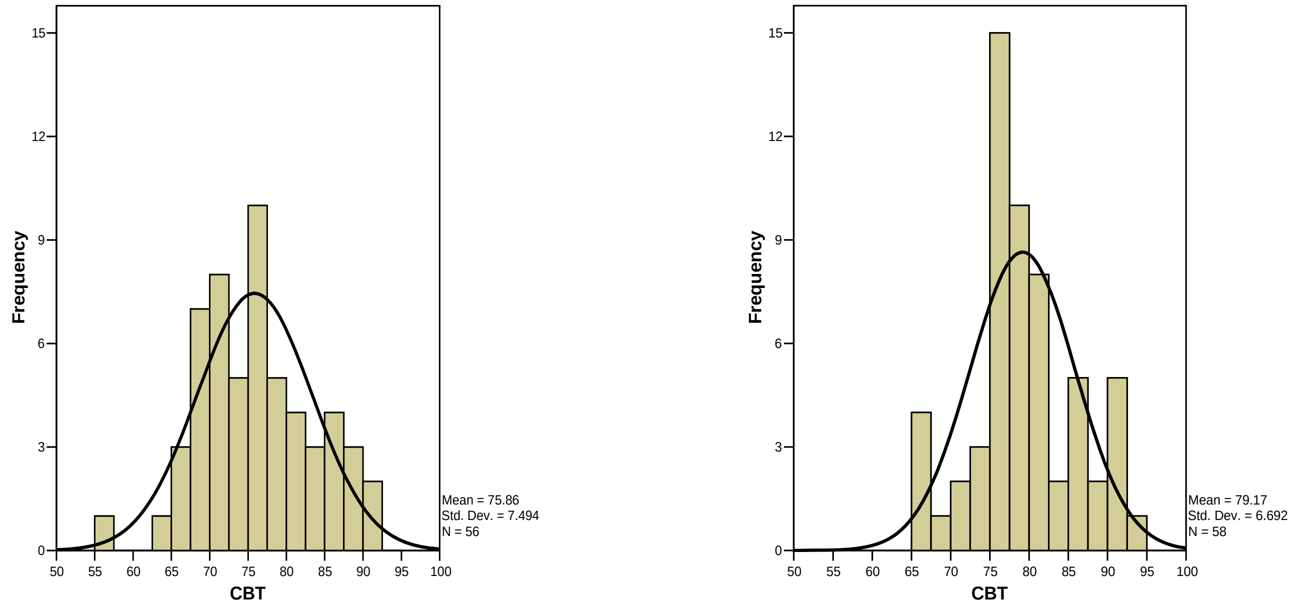


Figure 10(B). Total DIVO Fundamentals Exam Scores and Selected Class Distributions

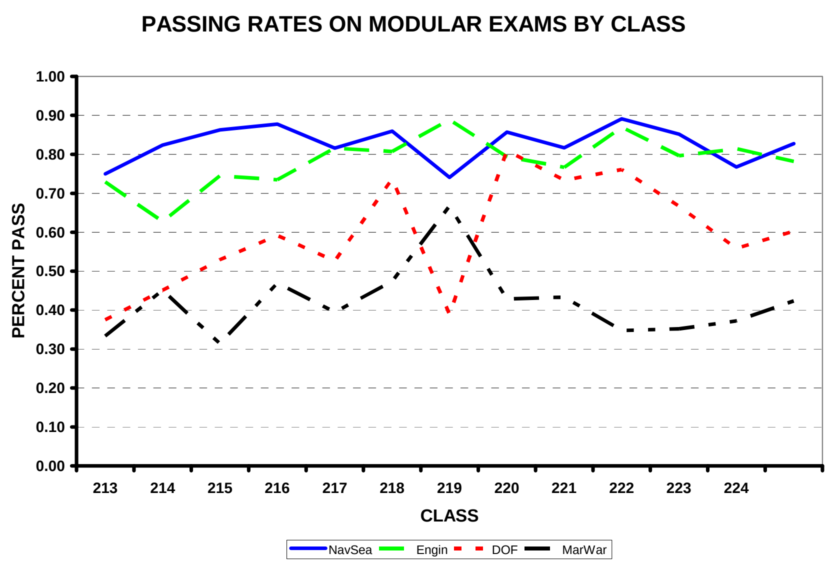


Figure 11. Passing Rates on DIVO Modular Exams: Classes 213-224

---

officers can be distinguished from each other most easily based on the scores on Maritime Warfare and Division Officer Fundamentals.

THIS PAGE INTENTIONALLY LEFT BLANK

VI. Statistical Analysis of Test Results

Data for all 732 enrollees for the DIVO course between July 2007 and March 2008 were obtained from SWOSDOC and were used to analyze the self-directed learning achieved in the program, along with the classroom training during the 3-week leveling school. The analysis focuses on commissioned officers. Differences between LDO-CWO and commissioned officers require that the two groups be analyzed separately.

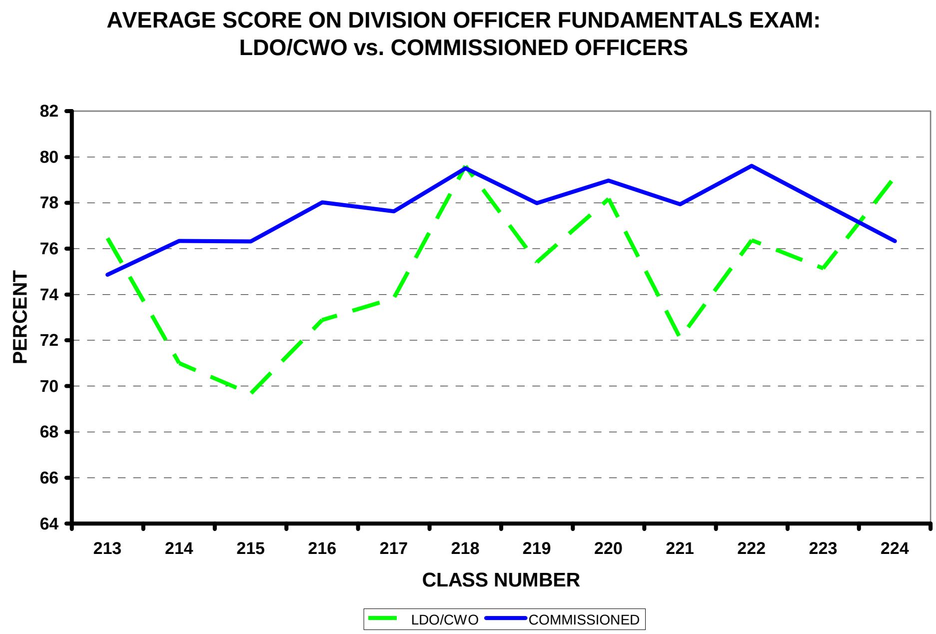
We first describe the differences between non-commissioned and commissioned officers and then estimate the impact of these differences on the passing rates of the various DIVO Fundamentals tests. We then analyze in more detail the impacts of Navy assignments and individual characteristics on the test pass rates. In particular, the analysis of commissioned officers' performance on self-directed training focuses on four main determinants: (i) ship type and home port assignments, (ii) commissioning source and college quality, (iii) academic major, and (iv) demographic factors. The results of this analysis are presented according to these four dimensions to explore the major factors that appear to affect the ability to learn information that is crucial in the training of junior surface warfare officers.

For the SWOSDOC classes convening between July 2007 and March 2008, more than 15% (118 out of a total of 732) of the Division Officers attending the 3-week classroom training program were non-commissioned officers (either Chief Warrant or Limited Duty Officers). These DIVOs, with few exceptions, do not have a college degree. Table 3 highlights important background differences between the two groups.

Table 3. Characteristics of SWOSDOC Classes 213-224

VARIABLE	VALUES	COMMISSIONED		LDO-CWO	
		COUNT	PERCENT	COUNT	PERCENT
ETHNIC GROUP:	1 White	443	78.8	81	74.3
	2 AfAmer	37	6.6	8	7.3
	3 Hispanic	23	4.1	6	5.5
	4 AsianPI	30	5.3	11	10.1
	5 Other	29	5.2	3	2.8
	Total	562	100.0	109	100.0
	Missing	52		9	
GENDER:	Male	477	77.7	115	97.5
	Female	137	22.3	3	2.5
	Total	614	100.0	118	100.0
GRADE:	Ensign	545	89.1	55	56.1
	LT-LCDR	67	10.9	43	43.9
	Total	612	100.0	98	100.0
	Missing	2		20	
SHIP TYPE:	1 DDG	226	36.8	31	26.3
	2 CG	94	15.3	10	8.5
	3 FFG	110	17.9	12	10.2
	4 AMPHIB	163	26.5	24	20.3
	5 SMCLF	20	3.3	18	15.3
	6 CVN	1	0.2	23	19.5
	Total	614	100.0	118	100.0
HOME PORT:	1 Atlantic	308	50.2	49	41.5
	2 West Pac	226	36.8	53	44.9
	3 Japan	57	9.3	11	9.3
	4 Other	23	3.7	5	4.2
	Total	614	100.0	118	100.0
YEAR GROUP:	<2006	95	15.5	58	49.2
	2006	470	76.5	44	37.3
	>2006	49	8.0	14	11.9
	Total	614	100.0	116	100.0
	Missing			2	
PRIOR SERVICE:	0 None	453	81.5	0	0.0
	1 1-7Yrs	25	4.5	5	5.0
	2 8-12Yrs	66	11.9	29	28.7
	3 13-16Yrs	11	2.0	46	45.5
	4 17-24Yrs	1	0.2	21	20.8
	Total	556	100.0	101	100.0
	Missing	58		17	
TIME FROM OOD-U:	1 1 mo	292	50.7	41	38.7
	2 2 mo	147	25.5	18	17.0
	3 3 mo	74	12.8	12	11.3
	4 4+ mos	63	10.9	35	33.0
	Total	576	100.0	16	100.0
	Missing	38		12	
TIME ON BOARD:	1 1-11 mos	114	19.8	18	17.0
	2 12-18 mos	400	69.4	31	29.2
	3 19+ mos	62	10.8	57	53.8
	Total	576	100.0	106	100.0
	Missing	38		12	

(A)



(B)

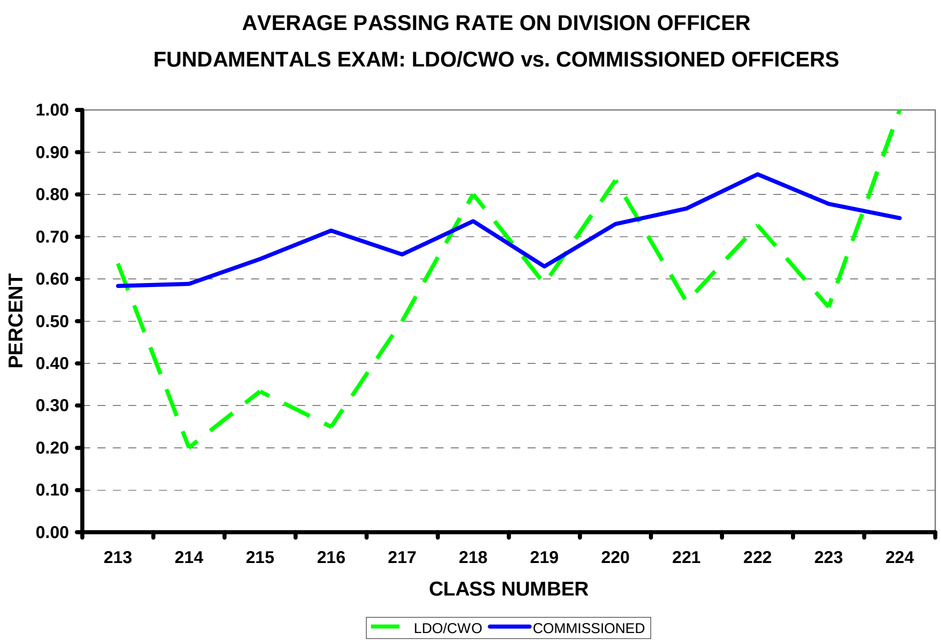


Figure 12. DIVO Fundamentals Total Score and Passing Rates for Commissioned Officers versus LDO-CWOs

Table 4 shows that LDO/CWOs differ from commissioned officers in the following attributes:

- They are overwhelmingly male (98%, versus 78% for commissioned officers);
- They are more likely to be LTJG or higher (44%, versus 11% for commissioned officers);
- The are less likely to be assigned to a CRUDES ship (35%, versus 52% for commissioned officers), especially carriers (20%, versus 0% for commissioned officers);
- They are from earlier year groups (49% before 2006, versus 16% for commissioned officers);
- They qualified OOD-U/W earlier (33% qualified at least 4 months prior to enrolling in SWOSDOC, versus 11% for commissioned officers); and
- They spent longer time onboard ship (54% spent over 18 months onboard, versus only 11% for commissioned officers).

