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Effectiveness of the Voluntary Education Program

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Summary

Background

The Voluntary Education (VOLED) Program provides off-duty educational opportunities integrating a variety of continuing education programs to Sailors seeking to enhance their professional and personal growth. VOLED supplements military training and allows Sailors to pursue college degrees of their choice. Funding for VOLED is $57.8 million in FY98. VOLED comprises three major instructional elements: Tuition Assistance, the Program for Afloat College Education (PACE), and the Academic Skills Learning Centers (ASLCs).

Tuition Assistance covers 75 percent of tuition at colleges, universities, and other schools. The current cap is $2,500 for undergraduate college courses and $3,500 for graduate courses. Effective 1 October 1998, the cap will be $3,500 for all courses; however, there will be a credit hour cap of $187.50.

PACE offers courses on Navy ships and at selected remote locations. It offers free college as well as academic skills (noncredit remedial modules) education in English, language arts, reading, math, and basic science. PACE courses are taught either by onboard instructors (instructor PACE) or through electronic means (technology PACE).

The Academic Skills Learning Centers provide free self-paced software instruction in reading, writing, math, science, and work skills. As of March 1998, 14 ASLCs were operational, but the Navy is establishing ASLCs at all major installations (about 1 per month), for a total of 52 by the end of FY01.

About 61,000 active-duty enlisted Sailors—18 percent of the force—participated in VOLED in FY97. The total registration of the participants was about 140,000 courses. During FY97, about 3,400 Navy officers received Tuition Assistance; in addition, about 1,300 Marines

received PACE instruction aboard Navy ships. By far, Tuition Assistance has the largest enrollment of any element of VOLED (77 percent of the total enlisted registration).

We built an educational history file for active-duty enlisted Sailors. We created a combined data file of almost 600,000 records covering 1992 through 1997.

Findings

What is the impact on promotion and career?

College education through VOLED improves promotion prospects significantly. Thirty-one percent of Sailors with no college education make it to E5 in 5 years or less. For Sailors with 15 college credits, the probability increases to 43 percent. For Sailors with 60 college credits—sufficient to obtain an associate degree in most cases—the probability increases to 66 percent.

Sailors who participate in VOLED are likely to have above-average motivation. To account for this, we applied a widely known regression technique that isolates the effect that is directly attributable to VOLED. We can link most of the promotion effect directly to VOLED; however, the high motivation of Sailors taking courses accounts for a small portion.

Academic skills education helps Sailors retake the Armed Services Vocational Aptitude Battery (ASVAB) to qualify for Navy ratings for which they were not eligible. Eighteen percent of academic skills participants switch ratings, compared to only 6 percent of those not enhancing their education through VOLED.

In addition to education, what can Sailors do to be more competitive? For Sailors with associate degrees, cross-rating to cryptology, for example, increases the probability of making E5 in 5 years from 66 percent to 79 percent. This largely reflects the abundance of vacancies in cryptology. For Sailors with associate degrees working in cryptology, a 20-percentage-point increase in the proportion of time spent at sea increases the probability of making E5 in 5 years to 84 percent.

Demotion is significantly less likely for Sailors who participated in VOLED than for those who did not. Among academic skills and college participants, only 7 and 6 percent, respectively, were demoted by the end of their first contract. Among nonparticipants, 14 percent were demoted. This suggests that education reduces disciplinary infractions.

What is the impact on retention?

College education through VOLED has a significant positive impact on retention. Thirty-one percent of first-term active-duty enlisted Sailors with no college education reenlist. For Sailors with 15 college credits, the reenlistment rate increases to 37 percent. For Sailors with 60 college credits, the reenlistment rate is 55 percent. This finding should lay to rest the argument that college education hastens the departure of Sailors seeking employment in the private sector.

Academic skills education also has a significant positive impact on retention. Thirty-four percent of Sailors who did not participate in academic skills reenlist. Participation in academic skills increases the reenlistment rate to 48 percent.

Is VOLED cost-effective?

All elements of VOLED are cost-effective. **College education** through VOLED is cost-effective. For each dollar invested in Tuition Assistance and instructor PACE, the Navy gets $2 from improved retention. For technology PACE, for each $1 invested, the Navy gets slightly over $1.

The monetary benefit of increased retention is the value of the reduced recruiting and training costs. The cost of replacing a first-term Sailor is $24,301.

Academic skills education is also cost-effective. In fact, it is *more* cost-effective than college education. For each dollar invested in instructor PACE, the Navy gets $14 from improved retention. For each dollar invested in technology PACE and the ASLCs, the Navy gets $22 and $9, respectively. Our results are consistent with other researchers'

findings in a variety of settings: the lower the level of education, the higher the rate of return.

Combining our results with those of an earlier CNA study of other quality-of-life (QOL) programs, we conclude that academic skills education and family service centers (FSCs) are the most cost-effective investments. College education and morale, welfare, and recreation are also cost-effective, but in a lower degree.

Is there a significant need for academic skills education in the force? In FY97, 99,600 Sailors—30 percent of the force—needed remedial education; however, only about 13,300 received help.

How can VOLED services be enhanced?

Many Sailors responded to the question of how the Navy should enhance its Voluntary Education services by saying that they would like more command support for education (51 percent). Command support is likely to be one of the most important determinants of student performance, particularly for Sailors taking PACE courses. Command support involves screening and counseling, as well as work schedule accommodation (when feasible). Academic orientation is an important tool to increase enrollments: participation in PACE academic counseling increases the probability of enrolling in a course by 13 percentage points.

Compared to community college students, Sailors do well in Tuition Assistance and PACE. Sailors complete 92 percent and 84 percent, respectively, of the Tuition Assistance and PACE lower level college courses. In comparison, civilians at community colleges complete 74 percent of the courses. For certain Sailors, though, PACE completion rates are low.

Course completion rates for junior Sailors are lower than for more senior Sailors. Completion rates for E1–E2s are 71 percent, compared to 81 percent for E3–E9s. Math courses tend to be the most difficult. Completion rates in math are 67 percent; in the other subject areas, completion rates are 81 percent.

While Sailors perform well in both delivery modes, completion rates in technology PACE are lower than in the instructor program (completion rates of 77 percent and 84 percent). This does not necessarily imply that the instructor method is superior. Rather, it reflects other aspects of the instruction, such as learner style and time management abilities, as well as student familiarization with technology.

Recommendations

Based on our analysis, we make the following recommendations:

- **Maintain full support for VOLED, and accelerate academic skills investments.** The Navy should reap the rewards of VOLED by continuing to support it fully. Because the returns on academic skills are especially high and there is a sizable need for remedial education, the Navy should accelerate its investment in academic skills.
- **Modify the ASLC contract to promote greater participation**. The Navy currently pays a per-center flat fee that is independent of the number of students. The Navy should pay the ASLC contractor a fee that is based on enrollments. This would provide the contractor with a greater incentive to be aggressive in publicizing the centers and to expand working hours through the evenings and weekends.
- **Establish an academic transcript system**. To facilitate program assessment and student counseling, the Navy should accelerate the implementation of the Sailor-Marine/American Council on Education Registry Transcript (SMART). The transcript would list all Navy training and subject tests of DANTES as well as the results of College Level Examination Program (CLEP) with the corresponsing college credit recommendations. The transcript would also list college credits earned through Tuition Assistant and PACE.
- **Encourage a more supportive command climate.** In a new VOLED instruction, the Navy should provide specific guidance to COs on establishing a supportive command climate for

education, including the identification, screening, and counseling of students.

- **Limit enrollment of E1s and E2s.** The Navy should consider limiting participation of E1s and E2s in college courses. Before enrollment, E1s and E2s should demonstrate potential for academic success. Indicators of potential for success include motivation, the ability to work independently, and a minimum B average on previous college courses or an ASVAB (arithmetic reasoning plus paragraph comprehension) score of 110 or more.

Introduction

The Voluntary Education (VOLED) Program integrates a variety of off-duty continuing education opportunities for Sailors who want to enhance their professional and personal growth. VOLED supplements military training, and allows Sailors to pursue college degrees. VOLED also offers remedial education and vocational/technical courses.

VOLED began in the early 1970s, with the advent of the all-volunteer force, to offer financial assistance to servicemembers who pursued further education. VOLED, an important quality-of-life program, has expanded considerably since then. A description of each element of the program follows.

Program elements

The VOLED Program has four major elements: Tuition Assistance, the Program for Afloat College Education (PACE), the Academic Skills Learning Centers (ASLCs), and the education centers. Funding for VOLED in FY98 is $57.8 million (see table 1). The program shows no funding growth through FY00.

Table 1. Funding for the Navy VOLED Program (in millions of dollars)

Element	FY98	FY99	FY00	FY01	FY02	FY03
Tuition Assistance	30.9	32.1	30.8	31.8	32.3	32.8
PACE	12.0	12.2	12.3	12.5	11.7	12.8
Academic skills	3.8	2.5	5.0	6.4	6.7	6.8
Navy Campus	11.1	10.5	9.6	9.8	10.6	10.2
Total	57.8	57.3	57.8	60.5	61.3	62.6

Tuition Assistance

Through the Tuition Assistance (TA) program, Sailors reduce the expenses of receiving instruction at accredited colleges, universities, and other schools. TA is the largest component of VOLED—at $30.9 million, it accounted for 54 percent of the VOLED funding in FY98.

All personnel on active duty, enlisted members and officers, are eligible to participate in the TA program. TA is managed by the Naval Education and Training Professional Development and Technology Center (NETPDTC).

In 1996, TA helped Sailors take courses at 820 postsecondary schools. Topping the list of schools with the largest attendance of Sailors (in descending order) are University of Maryland–University College (mainly through its European and Far East divisions), Saint Leo College (Saint Leo, Florida), State University of Illinois at Carbondale, Tidewater Community College (Portsmouth, Virginia), Florida Community College (Jacksonville, Florida), and Central Texas College (Killeen, Texas). Located near fleet concentration areas, the ten most attended colleges accounted for 48 percent of the enrollments (total course registration).[1]

Current policy

Tuition Assistance covers 75 percent of tuition at colleges, universities, and other schools. Currently, support is capped at $2,500 for undergraduate college (and vocational and technical) courses and $3,500 for graduate courses.

Future policy

The Department of Defense is implementing a uniform TA policy across all services effective 1 October 1998. The annual cap will be $3,500 for all courses—an increase of $1,000 for undergraduate college courses. However, there will be a credit hour cap of $187.50.

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1. Completing the list of the ten schools with the largest Navy attendance are Embry-Riddle Aeronautical University (Daytona Beach, Florida), Chaminade University (Honolulu, Hawaii), Hawaii Pacific University (Honolulu), and San Diego City College.

Program for Afloat College Education

Tuition Assistance primarily helps Sailors on shore duty. The Program for Afloat College Education (PACE) expands the opportunity of education to Sailors on sea duty. PACE offers courses on Navy ships and at selected remote locations. It also offers courses to detachments, air groups, and squadrons.

Currently, PACE is available on all ships with the exception of reserve, Military Sealift Command, and some support ships. On a ship-by-ship basis, course offerings are available only at certain times of the year depending on operating and maintenance schedules. Courses are usually offered in conjunction with extended deployments or operations at sea but may be conducted in the ship's home port as well.

PACE is free to Sailors—they pay for books and supplies only. PACE accounts for 21 percent of the FY98 VOLED funding ($12 million). Middlesex Research Center, a contractor based in Landover, Maryland, administers PACE.

PACE offers the following types of courses:

- College (credit-earning)
- Academic skills (noncredit remedial modules) in
  - English
  - Language arts
  - Reading
  - Math
  - Basic science.

Placement in college or academic skills courses depends on ASVAB scores, previous college or academic skills experience, and placement exams. The contractor tests the crew and determines eligibility. PACE is funded by the Navy, and both ship's company and embarked Marines are entitled to participate.

As in the other elements of VOLED, participation in PACE is voluntary. Commanding officers (COs) have the final say regarding the scope of PACE. Dealing directly with the contractor, COs choose the

combination of college and academic skills courses they believe best meets the needs of their Sailors. COs also request their preference for course delivery mode—instructor, electronic, or a combination of the two.