Figure 12 above also shows that non-commissioned officers have lower weighted total test scores (Panel A) and lower passing rates on the total self-directed tests (Panel B) compared with commissioned officers. There is roughly a 10-point difference in passing rates between the two groups, although it is of interest to note the gap has shrunk in the later classes.

Because non-commissioned officers appear to be so different from commissioned officers, their experiences in learning in self-directed OJT environments compared with classroom environments are analyzed separately. To examine differences between the non-commissioned and commissioned officers, two non-linear, logistic regression models are specified and estimated. The first model includes only a binary variable for non-commissioned officer status (LDO-CWO) and omits other important factors that also may predict who passes the DIVO Fundamentals Test (which combines questions from all four CBT modules). The marginal effect of each factor is reported in the first column, and the significance level is reported in the second column of Table 4.

The impact of non-commissioned status on the likelihood of passing the weighted score on all four self-directed DIVO tests in general mirrors that of commissioned officers. While it first appears NCO's are nearly 20% (in Row 1) less likely to pass the self-directed tests when the scores are combined (i.e., Total CBT Score), this difference turns out to be due mainly to their ship assignments. When ship assignments are included in the full model specification (Columns 3 and 4) those assigned to amphibious ships and carriers are 21% and 40%, respectively, less likely to pass. Over ½ of all non-commissioned officers are assigned to these ships—compared with only 30% of commissioned officers. In essence, what at first appears to be a difference due to non-commissioned status turns out to be related to the type of ships to which non-commissioned officers are more likely to be assigned—especially carriers, on which passing rates on the self-directed tests are abysmally low. The only DIVO Fundamental Module in which non-commissioned officers were less likely to pass than commissioned officers is the Navigation-Seamanship module and, once again, ship type differences most likely are the cause of the disparity in these passing rates.

Table 4. Effect of CWO/LDO on Passing Rates on DIVO Fundamental Tests and Exams

CBT or Classroom Exam	CWO-LDO Specification Only		Full-model Specification	
	Marg. Eff.	Sig. Lev.	Marg. Eff.	Sig. Lev.
Total CBT Score	**-.198**	.014	-.126	.145
Maritime Warfare Module	-.042	.390	-.029	.730
DIVO Fundamental Module	-.035	.484	+.017	.848
Engineering Module	-.028	.522	-.030	.570
Navigation-Seamanship Module	**-.158**	.001	-.098	.211
Maritime Warfare Exam	**-.115**	.005	**-.128**	.003
COVE Exam	-.047	.297	-.008	.913

During the SWOSDOC classroom training, a final exam is administered to all DIVOs on the intricacies of maritime warfare. Here, we see non-commissioned officers are roughly 13% less likely to pass the exam (i.e., with at least 75% correct answers) than commissioned officers—even when we controlled for ship assignments as well as other factors. This difference supports the hypothesis that those who previously shunned college do not learn as well as those who spent four or more years competing in a college classroom environment. We also note that training for the COVE exam is not truly done in a traditional classroom environment but rather in a one-on-one simulator training environment; in this case, there is no apparent performance differences between non-commissioned and commissioned officers noted.

In summary, the results above support the concept of a dual classroom training program separating DIVOs by non-commissioned status. It is possible that non-commissioned officers' performance on classroom tests may improve when they do not have to compete with college-educated officers in a classroom environment. It is also noted that their ability to learn in self-directed learning environments is similar to that of commissioned officers, with observed differences more related to ship assignments than to personal attributes.

A. Ship Type and Home Port Assignments

Ship type and home port assignment is not a random process for many commissioned officers. Graduates of the Naval Academy and NROTC programs are assigned a graduation rank order according to their academic and military performance over their college years. If graduates with higher rankings share similar preferences for ships (e.g., CRUDES ships over others) and home ports (e.g., San Diego and Hawaii over others), groups from these ships and ports may have better grades on both self-directed CBT tests and classroom DIVO exams. Thus, ship type and home port assignments may be indirectly related to DIVO testing results due to the self-selection process characteristic of Navy-funded scholarship students. Figure 13 below shows the average passing rate for all SWOSDOC classes by ship type (Panel A) and home port (Panel B).

1. Ship Type

Of the 551 SWOSDOC enrollees who were commissioned officers and had valid information on personal characteristics and Navy experience, roughly 1/3 were assigned to destroyers and 1/4 to amphibious ships. Less than 20% were assigned to either cruisers or frigates, and less than 5% to small boats or auxiliary ships. Panel A of Figure 13 classifies these differing ship types into three groups, including cruiser-destroyers, amphibious ships and small/auxiliary ships ("other").[5] Of the two largest ship type assignments, we note that it is not uncommon for the passing rate on the weighted total CBT tests of those from CRUDES ships to be 20% to 30% points higher than those from amphibious ships. The small number of officers assigned to the third group of ships (other) results in highly variable passing rates over the classes, and, on average, the passing rate is close to that of officers from CRUDES ships.

(A)

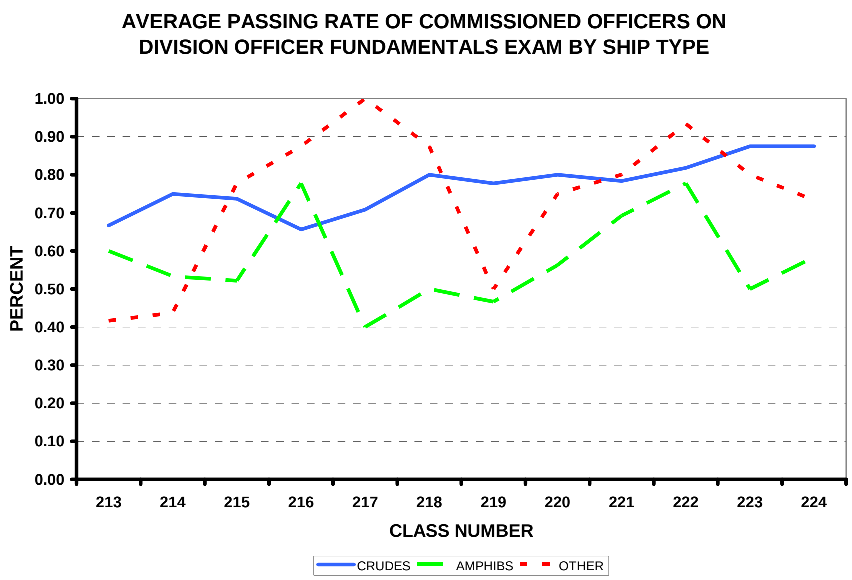


Figure 13(A). Passing Rates on Total DIVO Fundamentals Exam by Ship Type and Home Port Assignments

---

[5] There were only three commissioned officers assigned to carriers; thus, this ship type is not represented in the following analysis. It may also be noted that the statistical models are constructed with those assigned to destroyers as belonging to the comparison group—with others assigned to cruisers, frigates, amphibious and small/auxiliary ship types.

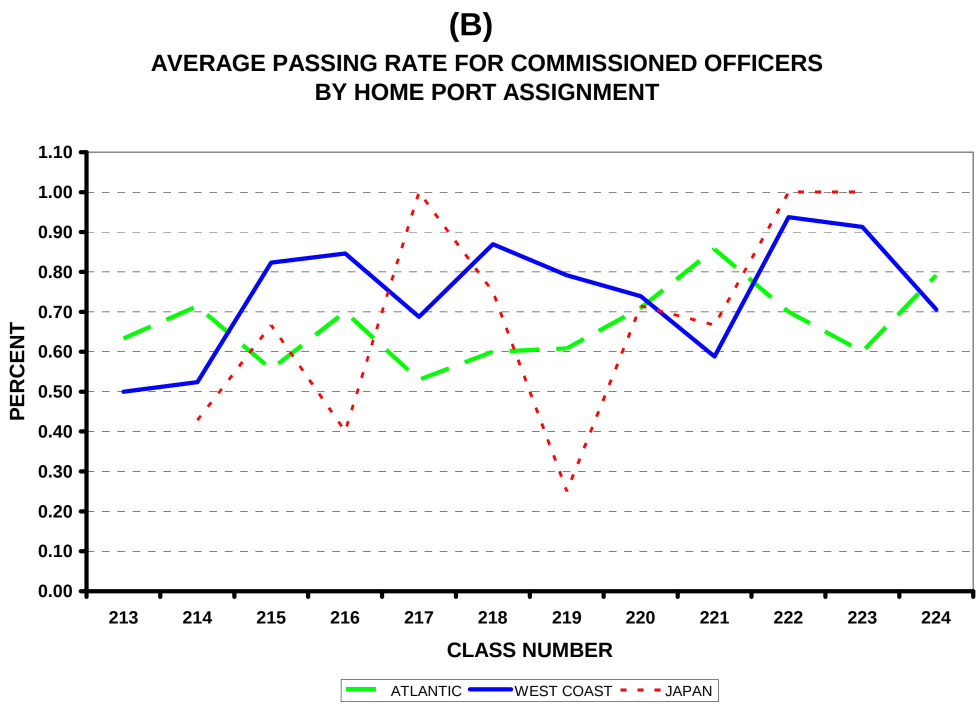


Figure 13(B). Passing Rates on Total DIVO Fundamentals Exam by Ship Type and Home Port Assignments

Multivariate models are next specified to estimate the marginal effect of ship type. In the first stage, the model controls only for ship type and includes binary variables for four ship types: cruisers, frigates, amphibious, and small/auxiliary ships. Next, the model is expanded by adding control variables for commissioning source, quality of college/university, academic majors, demographic variables (ethnicity and gender) and various Navy experience variables—including time since OOD-U/W qualification and SWOSDOC attendance, total time onboard ship, and years of prior enlisted experience.[6]

Selected results from this modeling process are shown below in Table 5. For each initial CBT test and SWOSDOC exam, we estimate the independent marginal

[6] Recall that these models are estimated on samples that include only commissioned officers. Of the 551 commissioned officers included in the analysis sample, roughly 18% were prior enlisted personnel.

effect of the four ship types (compared to the omitted category of destroyers). Statistically significant coefficients are highlighted with bold letters.

Table 5. Effect of Ship Assignment on Passing Rates on DIVO Fundamental Tests and Exams

CBT or Classroom Exam	Marginal Effects & Significance Levels of Ship Assignment							
	Cruisers		Frigates		Amphibious		Small/Auxiliary	
	Marg. Effect	Sig. Lev.	Marg. Effect	Sig. Lev.	Marg. Effect	Sig. Lev.	Marg. Effect	Sig. Lev.
Total CBT Score:								
Ship Type Only	+.001	.987	-.074	.252	**-.248**	.000	**-.264**	.053
Full Specification	-.005	.939	-.035	.561	**-.225**	.000	-.129	.309
Maritime Warfare Module:								
Ship Type Only	-.038	.559	**-.148**	.010	**-.252**	.000	**-.218**	.011
Full Specification	-.031	.626	**-.111**	.051	**-.230**	.000	-.128	.233
DIVO Fundamental Module:								
Ship Type Only	-.011	.867	**-.126**	.057	**-.115**	.040	**-.488**	.001
Full Specification	-.006	.923	**-.106**	.087	**-.116**	.032	-.156	.200
Engineering Module:								
Ship Type Only								
Full Specification	-.020	.719	-.016	.754	-.026	.563	+.098	.233
Navigation-Seamanship Module:								
Ship Type Only	**-.115**	.086	-.059	.305	**-.088**	.077	-.060	.587
Full Specification	-.078	.192	-.055	.312	**-.079**	.096	-.106	.372
Maritime Warfare Exam:								
Ship Type Only								
Full Specification	+.009	.835	+.002	.956	-.030	.415	**-.199**	.099
COVE Exam:								
Ship Type Only								
Full Specification	-.073	.244	-.093	.119	-.071	.164	-.021	.859

The estimated marginal effects of cruisers (vs. destroyers) indicate that the only significant difference in passing rates for self-directed CBT test scores is found in the Navigation-Seamanship module (in which those on frigates are 11.5% less likely to pass the initial test module). However, once other control variables are added to the model specification, this difference is no longer statistically significant. One possibility to account for this overall similarity in passing rates is that both ship platforms incorporate AEGIS weapons systems—making the environment for learning aboard these ships the same.

The passing rates of officers from frigates (having no AEGIS systems) differ only from those assigned to destroyers in two self-directed training modules—Maritime Warfare (-14.8%) and DIVO Fundamentals (-12.6%). The magnitude of these estimated marginal effects is only slightly lower once all other controls are added, though the differences remain statistically significant.

The most pervasive difference in passing rates for the self-directed training modules is found for those assigned to amphibious ships, where differences are statistically significant for three of the four self-directed training modules (all but Engineering), as well as in the weighted total score for all four modules. While the difference in passing rates varies from -8% (Navigation-Seamanship) to -23% (Maritime Warfare) for the three training modules, the overall difference in the total score of the four modules is estimated to be -22.5%—even after all control variables are included in the model. These results suggest that the main reason for differences in passing rates for officers aboard amphibious ships is due to the varied learning environments, as opposed to differences in schooling ability or the length of time onboard ship or the time between the OOD-U/W qualification and attendance at SWOSDOC.

Differences in passing rates of the overall weighted CBT score, along with the Maritime Warfare and DIVO Fundamentals modules, for officers assigned to small/auxiliary ships (e.g., mine sweepers and combat logistics ships) compared to those assigned to destroyers are significant only in the first model. The estimated marginal effects for small/auxiliary ships are reduced when control variables are added, and they become statistically insignificant. These results suggest that while assignment to these ship types is correlated with lower passing rates on self-directed training modules, most of the differences are due to schooling-related ability differences rather than to differences in the learning environment across differing ship types.

Two additional exams are administered toward the end of the 3-week SWOSDOC program: one in a traditional classroom environment (Maritime Warfare Exam) and the other in a simulator one-on-one environment (Conning Officer Virtual Environment, or COVE). Here, we find no significant difference in passing rates (i.e., where passing requires a minimum score of 75% correct for the Maritime Warfare Exam, and a score of 4.0 out of 5.0 on the COVE exam) by ship type.[7] Most interesting is the finding that officers assigned to amphibious ships are 23% less likely to pass the self-directed Maritime Warfare training module but have nearly identical probabilities of passing the end-of-SWOSDOC Maritime Warfare exam, which is given in a traditional classroom environment. One possible explanation for these differences may lie in the role personal motivation plays in the self-directed training environment. DIVOs aboard amphibious ships most often do not experience the same command hierarchy with respect to Surface Warfare officers, as most of their superiors are from non-surface warfare communities. It is likely that very little pressure or expectations are made on amphibs with regard to passing the self-directed CBT training modules. To the extent this is true, Navy ship assignment policies must ensure that all DIVOs receive at least one assignment aboard CRUDES ships during their initial two DIVO tours. Other assignment possibilities could include the assurance of a “quality spread” across ship types for the first ship assignment; this, however, would constrain the self-selection process based upon academic-military performance rank order for graduates of the Naval Academy and OCS.

[7] The only exception to this finding is the 20% lower probability of passing the COVE exam for those assigned to small/auxiliary ships. One possibility is that little, if any, prior experience on these ships is related to personal navigation compared to experiences of all other ship types.

2. Home Port Assignment

As indicated earlier, graduates of USNA and NROTC self-select not only their ship type but also their home port. This is not to imply that graduates from these commissioning sources always get their first pick for both assignments, but only that they may be more likely to be assigned to either their preferred ship type or their preferred home port location. The lower panel of Figure 13 above categorizes respondents' home port assignments into three main groups: Atlantic Coast (50% of all assignments), Western Pacific (37% of all assignments, including Hawaii), and Japan (9% of all assignments). A final home port assignment (others) exists in the data, but its numbers are too small to chart. Casual observation of the chart indicates that officers assigned to the West Coast generally have higher passing rates on the overall score of self-directed training modules, while those from the Atlantic Coast have relatively lower passing rates.

To analyze the effect of home port assignments, we estimate logit models of self-directed and classroom training tests that include binary variables for home port. Those assigned to the Atlantic Coast are treated as the comparison group. Binary variables for the West Coast, Japan, and Other Ports are the only variables included in the first model. A second model is then specified that adds ship type, commissioning source, and gender. This second specification seeks to determine how the effect of home port assignment on passing rates changes once we control for commissioning source and ship type.[8] Since gender preferences for ships and home ports also may be important, a binary variable for gender is also included in this second specification. Finally, a third model is specified that includes college quality, academic major, and various variables that capture the junior officers' experiences aboard ships prior to their arrival at SWOSDOC.

[8] For the three large home port groups (Atlantic, Western Pacific, and Japan), roughly 50% of all ships were CRUDES. Twice as many amphibious ships are "home ported" in Japan than in the Atlantic or Western Pacific bases, while the Other Home Port (comprised of Ingleside, TX, Pascagoula, MS, and Sardina) had no amphibious ships, 23% frigates and 77% small/auxiliary ships.

The results of these three models for each self-directed CBT test and the two end-of-SWOSDOC exams are shown in Table 6. The results indicate that very little of the difference in passing rates on the self-directed training modules is explained by home port assignments. The major exception is the finding that home port affects passing rates on the DIVO Fundamentals module. However, these differences are either not affected or become exaggerated once additional control variables are added to the model. Officers assigned to Western Pacific bases or to Japan are +7.8% and +12.6%, respectively, more likely to pass this important self-directed module than those assigned to Atlantic Coast bases. Once ship type, commissioning source, and gender are included in the model specification, passing rate differentials for officers assigned to the "other base" category jump from +3.4% to +32.1% and become highly significant.

Identifying the reasons for this difference in passing rates within a self-directed training environment is beyond the scope of this study. However, we can eliminate the factors that are included in the model as explaining the remaining differential in passing rates. That is, these differences in this self-directed module are not due to differing ship types, to self-selection occurring from commissioning source and college quality, or to gender or ethnicity differences. Instead, other possible reasons include the OPTEMPO scheduling differences ("dwell time") that may exist across home ports, or the expectations and training environments set by each ship's commanding officer. Clearly, further analysis is required to understand why this difference exists.

Table 6. Effect of Home Port on Passing Rates on DIVO Fundamental Tests and Exams

CBT or Classroom Exam	Marginal Effects & Significance Levels of Home Port Impacts:					
	Western Pacific		Japan		Other	
	Marg. Effect	Sig. Level	Marg. Effect	Sig. Level	Marg. Effect	Sig. Level
Total CBT Score:						
Home Port Only	+.036	.386	-.016	.815	+.030	.751
Ship-Source—Gender Added	**+.071**	.088	+.063	.315	+.182	.111
Full Specification	NS		NS		NS	
Maritime Warfare Module:						
Home Port Only	+.040	.380	+.005	.949	-.006	.956
Ship-Source—Gender Added	NS		NS		NS	
Full Specification	NS		NS		NS	
DIVO Fundamental Module:						
Home Port Only	**+.082**	.066	+.101	.149	+.034	.747
Ship-Source—Gender Added	**+.081**	.076	**+.127**	.067	**+.309**	.007
Full Specification	**+.078**	.099	**+.126**	.080	**+.321**	.002
Engineering Module:						
Home Port Only	+.026	.490	-.016	.805	+.041	.623
Ship-Source—Gender Added	+.037	.324	+.008	.900	-.173	.424
Full Specification	NS		NS		NS	

CBT or Classroom Exam	Marginal Effects & Significance Levels of Home Port Impacts:					
	Western Pacific		Japan		Other	
	Marg. Effect	Sig. Level	Marg. Effect	Sig. Level	Marg. Effect	Sig. Level
Navigation-Seamanship Module:						
Home Port Only	+.032	.342	+.068	.156	-.033	.700
Ship-Source—Gender Added	NS		NS		NS	
Full Specification	NS		NS		NS	
Maritime Warfare Exam:						
Home Port Only	+.017	.559	-.004	.929	-.118	.209
Ship-Source—Gender Added	+.013	.655	+.003	.955	+.035	.726
Full Specification	NS		NS		NS	
COVE Exam:						
Home Port Only	+.035	.358	+.090	.110	+.086	.275
Ship-Source—Gender Added	+.031	.422	**+.095**	.086	**+.198**	.012
Full Specification	NS		NS		NS	

Another noteworthy finding in Table 6 is the lack of statistical difference in passing rates for the exams administered at the end of the SWOSDOC program. No differences in passing rates for the traditional classroom training program (Maritime Warfare) are found in any of the models, and the positive differential in passing rates of the COVE exam for officers assigned to Japan and the Other Category become insignificant once schooling ability (i.e., college quality and academic majors) and experience aboard ships are included in the model specification. In summary, the effect of home port assignment on the learning environment of self-directed training aboard ships is supported by the data analysis but is not related to more traditional classroom learning found at SWOSDOC.

B. Commissioning Source and College Quality

As discussed earlier, graduates of the Naval Academy and Naval ROTC units are given a rank order according to their academic and military performance as midshipmen. Individuals with higher rank order get to choose their ships and related home ports accordingly; thus, one must control for commissioning programs when analyzing the performance on self-directed and classroom training tests and exams. In addition, while the study lacks data on the academic ability of individuals, it is possible to approximate general levels of academic ability according to the quality of the school attended. In this study, the college or university of each officer is linked to the quality index taken from *Barron's Guide to Colleges and Universities*.

1. Commissioning Source

The first set of statistics analyzes the difference in passing rates on these tests and exams between graduates of the Naval Academy and others who attended "most selective" colleges either as a NROTC student or an OCS graduate.[9] The reason this is done is to determine the unique impact, if any, on the probability of passing the DIVO Fundamental tests of Academy graduates as compared to graduates of equally selective schools. In essence, these tests approximate the difference in test scores between an individual qualified for entry into USNA with those who are equally qualified, but who instead chose to attend a similarly selective civilian college or university. In this data set, there are 200 Annapolis graduates and a total of 63 other commissioned officers who attended "most selective" colleges (56 NROTC graduates and 7 OCS graduates). The passing rates on the weighted total self-directed CBT scores for Academy versus other graduates of "most selective" schools are plotted in Figure 14.

---

[9] As explained in more detail in the following section, there are roughly 24 colleges/universities included in this category of colleges in the *Barron's Guide to Colleges and Universities.* Schools with the largest number of officers include: Notre Dame (11), Cornell University (6), University of Southern California (5), and the University of Pennsylvania (4). Other schools in this category are MIT, Carnegie Mellon, Vanderbilt, and the University of Virginia, among others.