Instructor delivery

Instructor delivery fits the bill when enough Sailors want a particular course and are able to meet a traditional course timetable. Professors from Central Texas College, an accredited two-year community college, embark with the ship to provide instruction.

Instructor college courses are 48 hours long and cover 8 weeks (in the east coast) or 6 weeks (in the west coast). Instructor academic skills modules are 4 to 5 hours long and cover a 4-week period.

Electronic delivery

If berthing is not available for an instructor, instruction is delivered through video, computer interactive video, or CD-ROM.[2] Electronic delivery is also used for Sailors with work shifts that prevent them from taking instructor-delivered courses. Electronic delivery allows Sailors to take courses that fit their schedules and to study independently on their off-watch time. The Navy's position is that Sailors, whenever possible, should have a choice of delivery systems.

At present, the contractor offers a menu of 43 electronic college courses ranging from geology to economics. These courses are typically 12 weeks long. The contractor also offers academic skills courseware. Electronic courses are self-paced but students are expected to finish before the end of the deployment.

The following universities and colleges offer electronic curricula to the Navy: Coastline Community College (San Diego, California), Richland Community College (Dallas, Texas), The George Washington University, The University of Maryland, and The University of Oklahoma. Students have no direct interface with professors until

2. On an experimental basis, the Navy recently contracted Old Dominion University and Georgia State University for teleconferencing delivery aboard USS *George Washington* and USS *Carl Vinson*. The Navy is also exploring instruction through the internet.

they turn in the course materials at the end of the term. Designated officers on the ship proctor exams and monitor student progress. Sailors earn credits from the school offering the course.

The instructor and the electronic PACE programs are both available in 30 percent of the ships. Only students who have completed coursework and demonstrated ability to do independent study are registered for the electronic college courses. The extent of the screening, though, varies widely from one ship to another.

Academic Skills Learning Centers

Academic skills courses through PACE serve to redress academic deficiencies of Sailors on sea duty. To provide the same opportunity to shore-based Sailors, the Navy is establishing Academic Skills Learning Centers (ASLCs) at all major installations.

ASLCs provide self-paced software instruction in basic academic skills. In October 1997, the Navy contracted TRO Learning to establish and run 52 ASLCs by the end of FY01. As of March 1998, 14 ASLCs were operational.[3] The contract calls for the activation of about one center per month.

The centers, which have from 4 to 12 computers, are staffed by facilitators who assist students and track their progress. All active duty personnel assigned to the base are eligible to use the ASLCs.

The contractor equips, staffs, and manages each center. It installs software on a local area network in the subject areas of reading, writing, math, science, and work skills.[4] The language arts, math, and reading coursework consists of lessons covering skill levels ranging from second through twelfth grades. Students attend the ASLCs 1 to 5 days a week for 2 hours a day.

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3. Two pilot ASLCs began operation in October 1994 for 2 years. Based on promising results, the Navy expanded the program worldwide.

4. ASLC courseware includes Fastrack (language arts, math, and reading). The advanced math offerings are geometry and beginning, intermediate, and advanced algebra. Science offerings are chemistry, physics, biology, and earth science. The work skills offerred are applied math, data skills, writing in the workplace, and reading for information.

Most students attend the centers to prepare for retaking the ASVAB or for taking a college admissions test. Others attend to prepare for trade school exams. Students need command approval to enroll.

Coursework at the ASLCs is free to Sailors. Funding in FY98 is $3.8 million. It will drop to $2.5 million in FY99 but will increase to $5 million in FY00.

Education centers

Education centers provide individual counseling to Sailors about their educational goals as well as program availability and degree requirements. Civil-service counselors familiarize Sailors with college and other education programs available in the geographic area. Education centers process applications for Tuition Assistance and administer college admission and General Educational Development (GED) tests. Education centers, also known as Navy Campus offices, are found on 60 Navy installations.

Education center counselors help Sailors explore non-traditional education options, such as obtaining college credit for military training. They also help Sailors pursue independent study through the Defense Activity for Non-Traditional Education Support (DANTES) programs.

Participation levels

About 60,800 active-duty enlisted Sailors—18.1 percent of the force—participated in the Voluntary Education Program in FY97. This includes Sailors who received Tuition Assistance, or who received instruction through PACE or at ASLCs.[5] The total registration of the participants was about 140,000 courses (see figure 1).

Also, 3,400 naval officers received Tuition Assistance during the year. In addition, 1,300 Marines received PACE instruction aboard Navy ships. Marines made up 7.4 percent and 3.5 percent of the instructor and technology PACE enrollment in FY97, respectively.

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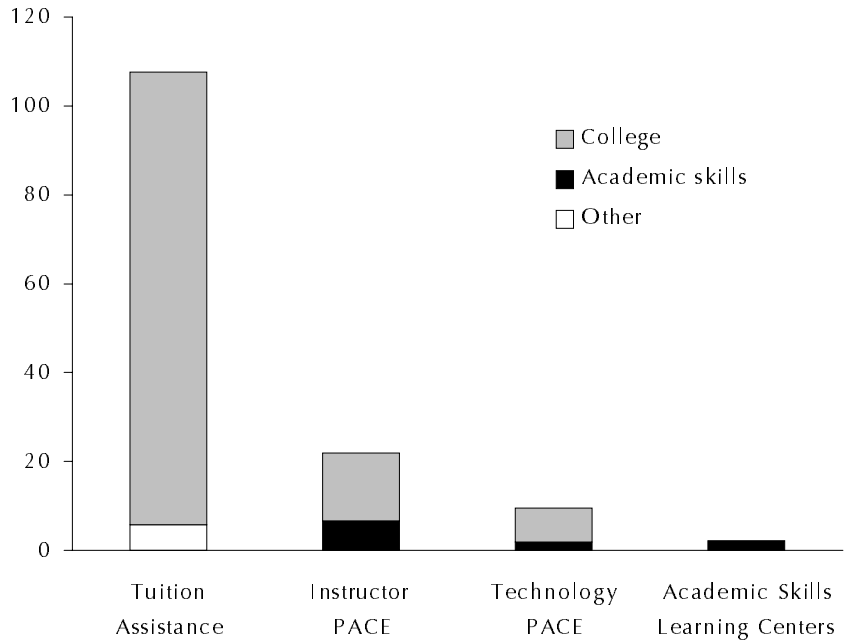
5. The enrollment figures account for the fact that some Sailors participated in more than one element of VOLED during the year.

Figure 1. VOLED participation level (enlisted Navy in FY97)[a]



a. The "Other" component of Tuition Assistance includes developmental (remedial), vocational and technical, and high school completion.

Tuition Assistance has by far the largest enrollment level of any element of VOLED. In FY97, 38,000 active-duty enlisted Sailors used TA to enroll in 107,750 courses. Instructor PACE has the second largest enrollment. In FY97, 9,600 Sailors took college courses through instructor PACE, and 5,450 Sailors took academic skills courses. These Sailors enrolled in 20,220 courses.

The technology PACE program was the third largest element of VOLED in FY97. About 5,500 Sailors took college courses through technology PACE. Also, 1,600 Sailors enrolled in academic skills courses. The total registration in technology PACE was 9,500 courses for the year.

Participation in the ASLCs was the smallest of all the VOLED elements in FY97. Approximately 2,150 Sailors took courses at these centers during the period. Enrollment should increase in the next several years as more centers begin operating.

Issues

The Chief of Naval Personnel has tasked CNA to determine the effectiveness of the Voluntary Education Program. We investigated the following issues:

- What is the impact of VOLED on personnel
  - Promotion?
  - Retention?
- Which VOLED elements have the greatest long-term benefit for the Navy?
- What is the current academic skills profile of the force?
- What factors are associated with successful completion of PACE courses?

This study conducts a cost-benefit analysis of the VOLED Program. In an era of shrinking resources and competing demands, it is critical for the Navy to determine the return on its investments. This study will assess the effectiveness of the different instructional elements of VOLED: Tuition Assistance, PACE, and ASLCs. It will also formulate ways to improve the effectiveness of the Navy's VOLED services.

Data and methodology

Sources of data

We built an educational history file for active-duty enlisted Sailors for August 1992 through March 1997. The Navy does not have a centralized student records system for the different elements of VOLED. We used the data described below:

Tuition Assistance

The Tuition Assistance data contain individual student and course information and consists of about 510,000 records. The data fields of relevance are the course level, credit hours, grade, course cost, authorized and collected amounts, course starting and completion dates, and school name.

The data cover all course levels: college (lower- and upper-level undergraduate and graduate), developmental (remedial precollege), vocational and technical, and high school. We obtained the TA data from the Navy Campus Management Information System (NCMIS), maintained by NETPDTC. NCMIS supports the administration of the Tuition Assistance program.

Instructor PACE

We obtained instructor PACE data, consisting of about 63,000 records, from Central Texas College (CTC). The data fields of relevance are course title, credit hours, grade, grade date, and command (ship or remote location). The data include all college and precollege (developmental) courses. It does not include, though, data for the instructor academic skills program. CTC does not maintain data on its academic skills courses in electronic format. We used data from technology PACE to analyze academic skills.

Technology PACE

We obtained data on technology PACE from Middlesex Research Center consisting of about 22,000 records. The data cover both college and academic skills courses and contain the course title, credit hours (for college courses), grade or course completion flag, course start and end dates, and command.

We did not get data from the Academic Skills Learning Centers. Because most ASLCs had been operating for only a few months, the breadth of their data was not sufficient to conduct statistical analyses. Thus, here again we relied on technology PACE academic skills data to analyze the ASLCs. The curricula are nearly identical in the two elements.

Other data

Orientation

We obtained a data file on 20,200 Sailors who participated in information and orientation briefs on the PACE program. These briefs, conducted for the crew over the course of several days, publicize course offerings. These briefs also help Sailors with degree planning and expose them to the availability of educational opportunities in the Navy. For example, they explain the process of converting military training to college credits.[6]

In principle, Sailors who have been exposed to the Voluntary Education Program through these briefs are more likely to take courses. The data allowed us to flag Sailors who were exposed to the benefits of the Voluntary Education Program. We obtained this data file from the PACE contractor.

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6. These briefs also explain the reduced residency requirements under the Servicemembers Opportunity Colleges, Navy (SOCNAV), a consortium of over 1,200 colleges and universities. SOCNAV considers the mobile lifestyle of military students and reduces the hassle of transferring credits and meeting residency requirements.

Schoolhouse course costs

We obtained data for all 2,230 courses offered at Navy schoolhouse training facilities during FY96. The data contain bootcamp, A- and C-school, team and fleet, and other training courses. The data include the course data processing (CDP) code, course title, length, number of participants, and, more important, detailed course cost information.

The course cost information is broken down at a great level of detail. This allowed us to select those components that are likely to be affected by a change in the size of the VOLED program, that is, the cost net of overhead. The course cost components are supplies, contracts, depot level repairables, operation of simulators, instructors, curriculum development, construction of new facilities, and general activities of the installation. We obtained this data file from NETPDC. We used it to calculate the cost of replacing a Sailor.

Method of analysis

Are all elements of the Voluntary Education program cost-effective? We conduct a cost-benefit analysis of the two main education levels: college and academic skills. We do this for each instructional element of VOLED: Tuition Assistance, instructor PACE, technology PACE, and Academic Skills Learning Centers. The focus in all our analyses is on active-duty enlisted Sailors. All the benefits and costs are in FY98 dollars. For values in previous years, we use the consumer price index to adjust them.

The cost-benefit analysis calculates the gains and losses resulting from increasing college and academic skills enrollments. It measures the investment returns on the different elements of the program. Armed with this information, the Navy should be able to make better decisions about the elements of VOLED that merit expanding (or contracting). For each education level and program element, we calculate the investment return, that is, the ratio of benefits to costs.