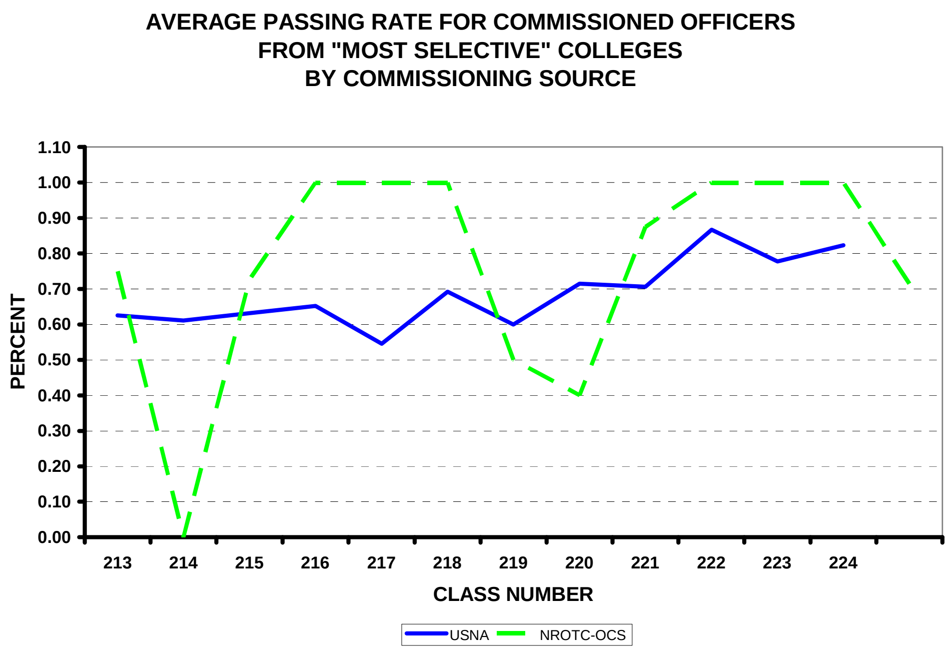


Figure 14. Average Pass Rate By College Selectivity

While the average passing rate of Academy graduates rises from 60% to over 80%, we notice many classes of NROTC and OCS graduates of most selective colleges have higher passing rates than USNA graduates. We now turn to statistical analysis of individual performance on self-directed and traditional classroom tests and exams for this sub-set of DIVOs. The results of the two-stage modeling of passing rates are presented in Table 7.

Table 7. Effect of Commissioning Source on Passing Rates on DIVO Fundamental Tests and Exams

CBT or Classroom Exam	Marginal Effects & Significant Levels of Commissioning Source:			
	NROTC*		OCS*	
	Marginal Effect	Signif. Level	Marginal Effect	Signif. Level
Total CBT Score:				
Commissioning Source Only	**+.139**	.075	**+.153**	.037
Full Specification	**+.157**	.042	**+.169**	.016
Maritime Warfare Module:				
Commissioning Source Only	**+..156**	.077	+.117	.279
Full Specification	**+.181**	.089	+.149	.175
DIVO Fundamental Module:				
Commissioning Source Only	+.119	.145	+.121	.188
Full Specification	**+.146**	.078	+.138	.138
Engineering Module:				
Commissioning Source Only	+.258	.111	**+.196**	.097
Full Specification	**+.265**	.000	**+.196**	.000
Navigation-Seamanship Module:				
Commissioning Source Only	+.023	.717	+.078	.196
Full Specification	NS		NS	
Maritime Warfare Exam:				
Commissioning Source Only	+.063	.256	+.057	.246
Full Specification	NS		NS	
COVE Exam:				
Commissioning Source Only	+.042	.583	-.056	.246
Full Specification	+.023	.590	**-.112**	.050

*Graduates of “most selective” colleges/universities only.

The first noteworthy outcome is that NROTC graduates from highly selective schools are more likely to pass three of the four self-directed modules and the overall CBT test than USNA graduates. The passing rate differential varies between 15% to 25% points (as compared to USNA graduates). These estimated marginal impacts are large, significant, and robust to adding control variables for ship type and home port, academic major, demographics, and junior officer Navy experience. We also find that the few OCS graduates of “most selective” colleges are also more likely than USNA graduates to pass the overall self-directed CBT test score and the Engineering module.

These results are surprising for two reasons. First, Naval Academy graduates receive the most Navy-specific education and training possible and have greater technical core exposure than others attending most selective colleges. One possible explanation for the outcomes in Table 5 is that performance on self-directed DIVO training modules—holding all other observables constant—mainly reflects self-motivation. The curriculum at USNA is highly structured with compulsory class attendance. Grades are assigned twice during the semester with severe penalties for those who have low grades or are failing a class, especially if it is in the core technical curriculum. Rarely do USNA midshipmen find academic environments that allow students to determine for themselves how much effort they exert during the semester. Graduates of highly selective colleges and universities, on the other hand, are far more likely to operate in learning environments that give greater latitude for student self-motivation. Other than flunking out, students are free to choose how to spend their time and effort in academic pursuits—with few, if any, repercussions for below-average performance. It is likely that the learning environment for the self-directed DIVO training modules is more akin to that experienced by graduates of selective civilian colleges and universities than by USNA graduates.

Another set of findings further support the above explanation in that once officers are brought together in the ”leveling experience” of SWOSDOC, few, if any, differences in performance are observed among students from different commissioning sources. There are no differences in passing rates of the more traditional classroom environment for the Maritime Warfare course, while OCS graduates are 11% less likely than USNA graduates to pass the simulator for the COVE course. This finding may support the notion that the naval seamanship and navigation courses taken by all midshipmen give them an edge over OCS graduates, who are not exposed to such professional academic courses during college.

2. College Quality

The model specifications also permit one to estimate the marginal effects uniquely related to college quality among NROTC and OCS graduates. As noted above, the study does not have any measure of academic performance of individual officers, so the quality of the school attended is used as a proxy for “student ability” in an academic environment. One would presume that graduates of higher quality educational institutions would be more likely to pass these self-directed and classroom tests than graduates of less selective colleges..

Table 8 below lists the names of colleges and universities attended by the officers attending SWOSDOC Classes 213 through 224 during 2007 and 2008. Over 100 officers attended “Highly Competitive” schools—including UC Berkeley, Lehigh, University of Miami, and large competitive state schools like Michigan, Minnesota, Penn State, and Wisconsin. Seventy officers attended “Very Competitive” schools including Virginia Tech, Purdue, VMI, and Auburn. The largest group of schools (117 officers) attended “Competitive Colleges,” including Florida State and the University of Florida, Maryland, Oklahoma, and The Citadel. A small number of officers (19) attended “Least Competitive” schools like Hampton Roads, Prairie View A&M, and Southern University.

Table 8. List of Colleges & Universities of NROTC & OCS Commissioned Officers by *Barron's* Quality Index

MOST COMPETITIVE:		HIGHLY COMPETITIVE:		VERY COMPETITIVE:		COMPETITIVE:		LEAST COMPETITIVE:	
Boston College	2	Bentley College	1	Auburn Univ	1	Abilene Christian University	1	Hampton Roads	2
Boston University	2	UC at Berkeley	3	California Poly S U	1	Arizona, Univ of	10	Idaho, Univ	7
UCLA	1	Colorado School of Mines	1	Drexel Univ	1	California Maritime Academy	1	New School Univ	1
Carnegie Mellon Univ	2	Connecticut, Univ of	1	Duquesne Univ	2	Central Missouri St Univ	1	Norfolk State Univ	2
Connecticut College	1	Fordham Univ	2	Georgia State Univ	3	Colorado, Univ of	5	Norfolk State University	1
Cornell Univ	6	George Washington Univ	7	Illinois, Univ of	4	Eastern Michigan	3	Prairie View A & M Univ	3
Georgetown Univ	2	Georgia Institute of Tech	5	Iowa State	3	Embry-Riddle Aero Univ	1	Savannah State Univ	1
Harvard	1	Illinois Institute of Tech	1	Louisiana State Univ	2	Florida State Univ	2	Southern Univ	1
Holy Cross, College of the	4	Kettering University	1	Loyola Univ	1	Florida, Univ of	5		
MIT	1	Lehigh	1	Missouri, Univ of	5	Hampton University	2		
New York Univ. at Buffalo	1	Marquette Univ	4	Nebraska Univ	2	Houston, Univ of	1		
UNC at Chapel Hill	3	Miami of Ohio	3	North Florida, Univ of	2	Humboldt State Univ	1		
Northeastern	1	Miami Univ	3	Purdue Univ	3	Jacksonville Univ	9		
Northwestern	1	Michigan, Univ of	2	Rochester Inst of Tech	4	Liberty Univ	1		
Notre Dame, Univ of	11	Minnesota Univ	1	South Carolina, Univ of	3	Maine Maritime Academy	5		
Pennsylvania, Univ of	4	North Carolina State Univ	6	South Florida, Univ of	6	Maine Univ	2		
Rice Univ	1	Ohio State Univ	8	St. Thomas, Univ of	1	Maryland, Univ of	4		
Rochester, Univ of	3	Penn State	13	SUNY Brockport	1	Massachusetts Marit Acad	1		
Southern California, Univ of	5	Pittsburgh, Univ of	2	SUNY Stoybrook	1	Memphis Univ	3		
Tulane Univ	3	Rensselaer Poly Institute	2	Utah Univ	2	Mississippi, Univ of	3		
University of Southern Cal	1	San Diego, Univ of	11	Virginia Military Institute	3	Morehouse College	1		
Vanderbilt Univ	5	Syracuse Univ	1	Virginia Tech	6	New Mexico, Univ of	1		
Virginia, University of	3	Texas A & M	10	Washington, Univ of	9	Norwich Univ	5		
Washington and Lee Univ	1	Texas, Univ of	2	Worcester Poly Institute	4	Oklahoma Univ	4		
		Villanova	4			Old Dominion Univ	16		
		Wisconsin-Madison Univ	4			Oregon State	9		
						Saint Leo University	1		
						San Diego State Univ	5		
						San Jose State Univ	1		
						Southern Illinois Univ	1		
						St. Leo College	1		
						Temple Univ	1		
						The Citadel	8		
						UMBC	1		
						Wayland Baptist Univ	1		
Total	65	Total	101	Total	70	Total	117	Total	19

As shown in Figure 15,, the passing rate on the weighted total self-directed CBT test varies greatly across the SWOSDOC classes by college quality. In general, the passing rate tends to rise over time. Often, 100% of graduates of the most selective colleges achieve passing scores on the weighted self-directed SWOSDOC test score.

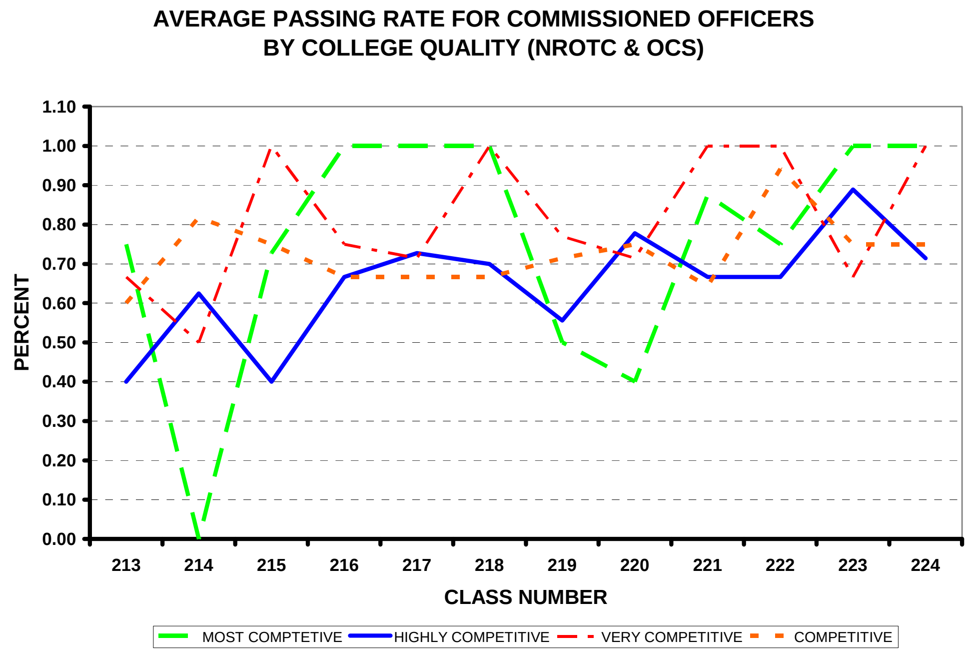


Figure 15. Passing Rates of NROTC & OCS Graduates on Total DIVO Fundamentals Exam by College Quality

To gain a better understanding of the possible effect of school quality on passing rates on DIVO training tests and exams, we once again structured two-stage econometric models; only school quality is included in the first model. The second model includes additional explanatory variables related to test performance. These results are reported in Table 9.

Since one would expect the marginal impacts of college quality to be negative (since the comparison group is the "most selective" schools), and the size of the estimated impacts to be larger the less competitive the school, the results shown in Table 9 are surprising. They indicate that only graduates from the "highly selective" (second rank in quality) and the "least selective" (lowest rank in quality) are less likely to pass most of the self-directed CBT modules. For example, graduates of the most selective and least selective colleges are 31% less likely to achieve a passing grade on the combined weighted total CBT score than those from the most selective colleges. Similar findings characterize the Maritime Warfare module. It is also of interest to note that graduates from all quality levels—compared to the omitted "most selective" category—are far less likely to pass the Engineering module, with lower passing rates varying from -25% to -42%. Finally, the passing rates on the self-directed CBT tests for graduates of the "very selective" colleges rank second to those from "most selective" colleges. The only passing rates that are significantly different for these graduates are found in the Engineering module, and the size of the marginal impact (-27.3%) is the smallest of all school quality categories reported in the table.

Table 9. Effects of College Quality on Passing Rates on DIVO Fundamental Tests and Exams

CBT or Classroom Exam	Marginal Effects & Significance Levels of College Quality*							
	Highly Selective		Very Selective		Competitive		Least Competitive	
	M.E.	Sig. Lev.	M.E.	Sig. Lev.	M.E.	Sig. Lev.	M.E.	Sig. Lev.
Total CBT Score:								
School Quality Only	**-.263**	.027	-.123	.241	-.123	.238	**-.261**	.024
Full Specification	**-.306**	.013	-.164	.136	-.152	.157	**-.303**	.011
Maritime Warfare Module:								
School Quality Only	**-.273**	.000	-.084	.369	-.113	.222	**-.215**	.009
Full Specification	**-.300**	.000	-.129	.157	**-.149**	.099	**-.247**	.001
DIVO Fundamental Module:								
School Quality Only	-.087	.414	+.052	.577	-.222	.815	-.057	.583
Full Specification	-.138	.213	+.010	.921	-.047	.636	-.058	.594
Engineering Module:								
School Quality Only	**-.424**	.002	**-.246**	.068	**-.317**	.015	**-.347**	.015
Full Specification	**-.451**	.002	**-.273**	.050	**-.346**	.010	**-.363**	.014
Navigation-Seamanship Module:								
School Quality Only	-.060	.517	-.041	.603	-.027	.726	-.081	.389
Full Specification	NS		NS		NS		NS	
Maritime Warfare Exam:								
School Quality Only	+.034	.608	-.094	.320	-.101	.275	-.058	.524
Full Specification	NS		NS		NS		NS	
COVE Exam:								
School Quality Only	-.030	.768	-.016	.863	-.055	.553	-.056	.579
Full Specification	NS		NS		NS		NS	

*Graduates of NROTC and OCS only.

These school quality differences, however, do not seem to affect the students' performances on the end-of-SWOSDOC exams, since none of the schooling variables are statistically significant predictors. One possible explanation for this pattern of marginal effects could be that school quality may be measuring differences in individual motivation levels rather than differences in cognitive skills. It is unfortunate that individual college grades were not included in the data base, as using overall school quality is an imperfect proxy for individual academic performance.

C. Academic Majors

The academic majors of commissioned officers were categorized into six groups. Thee first three are more technical in nature and include engineering, math/physical sciences, and biological sciences. The last three are non-technical in nature and include business/economics, the social sciences, and arts and humanities.[10] The passing rates on the weighted total CBT tests by academic majors are shown in Figure 16 below. This chart illustrates that engineers generally have higher passing rates than non-technical majors.

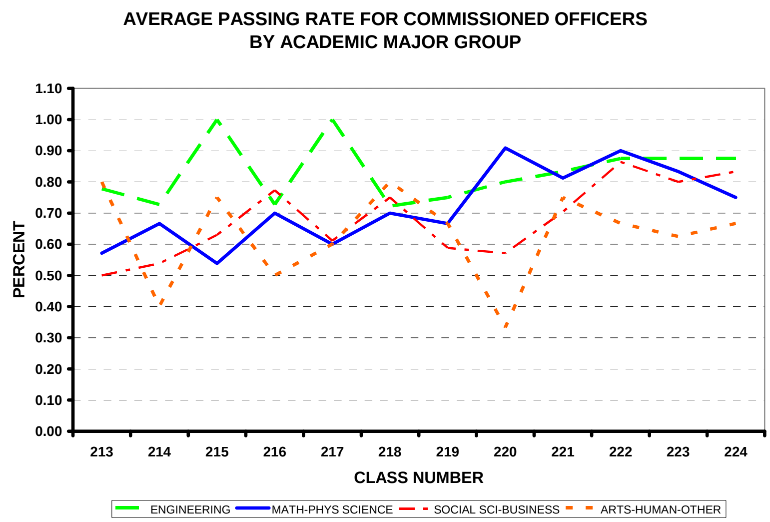


Figure 16. Passing Rates of Commissioned Officers on Total DIVO Fundamentals Exam by Academic Majors

---

[10] A seventh major group—other majors—is included in the statistical models but has only eleven officers. These majors are so different from the others that they were not included with the others and included such majors as physical education, design, health and wellness, and human nutrition.

To gain a better understanding of the effect of academic major on the self-directed CBT tests and more traditional classroom exams at SWOSDOC, we next developed two stage models of the probability of passing these tests. In these models, only college major is specified in the first stage and other significant explanatory variables are included in the second stage. The results of these logistic regression models are displayed in Table 10 below.

In general, there is little difference in performance on the self-directed training modules among the technical majors. The only exception is quite surprising: math/physical science majors are 17.5% less likely to pass the Engineering module than are engineering majors.

Table 10. Effect of Academic Major on Passing Rates on DIVO Fundamental Tests and Exams

CBT or Classroom Exam	Marginal Effects (M.E.) and Significance Levels of Academic Majors:											
	Math/Phys.Sci.		Bio Sciences		Bus/Econ		Social Sciences		Arts & Humanities		Other Majors	
	M.E.	Sig. Level	M.E.	Sig. Level	M.E.	Sig. Level	M.E.	Sig. Level	M.E.	Sig. Level	M.E.	Sig. Level
Total CBT Score:												
Academic Major Only	-.055	.496	-.129	.178	**-.187**	.012	-.102	.113	**-.170**	.081	-.188	.259
Full Specification	-.044	.592	-.087	.369	**-.169**	.031	-.095	.154	**-.167**	.103	-.134	.438
Maritime Warfare Module:												
Academic Major Only	-.063	.386	-.039	.654	-.092	.165	+.009	.880	-.042	.629	-.096	.515
Full Specification	NS		NS		NS		NS		NS		NS	
DIVO Fundamental Module:												
Academic Major Only	-.064	.413	-.044	.632	-.094	.185	-.079	.210	**-.179**	.047	-.029	.858
Full Specification	-.074	.362	-.060	.533	-.113	.130	**-.111**	.095	**-.178**	.057	-.083	.627
Engineering Module:												
Academic Major Only	**-.162**	.068	-.061	.531	**-.214**	.009	**-.137**	.040	**-.274**	.010	+.040	.792
Full Specification	**-.175**	.053	-.051	.591	**-.215**	.009	**-.163**	.017	**-.280**	.010	+.027	.857
Navigation-Seamanship Module:												
Academic Major Only	-.007	.906	-.038	.625	-.065	.295	-.045	.388	-.047	.557	+.063	.560
Full Specification	NS		NS		NS		NS		NS		NS	
Maritime Warfare Exam:												
Academic Major Only	-.013	.847	**-.210**	.070	**-.234**	.010	**-.109**	.078	-.041	.641	*	
Full Specification	-.007	.910	**-.228**	.057	**-.230**	.011	**-.111**	.069	-.048	.596	*	
COVE Exam:												
Academic Major Only	+.034	.621	+.017	.831	**-.167**	.020	-.076	.204	-.123	.187	-.092	.563
Full Specification	+.040	.553	+.026	.743	**-.182**	.016	**-.119**	.061	-.160	.109	-.211	.247

* All eleven officers in this “other majors” category passed, which forces the variable to be excluded from the logistic regression.

One expected outcome of this research is the finding that officers with non-technical majors are less likely to pass the self-directed training modules than are engineering majors. For example, commissioned officers with business/economics or arts and humanities majors are 17% less likely to score a passing grade on the combined weighted CBT test compared to engineers, and both are less likely to pass the engineering module than engineers (-22% and -28%, respectively). In addition, social science majors are less likely to pass the DIVO Fundamentals and the Engineering modules than engineers (-11% and-16%, respectively). In general, these findings suggest that many of the competencies required to pass the self-directed DIVO training modules are more quantitative and/or technical in nature and that academic major plays an important role in predicting achievement on these self-directed tests.

The impact of college major also correlates to performance in the more traditional classroom training programs at SWOSDOC. Business/economics majors are 23% less likely to pass the Maritime Warfare exam and 18% less likely to pass the COVE simulator test than are engineering majors. Likewise, social science majors are 11% less likely to pass the Maritime Warfare exam and 12% less likely to pass the COVE simulator test than are engineering majors. In summary, knowledge acquired in technical majors appears to be related to performance on both self-directed test onboard ships as well as exams administered in the classroom environment of SWOSDOC.

D. Demographic Factors

The last two factors included in the statistical models of self-directed CBT tests and SWOSDOC exams are ethnicity and gender. Ethnicity plays essentially no role in explaining the performance on the self-directed DIVO training modules or the traditional classroom Maritime Warfare course given at SWOSDOC.[11] It does, however, play a significant role in explaining the passing rate on the simulator environment COVE exam. As shown in Table 11 below, all ethnic minorities are less likely to pass the COVE exam than are members of the White majority. Specifically, African-Americans and Asian Pacific Islanders are roughly 25% less likely to pass this exam, and Hispanics are 34% less likely to pass the COVE exam than are Caucasian officers. Clearly, more analysis is required to gain a full understanding of these ethnic differences that are strong and significant, as there is no evidence of such differences for all other self-directed or traditional classroom training programs.

Table 11. Effect of Race and Ethnicity on Passing Rates on SWOSDOC COVE Exam

COVE Exam	Marginal Effects & Significance Levels of Ethnicity			
	Ethnicity Only		Full Model Specification	
	Marg. Effect	Sig. Level	Marg. Effect	Sig. Level
African American	**-.240**	.006	**-.246**	.009
Hispanic	**-.267**	.015	**-.339**	.003
Asian Pacific Islands	**-.245**	.010	**-.265**	.007
Other Ethnic	**-.219**	.028	**-.216**	.034

1. Gender

As noted in Figure 17, the passing rate on the weighted total CBT score for females is generally below that of males. This result is unexpected, as typically females test either the same or better than males in most administered tests. To better understand this outcome, we constructed two-stage logistic models on the probability of passing self-directed tests and classroom training exams. In the first stage, only gender is included as an explanatory variable; in the second stage, other

[11] The only exception is found with African-American commissioned officers, who are 16% less likely to pass the self-directed DIVO Fundamentals module than are White majority officers.

significant factors related to test performance are added so that we could derive a better estimate of the independent and unique impact gender may have on testing performance. The results of these logistic regression models are displayed in Table 12.