Following the guidelines from the Office of Management and Budget for cost-benefit analyses [1], we do the following:

- *Focus on incremental benefits and costs.* We measure the monetary benefits and costs of increasing college or academic skills

enrollments by 1,000. To determine VOLED's cost-effectiveness, we compare the incremental benefits and costs.

- *Ignore overhead.* We ignore overhead, that is, cost that does not increase with the enrollment level. For example, we ignore the administrative costs of running VOLED. We assume that a moderate increase in enrollments will not increase the expenses involved in processing forms or other administrative activities. We assume that the education centers will handle a moderate increase in workload using their available resources.

- *Include opportunity cost of resources.* Sailors are not productive during training. Our schoolhouse training costs include the forgone productivity of the students. We measure the opportunity cost of these personnel by their compensation. In addition to basic pay, our measure of compensation includes retired pay accrual, basic allowance for quarters, basic allowance for subsistence, incentive and special pays, permanent change of station, and miscellaneous expenses [2].

Table 2 summarizes the costs and potential benefits of VOLED. We now explain our measures of the benefits of the program. We then explain how we derived the costs.

Table 2. Benefits and costs of VOLED

Potential benefits[a]	Costs
Accelerates promotion of Sailors	Tuition Assistance: authorized amount minus collected amount
Lowers demotion chances	PACE: Per-class, per-credit-hour, or individual course registration fees as well as remote site travel
Helps increase ASVAB scores to cross-rate	Academic Skills Learning Centers: per-site fees
Increases reenlistment rate[b]	

a. An additional potential benefit of VOLED is the recruiting impact. Because of lack of recent data, we did not include it.
b. We calculated the monetary value of reduced recruiting and training costs resulting from a higher reenlistment rate.

Measuring benefits

As in most cost-benefit analyses, the monetary benefits of VOLED investments are not fully measurable. For some of the benefits of VOLED, no direct monetary value is available. In these cases, we provide nonmonetary measures of their effect. In particular, we assess the impact of participation in VOLED on the rates of promotion, demotion, and ability to cross-rate.

We also analyze the impact of VOLED participation on retention. By extrapolating the impact on retention, we are able to quantify the reduction in recruiting and training costs. We calculate the cost of replacing a Sailor, which enables us to quantify the monetary benefit of VOLED.

We may not be capturing all the benefits of VOLED, however. For example, Sailors with inadequate reading skills may be a work safety hazard. If so, academic skills education may be beneficial in reducing workplace accidents. We did not measure this effect.

Promotion

We investigated the effect of participation in the Voluntary Education Program on promotion using regression analysis. We tested whether Sailors enhancing their careers with college education are more likely to make it to E5 in their first 5 years of service. We merged the VOLED data files to the Enlisted Master Record to obtain information about Sailors' personal and career characteristics, such as AFQT score and rating.

Our promotion sample consists of all enlisted active-duty cohorts that accessed in the last two quarters of FY92 (8,112 observations). We selected the last two quarters of the fiscal year to track the promotion path of Sailors who joined the Navy up to 6 months apart.

Demotion

Are VOLED participants less likely to get demoted? VOLED may keep some Sailors away from disciplinary troubles. To analyze demotion, we tracked the FY92 cohort of active-duty enlisted Sailors (4-year

obligors) through the end of their first term to compare the demotion rates of participants and nonparticipants.

Cross-rating

One of the main reasons for Sailors to enroll in academic skills courses is to retake the ASVAB. Higher ASVAB scores give them a second chance to qualify for A-school. We determined whether academic skills participants are, on average, more likely to change ratings. We focused on changes in rating after being rated; that is, we did not include GENDETs getting rated.

Retention

To analyze retention, we tracked the FY92 cohort of 4-year obligors (GENDETs and school guarantee personnel) through their first reenlistment decision (24,756 observations). Our measure of retention includes reenlistments and extensions of more than a year. Sailors who did not reenlist include those who left before and on completion of their contracts. We estimated VOLED's impact on retention using regression analysis.

We measured all time-varying variables, including educational attainment, at the decision date (reenlistment or attrition). The monetary benefit of increased retention is the value of the reduced recruiting and training costs.

Recruiting benefits. Recruiting benefits include special recruit incentives, advertising, training and pay of staff, communications, and recruiting support. Based on data from Navy Recruiting Command, we calculated the average cost of recruiting a Sailor to be $5,164. This figure excludes overhead.[7]

Training benefits. Training benefits encompass bootcamp and a prorate of A-school and apprenticeship, C-school, and team and fleet training. The training benefits include:

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7. We subtracted the overhead by multiplying the total recruiting cost by the proportion of recruit training cost that is variable (74.5 percent). We did this to obtain an estimate of recruiting cost net of overhead.

- Student compensation
- Instruction
  - Supplies
  - Contracts
  - Depot level repairables
  - Operation of simulators
- Lodging and meals (where applicable)
- Travel (where applicable).

Our training benefits are somewhat conservative—we did not want to overestimate the retention benefits of VOLED. We did not include the following training cost components in the training benefits: instructors, construction of new facilities, general activities of the installation, and curriculum development. A moderate reduction in training requirements would not affect these activities.[8] Appendix A contains the enlisted training cost by training type.

We calculated the cost of bootcamp using cost data from NETPTDC. Bootcamp, conducted at the recruiting training center in Great Lakes, costs $6,668 for every recruit.

The next step was to calculate the cost of individual ratings and NECs. How did we do that? We mapped the courses needed to obtain each rating and NEC. We then matched the course costs to get the cost of training a Sailor in each rating and NEC. Here again, we used the course cost data from NETPTDC.

We calculated the cost of training a Sailor as a weighted average of the ratings as of the last quarter of FY97. We used the distribution of strength in each rating of the FY92 cohort at the first contract decision point.

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8. The number of instructors varies stepwise with the number of students. A small decrease in the number of students (say, of one per class) is not likely to reduce the requirement of instructors. Again, we avoided overestimating the retention benefits of VOLED.

How much does it cost to train a Sailor for a rating? The FY98 cost of training a Sailor for a rating ranges from $1,330 for a boatswain's mate to $49,290 for an electronics technician (nuclear-powered submarine or surface warfare). We assigned the average cost of the rating group to ratings with missing cost data (11 ratings). The overall average cost of a rating is $12,491.[9] Appendix B contains the training cost for each enlisted rating (in FY96 dollars).

How much does it cost to train a Sailor for an NEC? As for ratings, the cost of NECs varies greatly. The NEC cost ranges from $746 for NEC 9512 (3-M system coordinator) to $80,866 for NEC 1320 (Trident MK-118 combat control system maintenance technician). We were able to calculate the cost of 560 NECs. For the rest, we assigned the average NEC cost of $11,098.

For Sailors who did not attend A-school, we assigned the cost of apprenticeship training. We calculated the cost of apprenticeship training to be $1,707. Also, for every Sailor, we added the average cost of fleet and team training. The average costs of team and fleet training are, respectively, $426 and $890.

What is the cost of replacing a Sailor? The cost of replacing a first-term Sailor is $24,301. We obtained this figure by adding the costs of recruiting, bootcamp, A-school for Sailors with a rating at their reenlistment or attrition point (71 percent), and apprenticeship for the rest. We also added the NEC cost for Sailors who had earned one at reenlistment (35 percent), and we assumed that each Sailor had participated, on average, in one team training and one fleet training activity.[10] Table 3 summarizes the components of the cost of replacing a Sailor.

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9. For ratings with no A-school, such as boatswain's mate, we used the cost of apprenticeship training. For the medical ratings (hospitalman and dental technician), no cost data were available. We assigned them the average rating cost.

10. We took into account that 8.0 percent of GENDETs get rated, so that they cost the Navy in both apprenticeship and A-school training. We also considered that 3.1 percent of Sailors had a second NEC at reenlistment.

Table 3. Cost of replacing a Sailor[a]

	Cost ($)
Recruiting	5,164
Bootcamp	6,668
A-school/apprenticeship	6,902
C-school	4,251
Team training	426
Fleet training	890
Total	24,301

a. FY98 average of first-term Sailors. It takes into account the proportion of Sailors who have gone through each type of training at the end of the first term.

Accounting for high motivation of participants

Because we were unable to measure individual motivation, we did not factor it directly in our analysis. It is likely, though, that Sailors who participate in VOLED have above-average motivation. It is possible, for example, that VOLED participants would do well in promotion even if they had not pursued further education. If that is the case, we would overestimate the effect of VOLED on promotion. That is, we would capture the effect that is directly attributable to VOLED combined with what is attributable to the high motivation of these Sailors.

This analytical problem is known as "selection bias." We corrected for it, which allowed us to separate the effect that is directly attributable to VOLED and that which is attributable to the high motivation of participants.

In the case of retention, though, Sailors who decide to participate in VOLED may be those with unobserved characteristics that incline them to leave the Navy in high proportions. If that is the case, not correcting for selection bias would lead to an underestimate of the retention impact.

Solution

To account for the high motivation of VOLED participants, we applied a regression technique that isolates the promotion and retention

effects directly attributable to VOLED. This widely known technique consists of estimating the impact of VOLED on promotion or retention in two stages:

1. Decision to participate in VOLED
2. Impact of participation on promotion or retention.

Appendix C provides details about our method for estimating the promotion and retention effects of VOLED.

What did we factor in?

In our regression analyses of promotion and retention, we factored in the following variables:

- AFQT score
- Sea experience
- Age
- Marital status
- Rating group
- Degree of vacancies in the rating (promotion)
- Selective reenlisted bonus (SRB) multiple (retention).

(Appendices D and E, which contain the regression results, specify the variables we used for promotion and retention.)

Measuring costs

Tuition Assistance

By course level, we calculated the cost of Tuition Assistance based on the 1996 authorized amount.[11] To obtain the net cost, we subtracted an estimate of the amount that Sailors would refund to the Navy for

11. We estimated the authorized amount allowing for the conditions that will prevail under the new DOD policy effective 1 October 1998. In particular, we imposed for a $3,500 per-participant annual cap and a $187.50 per-credit cap.

failed courses. Through a written agreement, the Navy requires a full refund for failed TA courses (with some exceptions).

We estimated the refunded TA based on recent course failure and collection rates. The college TA failure rate for enlisted Sailors was 7.3 percent in 1996. NETPDTC, the TA manager, successfully collects 71.3 percent of owed college funds.[12] We divided the net cost of TA by the enrollments to obtain the cost per individual course.

PACE

In the instructor program, the contractor currently receives $1,630 for each academic skills class and $809 for each college credit hour. These fees are independent of the number of students. In the technology program, the contractor currently receives $154 and $302 for each individual academic skills and college course registration, respectively. We multiplied the fees by the number of units on which they are based (classes, credit hours, or individual course registration). We added the cost of instructor travel and hazard, $500, to each instructor course.[13]

Academic Skills Learning Centers

We calculated the cost of a course at the ASLCs based on the per site contractual fees. The Navy pays $106,800 for CONUS centers and $111,360 for OCONUS centers annually. We obtained a weighted average of the per-site fees based on the location of the centers. When all 52 centers are operational, 75 percent of them will be in CONUS. Based on current enrollments, we assumed an average number of 300 Sailors participating at each center annually.

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12. This is based on the 1993 owed amount that had been collected by April 1997. This allowed NETPTDC for at least 3 years to collect the owed funds. We assume that after 3 years, any additional collected amount is negligible.

13. For technology PACE courses, the Navy pays about $500 per command for remote site travel. A moderate increase in enrollments would result in some additional courses offered, but not necessarily an increase in the number of commands involved. Because the cost to the Navy would not change, we did not include the remote travel to the cost of the technology PACE program.

Student performance in PACE

What factors are associated with successful completion of PACE courses? The answer may facilitate efforts to enhance student screening and counseling. Here again, "selection bias" may arise because many of the electronic courses are upper level and may be more demanding than many of the instructor courses. They may have characteristics that make them difficult and that we are not able to factor into our analysis, such as the need for greater individual time management.

Using data on college-level PACE courses taken by active-duty enlisted Sailors during July 1995 through May 1996 (11,101 observations), we conducted the analysis in two stages:

1. The probability of receiving instruction electronically (as opposed to from an instructor).
2. The factors that determine the successful completion of PACE courses, including paygrade, subject area, and delivery mode.

We used the results of the first regression to compute a correction factor for selection bias. This allows us to estimate stage 2 free of selection bias.

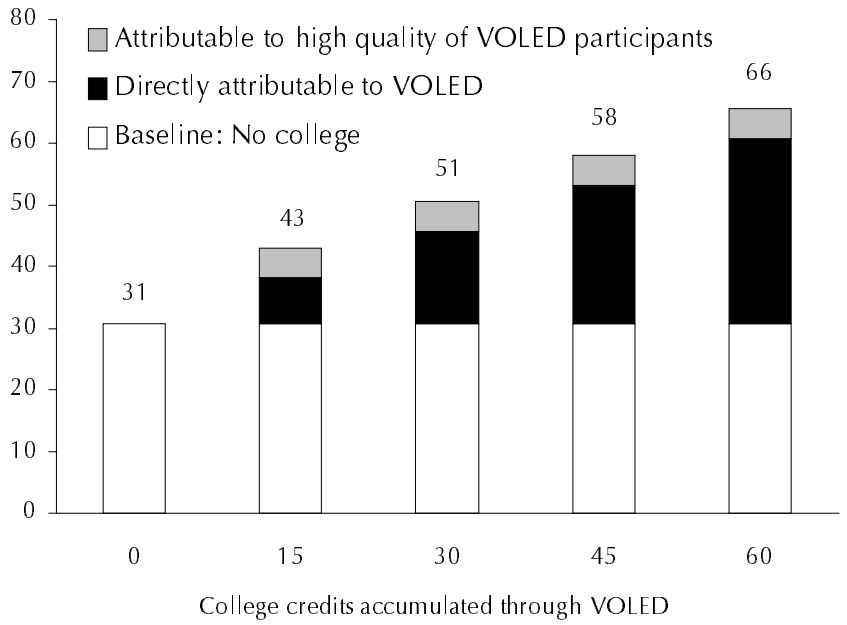
Findings

Impact on promotion and career

Promotion

Thirty-one percent of Sailors with no college education through VOLED make it to E5 in 5 years or less. For those who earned college credits through VOLED, promotion prospects are significantly better. For example, from our regression results we see that, for Sailors with 15 college credits, the chances of making E5 in 5 years increase to 43 percent (see figure 2). (Appendix D contains our estimates of the promotion regression.)

Figure 2. Effect of VOLED participation on promotion[a]



a. FY92 cohort tracked for five years. Based on regression analysis.

As Sailors' involvement in VOLED increases, their promotion prospects improve. For Sailors with 60 college credits—sufficient to obtain an associate degree in most cases—the chances of making E5 in 5 years are 66 percent. Most of the promotion effect is directly attributable to VOLED, though the high motivation of Sailors who decide to take courses accounts for a small portion of the promotion impact.

College education, then, helps Sailors promote faster. It helps Sailors get better evaluations from their supervisors—likely a result of improved work performance. College education may also help Sailors score higher on the advancement rating tests. We base these conclusions from tracking the FY92 cohort for 5 years. Academic skills education, which helps Sailors with deficiencies to catch up, does not have a direct impact on promotion.

Cross-rating

One of the main reasons Sailors participate in academic skills is to retake the ASVAB. Higher ASVAB scores qualify them for A-school training for which they were not originally eligible.

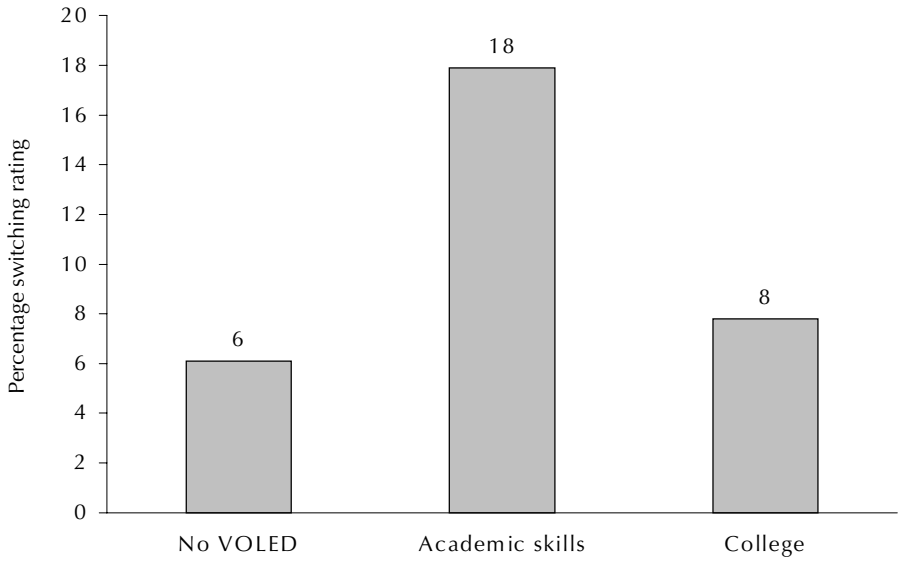
Academic skills participants are 3 times as likely to cross-rate as those not participating in the Voluntary Education Program (see figure 3). Eighteen percent of academic skills participants switch ratings, compared to only 6 percent of those not enhancing their education through VOLED. These figures, based on the FY92 cohort tracked for 5 years, do not include GENDETs getting rated.

Academic skills education, therefore, serves as a bootstrap for Sailors retaking the ASVAB to get a better Navy job. It helps Sailors qualify for Navy ratings for which they were not eligible and enables Sailors to refresh or upgrade their skills in preparation for further education.

Example of impact of education and career choices

We have shown that Sailors can enhance their promotion chances by pursuing college education. Is there anything else Sailors can do to be more competitive? Yes.

Figure 3. Participation in VOLED and cross-rating[a]



a. FY92 cohort at end of first term. Based on sample averages. Does not include GENDETs getting rated.

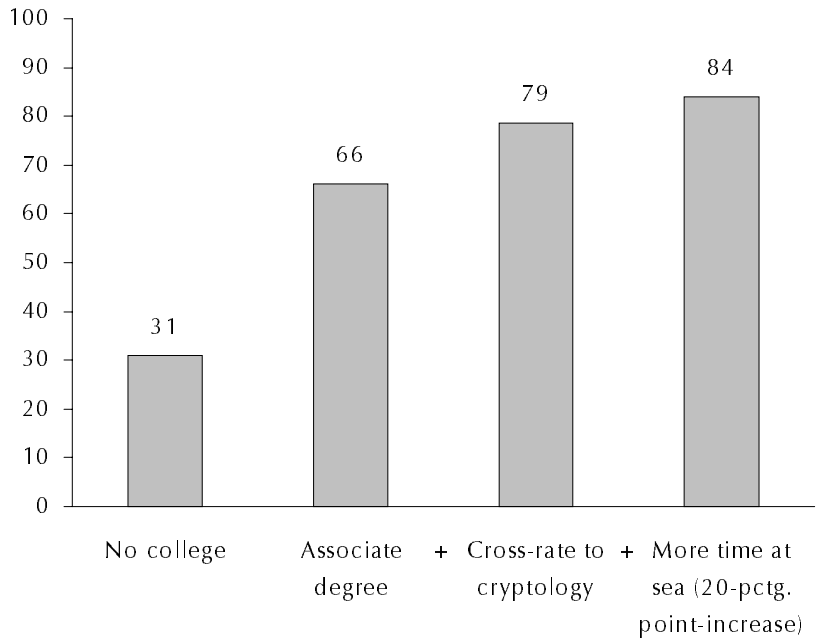
In addition to college education, a choice of a high-skill rating and the willingness to undertake sea-intensive jobs makes a difference. As we saw before, Sailors with no college education through VOLED have a 31-percent probability of making E5 in 5 years. An associate degree increases their chances to 66 percent.

For Sailors with an associate degree, switching to a high-skill rating improves their chances significantly more. For example, cross-rating to cryptology increases the probability of making E5 in 5 years from 66 to 79 percent (see figure 4). This largely reflects the abundance of vacancies in cryptology. Other rating groups that promote fast are surface operations (combat systems), aviation supply, aviation operations, and administration. These results are based on regression analysis.

As an additional boost to their promotion chances, Sailors may undertake more sea-intensive jobs. Take, for example, Sailors with associate degrees working in cryptology. For them, a 20-percentage-point

increase in the proportion of time spent at sea increases the chances of making E5 in 5 years to 84 percent.[14]

Figure 4. Impact of education and career choices on promotion: an example[a]



a. Based on regression analysis.

The positive effect of time at sea on promotion reflects the fact that some types of sea duty earn Sailors promotion points. Also, Sailors at sea get exposed to intensive hands-on training on the equipment and procedures of their rating. This training helps them do better in the

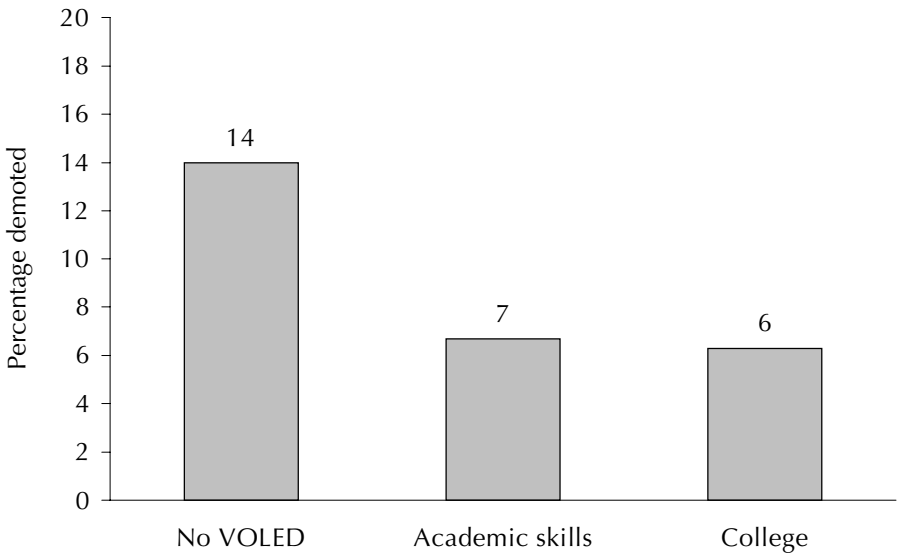
14. Although cryptology is generally a shore-intensive rating, some cryptologists spend over 50 percent of their careers at sea. We based the promotion probability impact on the finding that the marginal effect of cryptology (with respect to the other rating groups) is 10.4 percentage points. Also, we applied the marginal effect of the vacancies, 2.33, to the vacancy ratio difference between cryptology and the other ratings (1.9 minus 1.2). There were no statistically significant interaction between education, rating, and time at sea.

advancement tests. Also, it is a requirement that Sailors be at sea to earn combat skills insignia. In addition, Sailors at sea have a better chance of getting medals. Combat skills insignia and medals earn Sailors promotion points.

Demotion

Demotion is significantly less likely for Sailors who participated in the Voluntary Education Program than for those who did not (see figure 5). For academic skills and college participants, only 7 and 6 percent, respectively, were demoted by the end of their first contract. Among nonparticipants, on the other hand, 14 percent were demoted.

Figure 5. Participation in VOLED and demotion[a]



a. FY92 cohort at end of first term. Based on sample averages.

The low demotion rates of academic skills and college participants may partly reflect the high motivation of Sailors taking courses through VOLED. Nonetheless, the size of the difference in demotion rates suggests that education has a positive impact on discipline.