Quite surprisingly, female officers are less likely to pass two of the four self-directed DIVO training models, as well as to score below the weighted total CBT score. These differences in passing rates are large and significant—with females being 29% less likely to pass the overall CBT test, 27% less likely to pass the Maritime Warfare module, and 16% less likely to pass the Engineering module compared to male officers. It may also be noted that these marginal effects are larger than in the restricted model that includes only gender—suggesting that control factors on average favor females over males. For example, females are more likely to be assigned to a CRUDES ship (58% vs. 49%) and to be assigned to the West Coast (47% vs. 34%)—which, as noted earlier, is correlated with higher passing rates on the self-directed training modules.

It is also of interest to note that gender differences in passing rates are not found with the SWOSDOC classroom program for Maritime Warfare. The marginal effect for females is positive but not statistically significant compared with a highly negative and significant estimate for the self-directed Maritime Warfare module. In addition, no significant gender differences are found in passing rates on the COVE exam. These findings suggest that the environment aboard ships on which self-directed learning occurs may be quite different for female compared with male officers. Many background variables—such as commissioning source, school quality and academic majors—are controlled, as are the ship type and home port assignments. In spite of these controls, achievement on self-directed tests by females is lower than for males but is essentially the same in the SWOSDOC training program. These findings may suggest a need for improved mentoring of female junior officers, who may easily get forgotten in the hectic life aboard ships.

VII. Summary and Recommendations

The general success of self-directed CBT paired with OJT is found to vary significantly with respect to ship type and home port assignment, as well as with respect to pre-commissioning factors such as commissioning source, quality of undergraduate college, and academic majors, as well as demographic characteristics, especially gender. Considerations for rewarding exemplary achievement on these tests are also noted.

A. Ship Type and Home Port Assignments

Officers assigned to non-CRUDES ships are significantly less likely to pass the self-directed CBT modules aboard ships. At this point, one can only conjecture why this is so. It is possible that the hierarchical command structure of amphibious ships, which includes many non-surface warfare officers, and the size of aircraft carriers accounts for much of why junior officers from these ship types fail to do as well as those on CRUDES ships. If the Surface Warfare community is serious about improving JO training, we recommend that more resources be directed to determine the reasons for this anomaly. Similarly, we recommend that future research be conducted on why junior officers with home ports on the Atlantic coast (i.e., Norfolk and Jacksonville) have significantly lower passing rates on Division Officer Fundamental CBT tests than others. Researchers must distinguish possible differences due to OPTEMPO schedules from cultural differences that may exist in the senior commands between Pacific and Atlantic fleet ports. To the extent that these differences in self-directed training mirror larger differences in junior officer training opportunities, we recommend that the surface community consider developing incentives that will alter the motivation of both junior officers and their immediate superiors regarding the time devoted to and the value of self-directed CBT.

B. Pre-commissioning Factors

The study found significant differences in the success of self-directed CBT aboard ships across all the commissioning programs. Most surprisingly, Naval Academy graduates had significantly lower passing rates than otherwise similar officers commissioned via NROTC and OCS. Given the numerous explanatory variables included in the models, the study concludes that observed differences in passing are most likely related to differences in motivation that result from the structure and rigor in their academic programs. It is quite possible that observed differences in self-directed CBT tests aboard ships are due, to a large extent, to how motivated individuals are to do well on the CBT. Without any formal initial classroom training, all Division Officers must find time in a very busy day to study, generally on their own time. One possibility is that graduates of the more selective civilian colleges are already highly self-motivated to study on a regular basis without direct supervision—perhaps more so than Naval Academy midshipmen. On the other hand, USNA midshipmen have been exposed to far greater levels of military indoctrination than graduates of other sources, which would rule out their being ill-prepared for the material covered in the four self-directed training modules. We recommend that future research should investigate this difference.

The study also found that the quality of a student's undergraduate college—used as a proxy for general academic ability—is directly related to performance on the self-directed CBT modules. Graduates of the most selective colleges, including USNA, have significantly higher passing rates than those from less selective schools. We recommend the Navy consider both directing more resources to students enrolling in NROTC units at more prestigious schools, as well as directing greater efforts on part of OCS recruiters towards the more selective colleges.

The study also finds that graduates with technical majors have higher passing rates on the self-directed CBT tests than those with non-technical skills. We realize we must be careful here in drawing conclusions, since it may be possible that much of the skill content of the self-directed training modules may be more quantitative than qualitative in nature. Nowhere are Division Officers tested on inter-personal skills that may be directly related to leadership or military career aspirations. Clearily, the self-directed training modules only capture a portion of the skills need by JOs to be successful DIVOs. Nonetheless, it is still important for senior leadership aboard ships to point out to new Division Officers this finding regarding technical knowledge and to ensure that more time be devoted towards learning from these self-directed training modules for those without technical degrees. In addition, we recommend that the SWO community ensure that the material covered in these four modules be integrated into the curriculum taken near graduation for midshipmen from USNA and NROTC.

C. Demographic Factors

One of the most important findings of the study is that females have significantly lower passing rates on the self-directed CBT modules, but comparable pass rates in the SWOSDOC classroom exams. Given the many control factors specified in the model, the most likely explanation for this finding once again may well be motivational differences by gender. For example, female officers are relatively scarce aboard naval ships of all types, which may make it difficult to find strong mentors who can provide sound professional advice, while being fully upright and truthful regarding their performance relative to male junior officers. We recommend that senior leadership aboard ships be made aware of the gender performance differential and ensure that more effort on the part of female Division Officers be directed to the self-directed training. It is important to note, moreover, that the same can be said regarding all aspects of the culture and environment of junior officer training in general. One cannot presume that female DIVOs experience the same training environment as do their male counterparts, and the researchers highly recommended that greater resources be directed toward a better understanding of gender differences that may exist in the early developmental training aboard ships of junior SWOs.

In general, the study finds few differences in self-directed CBT tests by ethnicity. The only exception to this outcome is on the Conning Officer Virtual Environment (COVE) exam following one-on-one experience in a simulation environment that is given toward the end of SWOSDOC. The study finds that minorities are far less likely to pass this exam, which appears to be composed of fundamental skills relevant to passing the Surface Warfare Qualification on their ships. Future researchers need to analyze these exam results in more detail to see where and why minorities are performing below their counterparts. We recommend that SWOS consider extending time at SWOSDOC to anyone not passing this important exam so that all who complete the “leveling experience” can be counted as having passed this exam.

In summary, the most important results of the study suggest that the success of training opportunities for Division Officers differs significantly between self-directed CBT aboard ships and the more traditional classroom environment of SWOSDOC. The time directed to and motivation to acquire self-directed CBT varies widely across ship types, home ports and several demographic characteristics—including gender, commissioning source, college quality and academic major of newly commissioned JOs. Most, if not all, of these differences seem to disappear when junior officers are given introductory training in a traditional classroom environment in which DIVOs are given the single task of learning new information without other day-to-day responsibilities aboard ships. The instruction is highly standardized and communicated by instructors whose sole task is to teach and instruct junior officers. This study, if nothing else, underscores the realization that currently little is known regarding the impact of ship type and home port on training opportunities, let alone why differences in learning occur due to gender or commissioning source. It is highly recommended that additional resources be directed to a better understanding of learning and training opportunities aboard ships before final decisions are made regarding the division of resources between introductory classroom and early CBT aboard ships. It is important that the Surface Community both standardizes its introductory training of junior officers as well as ensures the initial training is highly effective and conducive to learning what is required to be a successful career surface warfare officer.

D. Rewarding Exemplary Behavior

As noted above, one way to improve motivation to complete the self-directed training is to adopt proper incentives for both Division Officers and their senior leadership aboard ships. Leadership at SWOSDOC has already begun such efforts by making the results of the initial test scores transparent to ship commands and by rewarding those who achieve superior scores on three selected tests and exams.

The first two include the CBT modules of Maritime Warfare (score of 84 or higher with a range of 42-100) and Division Officer Fundamentals (score of 84 or higher with a range of 44-100). The third is the Rules-of-the-Road exam at SWOSDOC (score of 95 or higher with a range of 68-102).[12] Out of the 733 Division Officers who completed the SWOSDOC program during the period covered by this study, 30 (or 4%) achieved superior scores according to the incentive program. Table 13 below indicates the distribution of officers with superior scores by ship type and home port assignments. Those assigned to destroyers or cruisers are twice as likely to earn this prestigious reward as those on frigates, who were three times as likely to earn the reward as those assigned to amphibious ships, carriers, and small or auxiliary ships. In addition, those assigned to the Western Pacific and Japan are twice as likely to earn the reward as those from Atlantic home ports, and six times as likely as those from Gulf shore ports. If the surface warfare community wants to provide incentives to all its junior officers, we recommend that more be done to standardize junior officer training opportunities across ship types and home port assignments, or to develop different awards for those with significantly different initial assignments.

---

[12] The ranges noted in parentheses are those reflected from the sample of Division Officers in the analysis data base of the study.

Table 13. Number and Percent Achieving Superior Performance

Division Officers Achieving Superior Performance on Surface Warfare Fundamental Tests and Exams			
Ship Type:	Number	Total	Percent
Destroyer	16	258	6.2
Cruiser	7	104	6.7
Frigates	3	122	2.5
Amphibious	4	187	2.1
Small Boat/Auxiliary	0	38	0
Carriers	0	24	0
	30	733	4.1
Home Port:			
Atlantic	10	358	2.8
Western Pacific	16	279	5.7
Japan	4	68	5.9
Other	0	28	0
TOTAL	30	733	4.1

In summary, the study addresses personal achievement on initial junior officer tests and exams, which are related to the technical skills and competencies of Division Officers. While uncovering achievement differences on these tests that are related to pre-commissioning factors, the study finds additional variations in test performance related to the environments aboard ships and across home ports that may possibly be indicative of a larger issue related to the early training opportunities of junior officers in the surface Navy. To the extent this is true, it is in the best interest of the community to investigate in more depth why training environments for junior officers differ to the extent that has been found in this study.

List of References

Abell (2000). Abell, M. (2000). *Soldiers as distance learners: What Army trainers need to know.* Futures Training Division, U.S. Army Headquarters Training and Doctrine Command, Fort Monroe, VA. Paper presented at the 2000 Interservice/Industry Training, Simulation & Education Conference.

Allen, M., Mabry, E., Mattrey, M., Bourhis, J., Titsworth, S., & Burrell, N. (2004). Evaluating the effectiveness of distance learning: A comparison using meta-analysis. Journal of Communication, 54 (3), 402 – 420.

Alliger, G. M., & Janak, E. A. (1989). Kirkpatrick's levels of training criteria: Thirty years later. *Personnel Psychology*, *42*(2), 331-342.

Alliger, G. M., Tannenbaum, S. I., Bennett Jr., W., Traver, H., & Shotland, A. (1997). A meta-analysis of the relations among training criteria. *Personnel Psychology, 50*(2), 341-358.

Anderson & Benjamin 1994 Anderson, G., & Benjamin, D. (1994). The determinants of success in university introductory economics courses. *Journal of Economic Education, 25*(2), 99.

Anderson, T. (2003). Modes of interaction in distance education: Recent developments and research questions. In Moore, M. & Anderson, G. (Eds.), *Handbook of Distance Education* (pp.129-144). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Arzigian, S. (1967). *On the job training costs: An analysis* (No. AD0656581). Washington, DC: US Navy Bureau of Naval Personnel. Retrieved June 10, 2008, from http://handle.dtic.mil/100.2/AD656581

Assistant Secretary of the Navy Financial Management and Comptroller. (2002). *Highlights of the Department of the Navy FY 2003 budget.* Washington, DC: Department of the Navy. Retrieved April 9, 2008, from http://www.finance.hq.navy.mil/

Assistant Secretary of the Navy Financial Management and Comptroller. (2008). *Highlights of the Department of the Navy FY 2009 budget*. Washington, DC: Officer of the Assistant Secretary of the Navy Financial Management and Comptroller. Retrieved March 12, 2008, from http://www.finance.hq.navy.mil/

Balisle, P. (Director Surface Warfare Division). (2002). *Surface warfare officer (SWO) qualification and designation* (OPNAVINST 1412.2H). Washington, DC: Office of the Chief of Naval Operations.