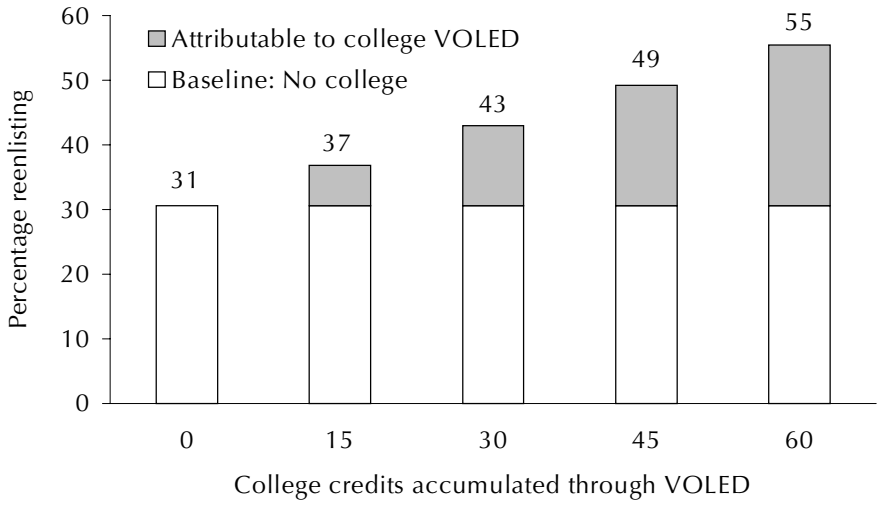
Impact on retention

What is the impact of VOLED on personnel retention? To answer this question, we tracked the FY92 cohort of 4-year obligors through their first reenlistment. In contrast to our promotion results, Sailors who decide to participate in VOLED have a greater initial proclivity to leave the Navy. VOLED turns things around: participants have a higher reenlistment rate than those who did not participate.

College

Sailors who participated in college VOLED have significantly higher reenlistment rates than nonparticipants. Thirty-one percent of Sailors with no college education reenlist. For those who earned college credits through VOLED, reenlistment rates are significantly higher. For example, using our regression results we can see that, for Sailors with 15 college credits, the reenlistment rate increases to 37 percent (see figure 6). (Appendix E contains our estimates of the reenlistment regression.)

Figure 6. Participation in college education and reenlistment[a]



a. First reenlistment, FY92 cohort. Based on regression analysis.

As Sailors' involvement in college education increases, their reenlistment rates also increase. For Sailors with 60 college credits, the reenlistment rate is 55 percent.

Sailors accumulating 60 college credits or more (who are therefore eligible for associate degrees in most cases) are significantly more likely to stay in the Navy. This finding should lay to rest the argument that college education hastens the departure of Sailors seeking employment in the private sector.

Academic skills

Sailors who participated in academic skills also have significantly higher reenlistment rates than nonparticipants. Thirty four percent of Sailors who did not participate in academic skills reenlist. Participation in academic skills increases the reenlistment rate to 48 percent (see figure 7).[15]

Is VOLED cost-effective?

Figure 8 shows the cost per individual course completion for the different VOLED courses. These costs reflect the course completion rates. For two equally costly courses, the cost per course completion is higher for that with the poorest completion rate.

VOLED is low in cost. The cost per course completion is under $500 for all courses. At $475, technology PACE college is the most expensive. This reflects its relatively high contractual fees as well as lower completion rates. At $185, instructor PACE college is the least expensive.

We now show the results of a cost-benefit analysis of the instructional elements of VOLED.

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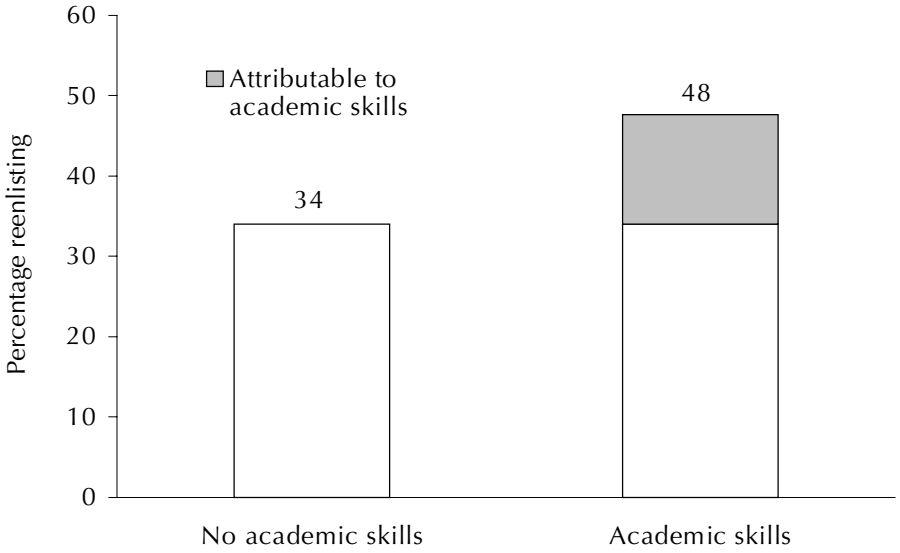
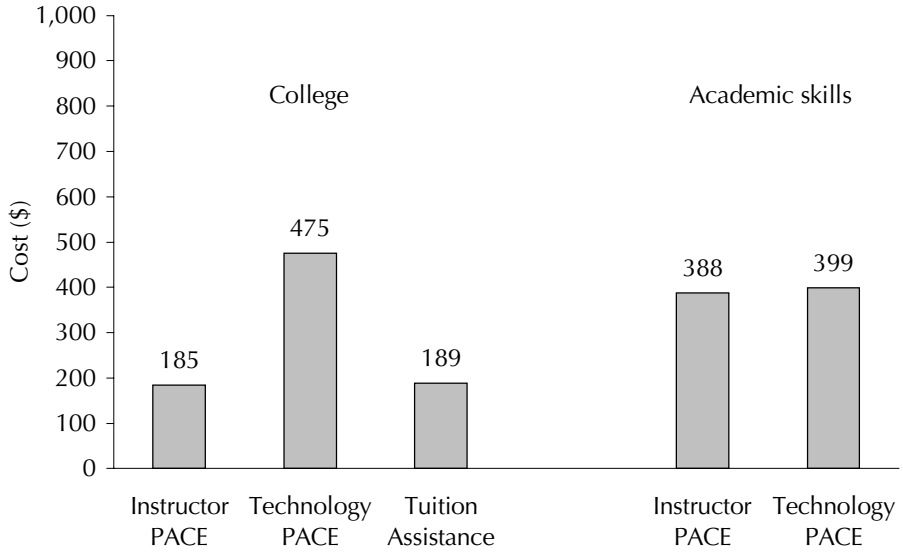
15. The marginal effect we used to assess the impact of "academic skills" is a weighted average of the marginal effects of technology PACE academic skills and instructor PACE and Tuition Assistance developmental (remedial) education. The weights are based on the FY97 enrollments: 23 percent for the technology PACE academic skills and 67 percent for the instructor PACE and Tuition Assistance developmental education.

Figure 7. Participation in academic skills and reenlistment[a]



a. First reenlistment, FY92 cohort. Based on regression analysis.

Figure 8. Cost per course completion[a]

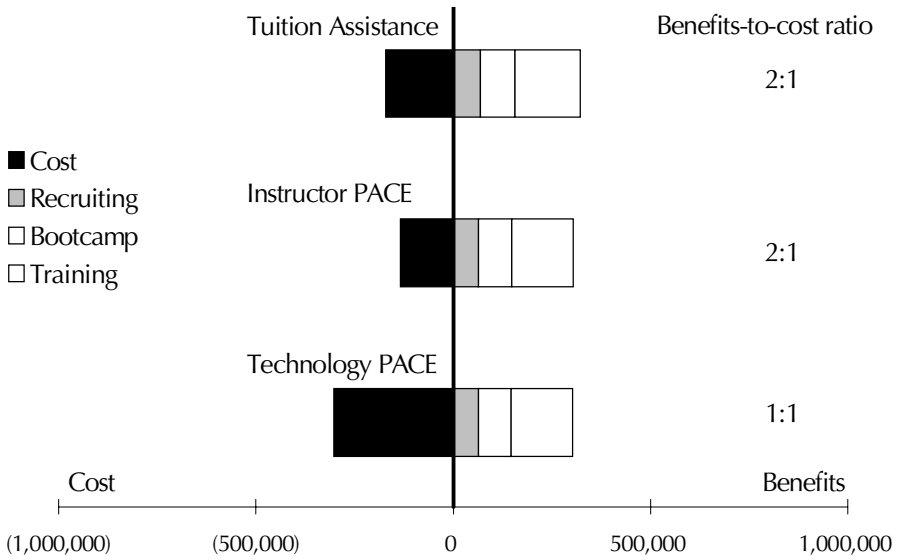


a. FY98 dollars. Because we did not get course completion data for the Academic Skills Learning Centers, we did not calculate their cost per completion.

College

Is college education a cost-effective investment for the Navy? Figure 9 summarizes our cost-benefit analysis of college education through VOLED. For each element, it shows the benefits and costs of increasing enrollments by 1,000 (in FY98 dollars).

Figure 9. Benefits and costs of increasing college enrollments by 1,000 (in FY98 dollars)



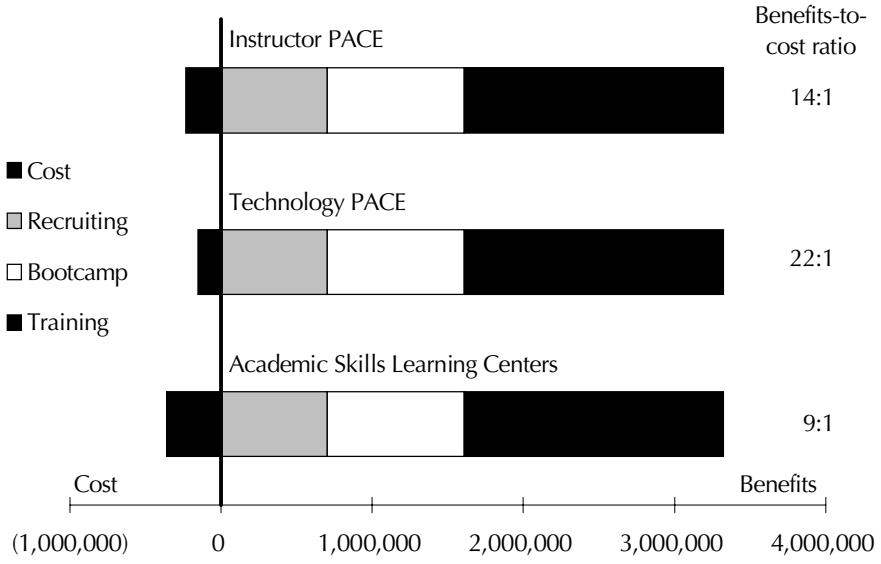
College education through Tuition Assistance, instructor PACE, and technology PACE is cost-effective. In each case, the benefits exceed the cost. For each dollar invested in Tuition Assistance and instructor PACE, the Navy gets $2 from improved retention.

The technology PACE program is also cost-effective, but to a lesser degree. For each $1 invested in the technology PACE program, the Navy gets slightly over $1 in return. In order of magnitude, the benefits from improved retention result from the reduction in the requirements for training (A- and C-school and team and fleet training), bootcamp, and recruiting.

Academic skills

Is remediation through academic skills a cost-effective investment for the Navy? Figure 10 summarizes our cost-benefit analysis of academic skills. For each element providing academic skills, it shows the benefits and costs of increasing enrollments by 1,000 (in FY98 dollars).

Figure 10. Benefits and costs of increasing academic skills enrollment by 1,000 (in FY98 dollars)



Academic skills through instructor PACE, technology PACE, and the Academic Skills Learning Centers is cost-effective. Furthermore, academic skills is *more* cost-effective than college education. For each dollar invested in instructor PACE, the Navy gets $14 from improved retention. For each dollar invested in the technology PACE program and the ASLCs, the Navy gets $22 and $9, respectively.

Our finding that VOLED is cost-effective is consistent with a 1989 study of PACE [3]. It found that participation in college PACE has a positive impact on retention. It also found that, for a 5-percentage-point increase in the reenlistment rate, the college PACE program is cost-effective. Our results are also consistent with a 1988 study of

Tuition Assistance in DOD [4]. This study found positive relationships between college TA and promotion and retention rates. These two studies, though, did not analyze academic skills education.

Our results are also consistent with other researchers' findings in a variety of settings. In studies of country-wide education investment, including in the United States, they have repeatedly found that the returns on education are positive for all education levels [5]. More important, they have found that basic (primary) education earns the highest rate of return: The lower the level of education, the higher the rate of return.

Comparison with other quality-of-life (QOL) programs

An earlier CNA study [6] conducted a cost-benefit analysis of other QOL programs, including family service centers (FSCs) and morale, welfare, and recreation (MWR). FSCs provide programs in personal financial management, deployment assistance, relocation assistance, and individual and family counseling. FSCs also provide programs for exceptional family members, parent education, crisis intervention, and information and referral. MWR, on the other hand, includes physical fitness centers and gyms, youth programs and outdoor recreation, clubs, bowling alleys, and exchanges.

The study concluded that the FSC and MWR programs have retention benefits that exceed program costs. It demonstrated a tangible benefit to QOL programs by linking use and satisfaction data from a DOD survey to actual retention data from CNA's Navy personnel files. [16]

Combining our results with those of the earlier CNA study, we conclude the following:

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16. As in VOLED, there is sample selection in participation in the FSC and MWR programs. Because the earlier CNA study did not have the extensive data we have, including a variable that affects program participation but not retention, the authors were not able to make a correction for sample selection. The earlier study also analyzed childcare and housing, but the survey questions for these programs were not complete enough to allow for definitive conclusions.

- *Most cost-effective.* Academic skills and FSCs are the most cost-effective QOL investments.
- *Cost effective but in lower magnitude.* College education and MWR are also cost-effective, but not to the same degree as academic skills and FSCs.

Enhancing VOLED services

What do Sailors think?

The September 1996 Navy-wide Personnel Survey [7] asked Sailors how the Navy should enhance its Voluntary Education services. Topping the list of factors are command support and publicity of the programs (see table 4). Fifty-one percent of respondents said that they would like more command support for education. Forty-two percent said the Navy should publicize the VOLED programs more. Among the other important considerations are the expansion of the education office hours and the availability of computers.

Table 4. "How can the Navy make education services even better?"[a]

	Percentage of Sailors selecting option
More command support	51
Publicize programs	42
Expand education office hours	39
More access to computers	39
Navy issues counselor	34
Better informed counselor	21
Shorten waiting time	18
Improve library access	13
Open education office at base	11

a. September 1996 Navy-wide Personnel Survey [7].

Command support is likely to be one of the most important determinants of student performance, particularly for Sailors taking courses aboard ship. Command support includes participation in the screening and selection process during registration and enrollment, as well as encouragement and work schedule accommodation (when feasible). Many Sailors aboard ship have rotating shifts and often work long hours. The responses to the survey reflect Sailors' desire for greater accommodation that allows them to pursue further education in their off-duty time.

Impact of counseling

The contractor conducts predeployment surveys, screening, and counseling. These counseling sessions serve as orientation about the course offerings and expose Sailors to the availability of educational opportunities in the Navy. Academic orientation is an important tool to increase enrollments—participation in PACE academic counseling increases the probability of enrolling in a course by 13 percentage points.

What is the need for academic skills?

We showed that academic skills investments are highly cost-effective—more than college education investments. Is there a significant need for remedial education in the force?

A 1989 study [3] showed that Sailors with a combined ASVAB arithmetic reasoning (AR) and paragraph comprehension (PC) score of 100 or below are significantly more likely to fail college courses.[17] These are Sailors with deficiencies in their reading, writing, or ability to solve basic math problems.

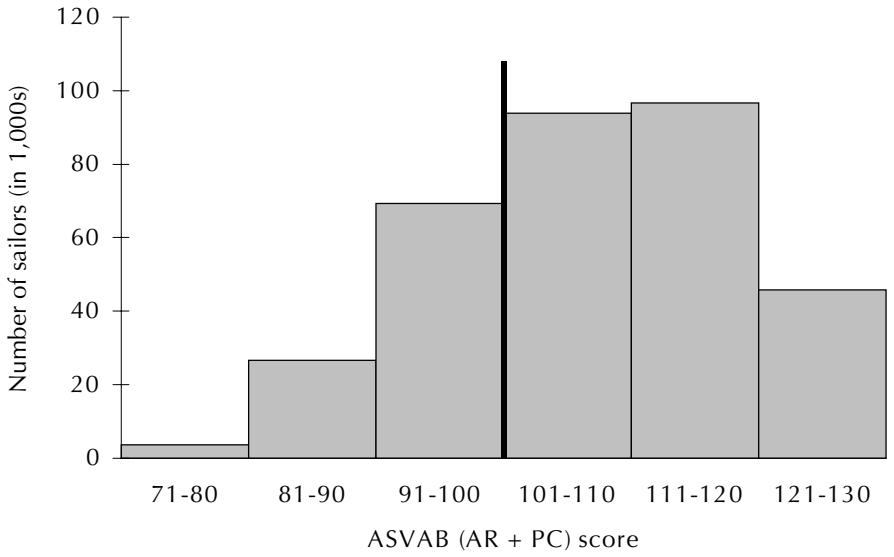
The Navy adopted this cut-off rule to determine who should complete academic skills before taking college-level PACE courses. Sailors may

17. The ASVAB consists of a battery of ten tests that measure knowledge and skill in the following areas: general science, arithmetic reasoning, word knowledge, paragraph comprehension, numerical operations, coding speed, auto and shop information, mathematics knowledge, mechanical comprehension, and electronics information.

get a waiver by obtaining a satisfactory score on the American College Testing Program ASSET test for the area in which they plan to study.

At the end of FY97, 99,600 Sailors—30 percent of the force—were in need of academic skills improvement because their ASVAB (AR plus PC) scores were 100 or below (see figure 11).[18] These Sailors are in need of academic skills improvement. We drew base-specific academic skills profiles. The proportion of the enlisted population in need of academic remediation is as high as 42 percent in Earle, New Jersey, and 41 percent in Atlanta, Georgia (see appendix F).

Figure 11. Academic skills profile of the force[a]



a. ASVAB AR and PC scores of active-duty enlisted Sailors in fourth quarter of FY97.

18. The range of scores of the AR component is 26 to 67. The range of scores of the PC component is 20 to 63. We estimated the proportion of the force that is in need of remedial education based on 336,024, the active-duty enlisted strength in the fourth quarter of FY97. Of this strength, 219,432 Sailors (65.3 percent) had valid ASVAB data. To account for the missing data, we inflated the counts by 1.53.

How many Sailors receive remedial education in a year? About 13,300 received help in FY97. This figure include 9,220 Sailors who participated in academic skills (instructor and technology PACE academic skills as well as in the Academic Skills Learning Centers). It also includes 4,080 Sailors who received remedial education at schoolhouse training facilities.[19]

Student performance

How do Sailors' course completion rates compare with those of civilians at community colleges? Sailors complete 92 percent and 84 percent of the TA and PACE lower level college courses, respectively. In comparison, civilians at community colleges complete 74 percent of the courses (see figure 12).[20]

Thus, compared to community college students, Sailors do well in TA and PACE. TA completion rates may exceed those of PACE because Sailors, who pay back the tuition on failed TA courses, have a direct monetary incentive for course completion. TA completion rates may also be high because of the relatively less demanding working conditions ashore.

PACE

To determine the factors leading to successful outcomes for Sailors enrolled in PACE college courses, we conducted a regression analysis of student performance. We measured individual successful outcome as a passing grade.[21] We accounted for several important determinants of student performance, including demographic, mental ability, career, and educational level.

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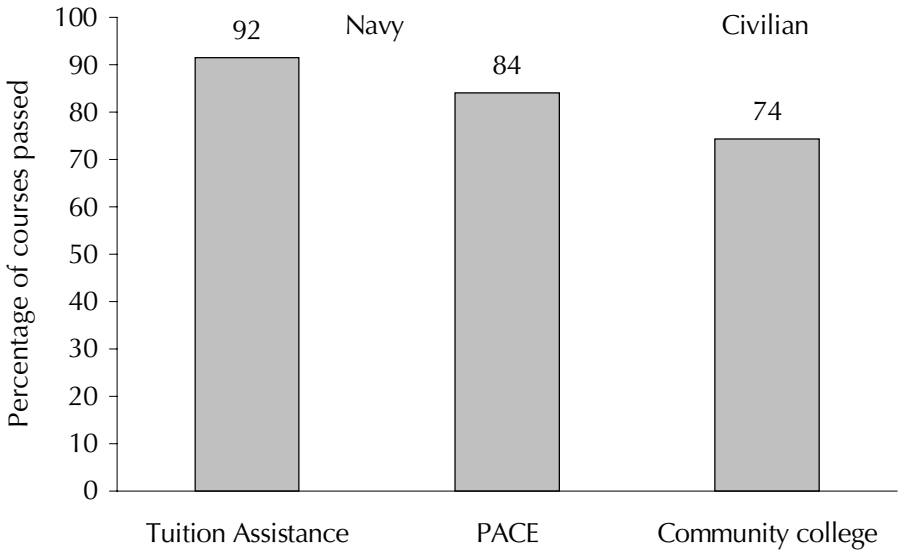
19. This includes those who participated in academic remedial, Fundamental Applied Skills Training (FAST), and Job Opportunity Basic Skills (JOBS) training.

20. We estimated the community college completion rate using 360 student grades downloaded from about 10 different college web pages. These data are for the 1997 spring and fall semesters, and include a cross section of subject areas: algebra, astronomy, biology, business, communications, and computer science.

21. We also analyzed student performance as measured by end-of-course grades, and arrived at similar conclusions.

Figure 12. Comparison of Navy and civilian course completion rates[a]



a. Low-level college courses. Does not include courses that were incomplete.

In particular, we analyzed the impact of paygrade, delivery mode (instructor or technology), and past academic performance. We also factored in the subject area and type of ship. (Appendix G contains our regression estimates of the probability of passing a PACE course.)

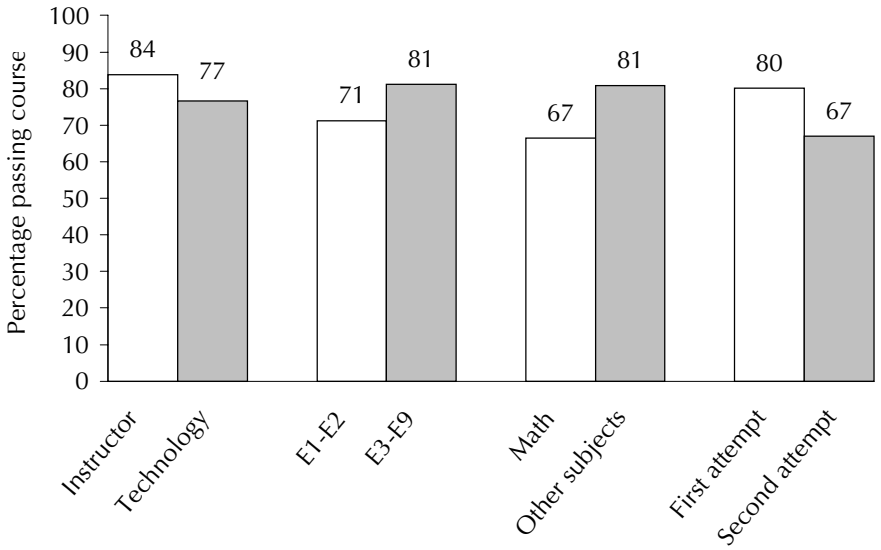
Our main findings are the following:

- Course completion rates for junior Sailors are lower than for more senior Sailors. Completion rates for E1–E2s are 71 percent, compared to 81 percent for E3–E9s. This suggests that maturity is a factor in student performance. E1s and E2s, mostly GENDETs, make up 9 percent of Sailors taking college PACE courses (see figure 13).
- While Sailors perform well in both delivery modes, completion rates in the technology program are lower than in the instructor program. Their respective completion rates are 77 percent and 84 percent.
- Math courses tend to be the most difficult courses. Completion rates in math are 67 percent; in the other subject areas, though,

completion rates are 81 percent. Business and social science courses had the highest completion rates.