Barron's profile of American colleges. (2006). (27th ed.). Hauppauge, NY: Barron's Educational Series, Inc.

Bates, R. (2004). A critical analysis of evaluation practice: The kirkpatrick model and the principle of beneficence. *Evaluation and Program Planning, 27*(3), 341-347.

Bernard, R., Abrami, P., Lou, Y., Borokhovski, A., Wozney, L., Wallet, P., Fiset, M., & Huang, B. (2004). How does distance education compare to classroom instruction? A meta-analysis of the empirical literature. Review of Educational Research, 74 (3), 379-439.

Blevins, L., Jones. S. , Mally, W. & Monroe, J. (2003). The U.S. Marine Corps distance learning program. In Moore, M. & Anderson W. (Eds.), Handbook of Distance Education (pp. 641-654). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Bowman, W. R., & Mehay, S. L. (2002). College quality and employee job performance: Evidence from naval officers. *Industrial and Labor Relations Review, 55*(4), 700-714.

Brewer, D. J., Eide, E. R., & Ehrenberg, R. G. (1999). Does it pay to attend an elite private college? *Journal of Human Resources, 34*(1), 104-123.

Butcher, D.F. & Muth, W.A. (1985). Predicting performance in an introductory computer science course. *Communication ACM, 28*(3), 263-268. Retrieved May 27, 2008, from http://doi.acm.org/10.1145/3166.3167.

Carey, N. B., Reese, D. L., Lopez, D. F., Shuford, R. W., & Wills, K. J. (2007). *Time to train in self-paced courses and the return on investment from course conversion*. Alexandria, VA: The CNA Corporation.

Chapman, D. S. (1992). *The performance of naval reserve officers training corps graduates at the surface warfare officers' school division officer course* (Master's Thesis). Monterey, CA: Naval Postgraduate School.

Chief of Naval Operations. (1999, August 3). *Surface warfare training strategy* (OPNAVINST 1500.57A). Washington, DC: Rear Admiral M. G. Mullen, Director Surface Warfare Division.

Chief of Naval Operations. (2002, May 3). *Surface warfare officer (SWO) qualification and designation* (OPNAVINST 1412.2H). Washington, DC: Philip M. Balisle, Director Surface Warfare Division.

Chief of Naval Operations Surface Warfare Directorate. (2002, June 15). *Navigation, seamanship and shiphandling training requirements document.* Washington, DC: Office of the Chief of Naval Operations.

Chief of Naval Operations. (2006, October 10). *Naval training system requirements, acquisition and management* (OPNAVINST 1500.76A). Washington, DC: Vice Admiral J. C. Harvey Jr., Deputy Chief of Naval Operations (Manpower, Personnel, Training and Education).

Chisholm, M., Cobb, H., & Kotzan, J. A. (1995). Significant factors for predicting academic success of first-year pharmacy students. *Am J Pharm Educ, 59*, 364-370.

Coleman, D. W. (1988). *Naval computer-based instruction: Cost, implementation and effectiveness issues.* (Master's Thesis). Monterey, CA: Naval Postgraduate School.

Commander Naval Surface Forces (2002, December 29). *Surface warfare division officer training and qualification*. Message sent to all Navy Surface Forces, Washington, DC: VADM LaFleur.

Corporate Leadership Council, Corporate Executive Board. (2004). *Fact brief: Determining e-learning strategies*. (Catalog No.: CLC11T0NNV). Available from: https://www.clc.executiveboard.com/Members/Default.aspx

Corporate Leadership Council, Corporate Executive Board. (2005). *Fact brief: Profiles of learning delivery channels.* (Catalog No.: CLC13Z3K4J). Available from: https://www.clc.executiveboard.com/Members/Default.aspx

Coulson, J. E. (1968). Computer-based instruction. *International Review of Education/Internationale Zeitschrift Für Erziehungswissenschaft/Revue Internationale De l'Education, 14*(2, Uses and Values of the Computer in Education/Verwendungsmoglichkeiten und Bedeutung des Computers in der Padagogik/L'emploi et les possibilities de l'ordinateur dans l'education), 140-154.

Crawford, A. M., & Hollan, J. D. (1983). *Development of a computer-based tactical training system* (92D Behavior & Society: Education, Law, & Humanities; 92A Behavior & Society: Job Training & Career Development No. NPRDCSR8313; SBIADF630505; ADA1497130). San Diego, CA: Navy Personnel Research and Development Center.

Damp, D. V. (2007). *Federal jobs net.* Retrieved June 9, 2008, from http://federaljobs.net/.

Davis, S. (2008, January). Building the next Nelson. *US Naval Institute Proceedings.*

Defense Finance and Accounting Service. (2008). *Military pay tables.* Retrieved June 2, 2008, from http://www.dfas.mil/militarypay/militarypaytables/militarypaypriorrates.html

De Jong, J., Thijssen, J., & Versloot, B. (2001). Planned training on the job: A typology. *Advances in Developing Human Resources,* 3 (4), 408-414.

Dertouzos, Lester, & Solow. (1989). *Made in America: Regaining the Productive Edge.* Cambridge, MA: MIT Press.

Division Officer Training Department. (2005a, May 12). *Division officer's course lessons.* Retrieved February 22, 2008, from the Surface Warfare Officers School Command website: https://wwwcfs.cnet.navy.mil/swos /restricted/Doc/Lessons.cfm

Division Officer Training Department. (2005b, May 12). *Shipboard coordinator handbook.* Retrieved January 22, 2008, from the Surface Warfare Officers School Command website: https://wwwcfs.cnet.navy.mil/swos /restricted/Doc/Downloads.cfm

Dyer, J., Singh, H., & Clark, T. (2005). *Computer-based approaches for training interactive digital map displays*. U.S. Army Research Institute for the Behavioral and Social Sciences. (Research Report 1842). Retrieved from: www.hqda.army.mil/ari/pdf/RR1842.pdf

Ehrenberg, R.G., & Smith, R.S. (2006). *Modern labor economics: Theory and public policy* (9th ed.). San Francisco, CA: Pearson Education.

Ellis, J. A. (1985). *Military contributions to instructional technology*. New York: Praeger.

Eskew, R. K., & Faley, R. H. (1988). Some determinants of student performance in the first college-level financial accounting course. *The Accounting Review, 63*(1), 137-147.

Ewing, P. (2008 June 15). Waterfront training planned for new SWOS 4-week 'Back to Basics' course begin in August. *Navy Times*.

Executive Review of Navy Training. (2001, August 8). *Revolution in training* (ADA419988). Washington, DC: Office of the Chief of Naval Operations.

Fortune. (2008). The 100 best companies to work for 2008. *Fortune, 157*(2), 61-80.

Fritzson, A., Howell Jr., L.W., & Zakheim, D.S. (2008). Military of millennials. *Strategy + Business, 49*, 1-6.

Gagne, R., Briggs, L., & Wagner, W. (1992). Principals of instructional design (4^{th} Ed.) HJB College Publishers.

Gallup, D. A., & Beauchemin, K. V. (2000). On-the-job training. In G. M. Piskurich, P. Beckschi & B. Hall (Eds.), *The ASTD handbook of training design and delivery* (pp. 121-132). San Francisco, CA: McGraw-Hill Companies.

Gavino, C.C. (2002). Cost effectiveness analysis of the “Sea to SWOS” training initiative on the surface warfare officer qualification process (Master's Thesis). Monterey, CA: Naval Postgraduate School. Retrieved January 3, 2008, from http://handle.dtic.mil/100.2/ADA411336

Gay, R. M. (1974). *Estimating the cost of on-the-job training in military occupations: A methodology and pilot study* (R-1351-ARPA). Santa Monica, CA: RAND. Retrieved April 30, 2008, from http://www.rand.org/pubs/reports/2006/R1351.pdf

Gibbons, A. S., & Fairweather, P. G. (2000). Computer-based instruction. In S. Tobias & J. D. Fletcher (Eds.), *Training & retraining: A handbook for business, industry, government, and the military* (pp. 410-442). New York: Macmillan Reference.

Goodwin, D. (2003, February 14). Navy reengineers surface warfare training. *NETC News,* News Release #008-03.

Holden, J. & Westfall, P. (2006). *An instructional media selection guide for distance learning.* United States Distance Learning Association. Boston, MA. Retrieved from: www.usdla.org/pdf/2%20_USDLA_Instructional_Media_Selection_Guide.pdf

Howe, N. (2005). Harnessing the power of millennials. *School Administrator, 62*(8), 18-22.

Howe, N., & Strauss, W. (2000). *Millennials rising*. New York, NY: Vintage Books.

Hui, W., Hu, P., Clark, T., Tam, K., & Milton, J., (2007). Technology-assisted learning: a longitudinal field study of knowledge category, learning effectiveness and satisfaction in language learning. *Journal of Computer Assisted Learning*, 24, 245-259. doi: 10.1109/TSMCA.2007.904741

Hurlock, R. & Slough, D. (1976). *Experimental evaluation of PLATO IV technology final report.* Naval Personnel Research and Development Center. (Technical Report 76TQ-44). San Diego, CA.

Jacobs, R. (2003). *Structured on-the-job training: Unleashing employee expertise in the workplace.* San Francisco: Berrett-Koehler Publishers.

Joy II, E. H., & Garcia, F. E. (2000). Measuring learning effectiveness: A new look at no-significant-difference findings. *JALN, 4*(1), 33-39.

Ketter, P. (2006). Training versus development. *Training & Development, 60*(5), 78.

Kim, J., Lee, C., & Jacobs, R. (2001). Exploring transfer of training on structured on-the-job training. *Proceedings of the Twentieth Annual Midwest Research-to-Practice Conference in Adult, Continuing and Community Education,* Charleston, IL. (pp.82-87). (ERIC Document Reproduction Service No. ED 457336)

Kirkpatrick, D. L. (1998). *Evaluating training programs: the four levels* (2nd ed.). San Francisco, CA: Berrett-Koehler Publishers.

Kulik, C. C., & Kulik, J. A. (1991). Effectiveness of computer-based instruction: An updated analysis. *Computers in Human Behavior, 7*, 75-94.

Kulik, J.A, 1994 . Meta-analytic studies of findings on computer-based instruction. In Baker, E., O'Neil, Jr., H., O'Neil, H. (Eds.), *Technology assessment in education and training,* 9-34*.* Hillsdale, N.J.: Lawrence Erlbaum Associates, Inc.

Lafleur, J (2002). *Surface warfare division officer training and qualification.* Naval Message. San Diego, CA: Commander Naval Surface Forces. Retrieved December 13, 2007, from https://wwwcfs.cnet.navy.mil/swos/restricted/Doc/download%5CCNSF291506zDEC02.txt

LaFleur, J. (2002, December 29). *Surface warfare officer division officer training and qualification.* General Administrative Message. San Diego, CA: Commander Naval Surface Forces.

Lafleur, J. (2003). *Surface warfare junior officer transformation best practices.* Naval Message. San Diego, CA: Commander Naval Surface Forces. Retrieved December 19, 2007, from https://wwwcfs.cnet.navy.mil/swos/restricted/Doc/download%5CCNSF081746zSEP03.txt

Lee, W. & Owens, D. *A systemic approach to media selection*. American Society for Training and Development. E-Learning White Paper. Retrieved July 2008 from http://www.astd.org/content/publications/whitePapers/vision.htm

LeFrere, K. J. (2002). Assessment of U.S. Navy junior officer retention from 1998-2000. Air University. (Product reproduced from digital image received from NTIS, orders@ntis.gov. NTIS).