- Sailors who were taking a course for the first time scored higher than those who attempted a second time. The completion rate for the first attempt is 80 percent; for the second attempt, it is 67 percent.
- The following factors are associated with higher course completion rates: participation in predeployment orientation, AFQT score, and semester hours of college-level courses passed in the previous 4 years. Also, completion rates aboard submarines are at least 10 percentage points higher than in the other platforms.

Figure 13. Completion rates for PACE courses (college-level)[a]



a. 1995-1996. For each pair of values, one represents the baseline (from data), and the other reflects the marginal effect from the regression analysis.

Our finding that completion rates in the instructor-delivered courses are higher does not necessarily mean that the instructor delivery mode is superior to the technology delivery mode. Delivery mode is a

complex variable that implies more than differences in the media themselves. It includes course time on task (6- or 8-week terms versus 12-week terms), methods of instruction and teacher effects, learner style, time management abilities, individual motivation, and student familiarization with technology. It also includes differences in assessed aptitude for college courses.

Recommendations

Education is more important than ever in an environment of downsized forces and increased competitiveness. Education is a necessary readiness investment for a more technologically sophisticated force. Education builds individual confidence and sense of accomplishment. Based on our analysis, we have the following recommendations:

- **Maintain full support for VOLED, and accelerate academic skills investments.** The Navy should reap the rewards of VOLED by continuing to support it fully. Because the returns on academic skills are especially high and there is a sizable need for remedial education, the Navy should accelerate its investment in academic skills.

- **Modify the ASLC contract to promote greater participation**. The number of participants at the Academic Skills Learning Centers is low. The Navy currently pays a per-center flat fee that is independent of the number of students. The Navy should pay the ASLC contractor a fee that is based on enrollments. This would provide the contractor with a greater incentive to be aggressive in publicizing the centers and to expand working hours through the evenings and weekends.

- **Establish an academic transcript system**. To facilitate program assessment and student counseling, the Navy should accelerate the implementation of the Sailor-Marine/American Council on Education Registry Transcript (SMART). In a format similar to a collegiate record, the transcript would provide a uniform and permanent record of a Sailor's academic history. The transcript would list all Navy training and subject tests of DANTES as well as the results of College Level Examination Program (CLEP) with the corresponsing college credit recommendations. The

transcript would also list college credits earned through TA and PACE.

- **Encourage a more supportive command climate.** In a new VOLED instruction, the Navy should provide specific guidance to COs on establishing a supportive command climate for education, including the identification, screening, and counseling of students.

- **Limit enrollment of E1s and E2s.** To make college PACE even more effective, the Navy should consider limiting participation of E1s and E2s in college-level courses. Before enrollment, E1s and E2s should demonstrate potential for academic success as determined by both the command authorities and the contractor. Indicators of potential for academic success could include the following:

  — An objective assessment by the next superior in the chain of command of the Sailor's motivation and ability to work independently

  — Consideration of the following criteria: a minimum B average on previous college courses or an ASVAB (AR plus PC) score of 110 or more

  — An appraisal of other risk factors identified in this study: math courses and second attempt at same course.

Appendix A: Enlisted training cost

Table 5 shows the enlisted training cost per course completion. By training type, it contains the enrollment, attrition rate, and number of courses offered, as well as the average cost per course. Some types of training consist of course pipelines (e.g., A-school), so the cost of training may be greater than the cost of one course. All the values in the table are for FY96.

Table 5. Enlisted training cost per graduate (FY96 values)[a]

Type of training	Code	Enrollment	Attrition rate (percentage)	Number of courses	Average cost (per course)[b]
Team functional skill	T1	151,766	0.9	124	$404
Functional	F1	98,742	1.8	738	844
Recruit	R1	49,115	12.3	1	6,320
Initial skill (A-school)	A1	43,241	7.2	112	6,469
Preparatory courses	AP	36,988	4.5	80	2,724
Pipeline skill progression	G1	30,055	1.1	273	3,911
Skill progression (C-school)	C1	26,268	3.8	468	5,414
Professional development functional skills	D1	11,026	5.3	67	4,442
Apprenticeship	AA	7,744	2.3	4	1,618
FAST	R4	2,048	6.9	3	1,994

a. Source: Naval Education and Training Professional Development and Technology Center (NETPDTC). Training types with FY96 enrollment under 1,000 are not shown. These smaller training categories are initial skill A-school or A-school pipeline (A3), initial skill nonaccession A-school (A4), initial skill remedial (AR), skill progression medical NEC (C5), and nondegree educational program (E6).

b. We included variable costs only. In particular, we included instruction, student compensation, and, where applicable, lodging, meals, and travel. We included the following cost components: direct supplies, direct contract, direct miscellaneous, depot level repairable (DLR) manpower, DLR civilian pay, DLR supplies, DLR contract, DLR miscellaneous, contractor operation and maintenance for simulators (COMS) manpower, COMS civilian pay, COMS supplies, COMS contract, and COMS miscellaneous. We did not include costs that would not be affected by a moderate change in the number of trainees: instructors, construction of new facilities, and general activities of the installation command and staff (such as logistics, transportation, safety, and facility engineering). We also excluded curriculum development as well as base operating support functions, such as base facility and vehicle operations and maintenance.

Appendix B: Training cost of a rating

Table 6 contains the training cost of Navy enlisted ratings (in FY96 dollars). We matched the course data processing (CDP) codes in each training pipeline to course cost data from NETPDTC.

Table 6. Training cost by enlisted rating (FY96 dollars)

Rating[a]	Specifics	Location	Training cost[b]
ABE		NATTC, Pensacola	$2,975
ABF		NATTC, Pensacola	3,469
ABH		NATTC, Pensacola	4,714
AC		NATTC, Pensacola	10,189
AD	Helicopter	NATTC, Pensacola	4,447
AD	Jet	NATTC, Pensacola	4,471
AD	Turbo	NATTC, Pensacola	4,443
AE		NATTC, Pensacola	13,183
AG		NTTU, Keesler AFB	5,328
AK		NTTC, Meridian	5,521
AME		NATTC, Pensacola	5,245
AMH	I-level	NATTC, Pensacola	4,693
AMH	O-level	NATTC, Pensacola	3,061
AMS		NATTC, Pensacola	4,411
AO	Air wing	NATTC, Pensacola	5,297
AO	Weapons department	NATTC, Pensacola	4,481
AS		NATTC, Pensacola	11,104
AT	I-level	NATTC, Pensacola	16,642
AT	O-level	NATTC, Pensacola	8,499
AW		NASC, Pensacola/NATTC, Pensacola	7,063
AZ		NTTC, Meridian	5,102
BU		NAVCONSTRACEN, Gulfport	12,293
CE		NCTCDET, Sheppard AFB	10,038
CM		NAVCONSTRACEN, Port Hueneme	9,885
CTA		NTTC, Correy Station	6,235
CTI	Arab	DLI, Monterey/NTTCDET Goodfellow	11,045

Table 6. Training cost by enlisted rating (FY96 dollars) (continued)

Rating[a]	Specifics	Location	Training cost[b]
CTI	Chinese Mandarin	DLI, Monterey/NTTCDET Goodfellow	11,045
CTI	French	DLI, Monterey/NTTCDET Goodfellow	11,045
CTI	Hebrew	DLI, Monterey/NTTCDET Goodfellow	11,045
CTI	Korean	DLI, Monterey/NTTCDET Goodfellow	11,045
CTI	Persian-Farsi	DLI, Monterey/NTTCDET Goodfellow	11,045
CTI	Russian	DLI, Monterey/NTTCDET Goodfellow	11,045
CTI	Serb-Croat	DLI, Monterey/NTTCDET Goodfellow	11,045
CTI	Spanish	DLI, Monterey/NTTCDET Goodfellow	11,045
CTI	Tagalog	DLI, Monterey/NTTCDET Goodfellow	11,045
CTI	Vietnamese	DLI, Monterey/NTTCDET Goodfellow	11,045
CTM		NTTC, Correy Station	18,387
CTO		NTTC, Correy Station	6,248
CTR		NTTC, Correy Station	13,868
CTT		NTTC, Correy Station	9,843
DC		SERVSCOLCOM, Great Lakes	11,783
DK		NTTC, Meridian	4,812
DS		SERVSCOLCOM, Great Lakes	25,725
EA		NCTCDET, Ft Leonmo	10,165
EM		SERVSCOLCOM, Great Lakes	13,118
EM-NF		NAVNUPWRTRACOM, Orlando	34,799
EN		SERVSCOLCOM, Great Lakes	13,293
EO		NCTCDET, Ft Leonmo	10,165
ET	Comms	SERVSCOLCOM, Great Lakes	20,813
ET	Radar	SERVSCOLCOM, Great Lakes	20,813
ET-NF		NAVNUPWRTRACOM, Orlando	46,720
ET-SS (5YO)	RF Elect Tech. (SSBN)	NAVSUBSCOL, Groton/TRITRAFAC Bangor	28,856
ET-SS (6YO)	NAV OP (SSN)	NAVSUBSCOL, Groton	32,073
ET-SS (6YO)	NON-TNCP NAV OP (SSBN)	NAVSUBSCOL, Groton/TRITRAFAC, Kings Bay	36,770
ET-SS (6YO)	RF OP (SSBN)	NAVSUBSCOL, Groton/TRITRAFAC Bangor	36,770
ET-SS (6YO)	RF OP (SSBN)	NAVSUBSCOL, Groton/TRITRAFAC, Kings Bay	24,897
ET-SS (6YO)	RF OP (SSN)	NAVSUBSCOL, Groton	21,675
ET-SS (6YO)	TNCP NAV OP (SSBN)	NAVSUBSCOL, Groton/TRITRAFAC Bangor	21,507
ET-SS (6YO)	TNCP NAV OP (SSBN)	NAVSUBSCOL, Groton/TRITRAFAC, Kings Bay	18,824
EW (4YO)		NTTC, Correy Station	9,888
EW (6YO)		NTTC, Correy Station	33,790
FC		SERVSCOLCOM, Great Lakes	27,973
FT		NAVSUBSCOL, Groton	11,350

Table 6. Training cost by enlisted rating (FY96 dollars) (continued)

Rating[a]	Specifics	Location	Training cost[b]
GM		SERVSCOLCOM, Great Lakes	19,269
GSE		SERVSCOLCOM, Great Lakes	17,873
GSM		SERVSCOLCOM, Great Lakes	9,487
HT		SERVSCOLCOM, Great Lakes	7,994
IC		SERVSCOLCOM, Great Lakes	13,880
IM		NTTC, Correy Station	10,758
IS		NMITC, Dam Neck	11,691
JO		NTTCDET Ft Meade	4,608
LI		Navy Training, Ft Belvoir	4,608
MM		SERVSCOLCOM, Great Lakes	7,013
MM-A(SS)	Weapons	NAVSUBSCOL, Groton	23,424
MM-W(SS)	Auxillary	NAVSUBSCOL, Groton	22,948
MM-W(SS)	Auxillary	NAVSUBSCOL, Groton/TRITRAFAC Bangor	22,955
MM-W(SS)	Auxillary	NAVSUBSCOL, Groton/TRITRAFAC, Kings Bay	23,290
MMN		NAVNUPWRTRACOM, Orlando	32,188
MN		NWTC, Ingleside	8,516
MR		SERVSCOLCOM, Great Lakes	9,359
MS		NTTCDET LACKLAND AF	3,967
MS-SUB		NTTCDET LACKLAND AF/NAVSUBSCOL, Groton	7,196
MT		NAVSUBSCOL, Groton	11,912
OM		NTTC, Correy Station	15,591
OS		FCTCL, Dam Neck	9,545
PC		USAAGSCH, Ft Jax	4,608
PH		Phototraining, Pensacola	5,328
PN		NTTC, Meridian	4,592
PR	I-level	NATTC, Pensacola	5,271
QM		SERVSCOLCOM, Great Lakes	4,549
RM		SERVSCOLCOM, Great Lakes	8,730
RM21		SERVSCOLCOM, Great Lakes	8,730
RP		NTTC, Meridian	4,327
SH		NTTC, Meridian	2,768
SK		NTTC, Meridian	5,446
SK-SUB		NTTC, Meridian/NAVSUBSCOL, Groton	8,675
SM		SERVSCOLCOM, Great Lakes	3,409
SN		SERVSCOLCOM, Great Lakes	1,267
STG	NEC 0445	FLEASWTRACENPAC, San Diego	8,104
STS		NAVSUBSCOL, Groton	15,991
SW		NAVCONSTRACEN, Gulfport	8,443