MacDonald, C., & Thompson, T. (2005). Structure, content, delivery, service, and outcomes: Quality e-learning in higher education. *The International Review of Research in Open and Distance Learning,* 6 (2). Retrieved from: http://www.irrodl.org/indx.php/irrodl/article/view/237/321

Mackay, S. & Stockport, G. (2006). Blended learning, classroom and e-learning. *The Business Review, Cambridge*, 5 (1), 82-89. Retrieved from Proquest database.

Manacapilli, T., Bailey, A., Beighley, C., Bennett, B., & Bower, A. (2007). *Finding the balance between schoolhouse and on-the-job training*. Santa Monica, CA: RAND. Retrieved November 30, 2007, from http://www.rand.org/pubs/monographs/2007/RAND_MG555.pdf

Mathis, R. L., & Jackson, J. H. (2006). *Human resource management* (11th ed.). Mason, OH: South-Western/Thomson.

Mullen, M. G. (August 3, 1999). *Surface warfare training strategy* (OPNAVINST 1500.57A). Washington, DC: Office of the Chief of Naval Operations.

Naval Education and Training Command. (2004). *Personnel qualification standard for surface warfare officer* (SWO) (NAVEDTRA 43101-4F). Pensacola, FL: NETC.

Noja, G. P. (1987). New frontiers for computer aided training. In R. J. Seidel & P. D. Weddle (Eds.), *Computer-based instruction in military environments* (pp. 215-229). New York: Plenum Press.

O'Conner, B. N., Bronner, M., & Delaney, C. (2002). *Training for organizations* (2nd ed.). Cincinnati, OH: South-Western Thompson Learning.

O'Malley, J. (1999). Students' perceptions of distance learning, online learning and the traditional classroom. *Online Journal of Distance Learning Administration,* 2 (4). Retrieved from: http://www.westga.edu/~distance/ojdla/winter24/omalley24.html

Office of the Chief of Naval Operations. (2001). *Revolution in training executive review of Navy training* (No. XBCNO). Washington, DC: Author. Retrieved on June 6, 2008, from http://handle.dtic.mil/100.2/ADA419988

Office of the Secretary of Defense. (2007). *Defense budget materials (FY 2009).* Washington, DC: Office of the Secretary of Defense. Retrieved June 9, 2008, from http://www.defenselink.mil/comptroller/defbudget/fy2009/index.html

Orlansky, J., & String, J. (1979). *Cost-effectiveness of computer-based instruction in military training* (IDA-P-P-1375). Arlington, VA: Institute for Defense Analysis.

Peltier, Schibrowsky and Drago (2007)

Peltier, J., Schibrowsky, J., & Drago, W. (2007). The interdependence of the factors influencing the perceived quality of the online learning experience: A Causal Model. *Journal of Marketing Education*, 29 (2), 140-153.

Phillips, J. J. (1997). *Return on investment in training and performance improvement programs*. Houston, TX: Gulf Publishers.

Pike, J. (2008). *CNO guidance for 2003.* Retrieved May 12, 2008, from http://www.globalsecurity.org/military/library/policy/navy/cno-guidance_2003.htm

Popham, W. J. (1971). *Criterion-referenced measurement: An introduction.* Englewood, NJ: Educational Technology Publications.

Rostker, B. (2006). *I want you: The evolution of the all-volunteer force.* Santa Monica, CA: RAND.

Rowden, T. (2008). *Major commanders conference.* Unpublished Powerpoint presentation. Newport, RI: Surface Warfare Officers School Command.

Schram, C. M. (1996). A meta-analysis of gender differences in applied statistics achievement. *Journal of Educational and Behavioral Statistics, 21*(1, Special Issue: Teaching Statistics), 55-70.

Shovlin, K. (2008). *SWOS-in-a-box: Generation Y's division officer training*. Retrieved May 11, 2008, from http://www.usni.org/getthegouge/insider.

Sitzmann, T., Wisher, R., Stewart, D., & Kraiger, K. (2006). The comparative effectiveness of web-based and classroom instruction: A meta-analysis. Personnel Psychology, 59 (3), 623-665.

Sisson, G. (2001). *Hands on-training: A simple and effective method for on-the-job training.* San Francisco: Berrett-Koehler Publishers.

Steinbach, R. (2004). *On-the-job training: Preparing employees for success.* Boston, MA: Thomson Crisp Learning.

Stoker, C., & Crawford, A. (2008). *Surface warfare officer retention: Analysis of individual ready reserve survey data* (Manpower, Personnel, Training & Education Research, NPS-HR-08-001). Monterey, CA: Naval Postgraduate School.

Strother, J. (2002). An assessment of the effectiveness of e-learning in corporate training programs. International Review of Research in Open and Distance Learning, 3 (1). Retrieved from: http://www.irrodl.org/index.php/irrodl/article/viewArticle/83%20-%206k

Surface Warfare Directorate, 2002, June 15. Washington, DC: Office of Chief of Naval Operations, pp. 3-4

Surface Warfare Directorate. (December 16, 2003). *Surface warfare officer qualification and designation.* General Administrative Message. Washington, DC: Office of the Chief of Naval Operations.

Surface Warfare Enterprise. (December, 2007). *Surface warfare enterprise vital signs.* Unpublished PowerPoint presentation. Washington, DC: Author.

US Bureau of Labor Statistics. (2008). *Inflation calculator.* Retrieved June 15, 2008, from http://www.bls.gov/

U.S. Government Accountability Office [GAO]. (2004). *Military education: DOD needs to develop performance goals and metrics for advanced distributed learning in professional military education*. Report to the Ranking Minority Member, Committee on Armed Services, House of Representatives. (GAO publication No.GAO-04-873). Retrieved from: http://purl.access.gpo.gov/GPO/LPS52476

Vaas, M. R. (2004). An analysis of junior officer performance at the surface warfare officer school division officer course (Master's thesis, ADA424973). Retrieved November 11, 2008, from http://handle.dtic.mil/100.2/ADA424973

Van Matre, N., Hamovitch, M., Lockhart, K. A., Squire, L., & Navy Personnel Research and Development Center, San Diego, CA. (1981). *Computer managed instruction in the Navy. A comparison of two student/instructor ratios in CMI learning centers.* Ft. Belvoir, VA: Defense Technical Information Center.

Vernon, S. (1999). Learning to be an effective team member. *Advances in Developing Human Resources*, 1 (3), 33-41.

Weiher, R., & Horowitz, S. A. (1971). *The relative cost of formal and on-the-job training for Navy enlisted occupations (*Professional Paper No. 83). Alexandria, VA: Center for Naval Analysis. Retrieved May 22, 2008, from http://www.cna.org/documents/5500008300.pdf

Wiggs, C. L., & Seidel, R. J. (1987). Computer-based instruction in military environments: Defense research series. In R. J. Seidel & P. D. Weddle (Eds.), *Computer-based instruction in military environments: Defense research series* (Vol.1, pp. 1-20). Alexandria, VA: US Army Research Institute.

Yatrakis, P., Simon, H. (2002). The effect of self-selection on student satisfaction and performance in online classes. *The International Review of Research in Open and Distance Learning*, 3(2). Retrieved from: http://www.irrodl.org/index.php/irrodl/article/view/93/567

Young, J. W. (1991). Gender bias in predicting college academic performance: A new approach using item response theory. *Journal of Educational Measurement, 28*(1), 37-47.

Zimmerman, T. (2001). Better training is just a click away. *Workforce, 80*, 36-42.

THIS PAGE INTENTIONALLY LEFT BLANK

2003 - 2008 Sponsored Research Topics

Acquisition Management

- Acquiring Combat Capability via Public-Private Partnerships (PPPs)
- BCA: Contractor vs. Organic Growth
- Defense Industry Consolidation
- EU-US Defense Industrial Relationships
- Knowledge Value Added (KVA) + Real Options (RO) Applied to Shipyard Planning Processes
- Managing Services Supply Chain
- MOSA Contracting Implications
- Portfolio Optimization via KVA + RO
- Private Military Sector
- Software Requirements for OA
- Spiral Development
- Strategy for Defense Acquisition Research
- The Software, Hardware Asset Reuse Enterprise (SHARE) repository

Contract Management

- Commodity Sourcing Strategies
- Contracting Government Procurement Functions
- Contractors in 21st Century Combat Zone
- Joint Contingency Contracting
- Model for Optimizing Contingency Contracting Planning and Execution
- Navy Contract Writing Guide
- Past Performance in Source Selection
- Strategic Contingency Contracting
- Transforming DoD Contract Closeout
- USAF Energy Savings Performance Contracts
- USAF IT Commodity Council
- USMC Contingency Contracting

Financial Management

- Acquisitions via leasing: MPS case
- Budget Scoring
- Budgeting for Capabilities Based Planning
- Capital Budgeting for DoD
- Energy Saving Contracts/DoD Mobile Assets
- Financing DoD Budget via PPPs
- Lessons from Private Sector Capital Budgeting for DoD Acquisition Budgeting Reform
- PPPs and Government Financing
- ROI of Information Warfare Systems
- Special Termination Liability in MDAPs
- Strategic Sourcing
- Transaction Cost Economics (TCE) to Improve Cost Estimates

Human Resources

- Indefinite Reenlistment
- Individual Augmentation
- Learning Management Systems
- Moral Conduct Waivers and First-tem Attrition
- Retention
- The Navy's Selective Reenlistment Bonus (SRB) Management System
- Tuition Assistance

Logistics Management

- Analysis of LAV Depot Maintenance
- Army LOG MOD
- ASDS Product Support Analysis
- Cold-chain Logistics
- Contractors Supporting Military Operations
- Diffusion/Variability on Vendor Performance Evaluation
- Evolutionary Acquisition
- Lean Six Sigma to Reduce Costs and Improve Readiness

- Naval Aviation Maintenance and Process Improvement (2)
- Optimizing CIWS Lifecycle Support (LCS)
- Outsourcing the Pearl Harbor MK-48 Intermediate Maintenance Activity
- Pallet Management System
- PBL (4)
- Privatization-NOSL/NAWCI
- RFID (6)
- Risk Analysis for Performance-based Logistics
- R-TOC Aegis Microwave Power Tubes
- Sense-and-Respond Logistics Network
- Strategic Sourcing

Program Management

- Building Collaborative Capacity
- Business Process Reengineering (BPR) for LCS Mission Module Acquisition
- Collaborative IT Tools Leveraging Competence
- Contractor vs. Organic Support
- Knowledge, Responsibilities and Decision Rights in MDAPs
- KVA Applied to Aegis and SSDS
- Managing the Service Supply Chain
- Measuring Uncertainty in Eared Value
- Organizational Modeling and Simulation
- Public-Private Partnership
- Terminating Your Own Program
- Utilizing Collaborative and Three-dimensional Imaging Technology

A complete listing and electronic copies of published research are available on our website: www.acquisitionresearch.org

THIS PAGE INTENTIONALLY LEFT BLANK

Initial Distribution List

1.	Defense Technical Information Center 8725 John J. Kingman Rd., STE 0944; Ft. Belvoir, VA 22060-6218	2
2.	Dudley Knox Library, Code 013 Naval Postgraduate School, Monterey, CA 93943-5100	2
3.	Research Office, Code 09 Naval Postgraduate School, Monterey, CA 93943-5138	1
4.	William R. Gates Dean, GSBPP Naval Postgraduate School, Monterey, CA 93943-5138	1
5.	Stephen Mehay Associate Dean for Research, GB Naval Postgraduate School, Monterey, CA 93943-5138	1
6.	Alice Crawford Senior Lecturer, GB Naval Postgraduate School, Monterey, CA 93943-5138	1

Copies of the Acquisition Sponsored Research Reports may be printed from our website: www.acquisitionresearch.org