Table 6. Training cost by enlisted rating (FY96 dollars) (continued)

Rating[a]	Specifics	Location	Training cost[b]
TM		SERVSCOLCOM, Great Lakes	5,696
UT		NCTCDET, Sheppard AFB	10,165
YN		NTTC, Meridian	4,906
YN-SUB		NTTC, Meridian	6,520

a. Cost data were not available for the following ratings: AG, CTI, DT, EA, EO, HM, JO, LI, MU, PC, PH, and UT.
b. We included variable costs only. The cost components include instruction, student compensation, and, where applicable, lodging, meals, and travel. We included the following cost components: direct supplies, direct contract, direct miscellaneous, depot level repairable (DLR) manpower, DLR civilian pay, DLR supplies, DLR contract, DLR miscellaneous, contractor operation and maintenance for simulators (COMS) manpower, COMS civilian pay, COMS supplies, COMS contract, and COMS miscellaneous. We did not include costs that would not be affected by a moderate change in the number of trainees: instructors, construction of new facilities, and general activities of the installation command and staff (such as logistics, transportation, safety, and facility engineering). We also excluded curriculum development as well as base operating support functions, such as base facility and vehicle operations and maintenance.

Appendix C: Estimation of the promotion and retention models

Promotion

To analyze the effect of participation in VOLED on promotion, we conducted a regression analysis of the paygrade attained after 5 years of service. Because paygrade is a ranking, ordinary least squares is not an appropriate option. For example, ordinary least squares would take the difference between paygrades 1 and 2 to be the same as that between paygrades 4 and 5.

A multinomial logit or probit model would not be appropriate either because it would fail to account for the ordinal nature of paygrade. We wanted to see whether participation in VOLED increased the probability of making it to E5 *and* decreased the probability of being in the lower paygrades.

To tackle the ordered nature of paygrade, we used an *ordered probit* model. This model has been applied to other ordinal variables, such as the assignment of military personnel to job classifications by skill level (high-skill, medium-skill, and low-skill), opinion surveys (agree, neutral, disagree), and results of taste tests.

The ordered probit model is built around a latent equation [8]:

$$y^* = \beta' x + \varepsilon \ ,$$

where y^*, Sailors' individual ranking (based on Sailors' individual productivity compared to each one of their peers), is unobserved. The term x denotes measurable factors, such as college education, vacancies in the rating, and sea experience; ε denotes unmeasurable factors (the error term).

We do observe Sailors' five possible paygrade levels (E1-E5). We know that the paygrade ranks Sailors, but we do not know how precisely they rank within paygrade. That is, the unit distance between the set of observed values of y_i^* is not significant.

The estimates of the ordered probit model are obtained with maximum likelihood estimation. The probabilities entering the log-likelihood function are: $Prob[y^* = j]$, which equals the probability that y^* is in one of the five paygrades.

Correcting for selection bias

We extend the ordered probit model to account for sample selection in the choice to participate in the Voluntary Education Program. Because the most motivated Sailors may be the ones pursuing college education, the education coefficients may overestimate the promotion impact of VOLED if we do not control for sample selection. We need to figure out to what extent Sailors who participated in VOLED would have gotten promoted fast even if they had not participated in VOLED.

Let the equation that determines the sample selection be

$$z_i^* = \gamma' w_i + u_i \ ,$$

where z_i^* denotes participation in the Voluntary Education Program, w_i is a vector of measurable factors that explain the choice to participate, and u_i is a random error term. The vector w_i includes an "instrument," that is, a variable that is expected to affect participation in VOLED but not promotion or retention. We used participation in academic counseling on a ship as the instrument.

We estimated the sample selection model using the Heckman two-step procedure:

1. Fit a probit model for the selection variable z_i^*. Retain

$$\hat{\lambda}_i = \frac{\phi(\hat{\gamma}'\omega_i)}{\Phi(\hat{\gamma}'\omega_i)} \ ,$$

where $\phi(\hat{\gamma}\omega_i)$ is the normal probability density function, and $\Phi(\hat{\gamma}\omega_i)$ is the normal cumulative density function. The ratio λ_i is also known as the "Inverse Mills Ratio."

2. Estimate the selection-corrected estimates of β by regressing y on x and $\hat{\lambda}$.

The marginal effect of college credits (a component of the term x) gives us the promotion effect that is directly attributable to VOLED. The marginal effect of the Inverse Mills Ratio gives us the promotion effect that is attributable to the high motivation of VOLED participants.

Retention

To analyze the effect of participation in VOLED on retention, we estimated a binomial probit model. The dependent variable captured whether the first-term Sailor reenlisted (or extended). We tracked the FY92 cohort of 4-year obligors (GENDETs and school guarantee personnel) through their first reenlistment decision. Sailors who did not reenlist include the early-outs as well as those who left upon completion of their contract terms.

Because sample selection arises in retention, we corrected for it using a procedure similar to the one we used for promotion. Here again we followed the Heckman two-step process, where the first regression is identical to the one we used for promotion.

Appendix D: Regression estimates of promotion

Table 7 shows the factors that determine the probability of participating in the Voluntary Education Program. We used the results of this regression to estimate a correction factor for selection bias in the decision to participate in VOLED. The analysis is based on active-duty enlisted Sailors who accessed in the last two quarters of FY92 and served in the Navy for at least 5 years.

Table 8 shows the factors that determine the probability of making it to E5 in 5 years or less. To control for sample selection in the choice to participate in the Voluntary Education Program, we included the correction factor (Inverse Mills Ratio) from the first regression as an explanatory variable.

The "marginal effects" reflect the percentage-point change in promotion probability associated with a unit change in the variable in question. For example, in table 2, the marginal effect of college credits through the Voluntary Education Program is 0.50 for promotion to E5 (significant at the 99 percent level). This means that each college credit is associated with an increase in the probability of promotion to E5 of 0.50 percentage points. Thus, 10 college credits increase the probability of promotion to E5 by 5.0 percentage points.

Table 7. The probability of participating in the Voluntary Education Program: probit estimates[a]

Variable	Marginal effect (percentage points)[b]	t-ratio	Average
Orientation	12.31***	7.06	0.06
AFQT score	0.24***	8.83	59.70
Education at accession[c]			
No high school degree	-1.11	-0.15	0.01
Nontraditional high school	-0.21	-0.07	0.02
College experience	-12.83	-0.81	0.00

Table 7. The probability of participating in the Voluntary Education Program: probit estimates[a]

Variable	Marginal effect percentage points[b]	t-ratio	Average
Individual and career			
Female	7.95***	5.95	0.15
African American	-0.29	-0.24	0.23
Hispanic	3.99***	2.85	0.11
Asian Pacific Islander	10.85***	5.21	0.05
Married	3.35*	1.69	0.05
Age (at accession)	-1.46***	-11.79	19.46
Demoted	-7.31***	-3.09	0.05
Sea duty (% of career)	-0.17***	-9.60	81.23
Rating group[d]			
Administration	9.16***	3.42	0.05
Aviation maintenance	-0.44	-0.19	0.09
Aviation operations	2.55	0.94	0.05
Aviation supply	12.86***	4.19	0.03
Construction battalion	0.07	0.02	0.03
Cryptology	4.64	1.59	0.03
Deck	5.14	1.35	0.02
General detail	-0.33	-0.17	0.28
Hull, mechanical, electrical	-3.42	-1.18	0.04
Medical	8.14***	3.48	0.09
Musician	-8.93	-0.67	0.00
Submarine	-4.09	-1.09	0.02
Supply	1.13	0.45	0.07
Surface operations	0.26	-0.11	0.08
Surface operations (combat systems)	3.36	1.32	0.06

a. Five-year survivors only. Dependent variable is participation in any of the elements of the Voluntary Education Program (college, academic skills, developmental, and vocational/technical). Average = 0.26. Standard deviation = 0.44. Number of observations = 8,113. Log likelihood function = -4,332. Chi-squared test (27) = 595. Regression confidence level = 99.99 percent.

b. Partial derivatives computed at the averages of the explanatory variables.
*** Statistically significant at 99-percent confidence level.
* Statistically significant at 90-percent confidence level.

c. Reference educational background group is high school graduates.

d. Rating group at 24 months of service or latest. Reference rating group is surface engineer.

Table 8. The probability of reaching a determined paygrade: ordered probit model corrected for sample selection[a]

	Marginal effect (percentage points)[b]						
	E1	E2	E3	E4	E5	t-ratio[c]	Average
Voluntary Education Program							
College credits[d]	0.00	0.00	-0.07	-0.42	0.50	4.77***	2.24
Developmental (remedial) credits	0.00	0.00	0.00	-0.01	0.01	0.01	0.10
Academic skills participation	0.03	0.05	0.78	4.47	-5.33	-1.17	0.01
Vocational/technical coursework	-0.02	-0.03	-0.47	-2.70	3.22	1.37	0.01
Education at accession[e]							
No high school degree	-0.04	-0.07	-1.04	-6.01	7.17	0.75	0.00
Non-traditional high school	0.02	0.04	0.56	3.24	-3.86	-1.12	0.02
College experience	0.17	0.27	4.04	23.26	-27.74	-1.25	0.00
Vacancies: ratio of E5 billets and E4 inventory	-0.02	-0.04	-0.55	-3.15	3.76	3.03***	1.28
Individual and career							
Demoted	0.29	0.48	7.05	40.60	-48.43	-22.56***	0.05
Sea duty (% of career)	0.00	0.00	-0.04	-0.22	0.26	12.15***	56.23
AFQT score	0.00	-0.01	-0.09	-0.51	0.61	17.89***	59.70
Age (at E5 or latest)	-0.01	-0.01	-0.18	-1.06	1.27	5.85***	24.61
Female	0.02	0.04	0.58	3.32	-3.96	-2.34**	0.15
African American	0.05	0.09	1.31	7.52	-8.97	-6.64***	0.23
Hispanic	0.04	0.06	0.95	5.49	-6.55	-4.10***	0.11
Asian Pacific Islander	0.00	0.00	-0.05	-0.27	0.33	0.13	0.05
Married	-0.05	-0.07	-1.09	-6.28	7.49	3.34***	0.05
Accession program[f]							
School guarantee 4YO	0.04	0.07	1.07	6.14	-7.33	-2.35**	0.34
School guarantee 6YO	0.02	0.03	0.39	2.22	-2.65	-0.80	0.19
General detail	0.03	0.04	0.61	3.51	-4.18	-1.30	0.34
Other program	0.00	0.01	0.11	0.62	-0.75	-0.22	0.08
Rating group[g]							
Administration	-0.13	-0.21	-3.14	-18.07	21.55	6.79***	0.05
Aviation maintenance	0.03	0.05	0.75	4.32	-5.16	-1.88*	0.09
Aviation operations	-0.06	-0.10	-1.55	-8.93	10.65	3.35***	0.05
Aviation supply	-0.09	-0.14	-2.07	-11.95	14.25	3.95***	0.03
Construction battalion	-0.03	-0.05	-0.81	-4.64	5.54	1.31	0.03
Cryptology	-0.23	-0.38	-5.63	-32.40	38.64	10.35***	0.03

Table 8. The probability of reaching a determined paygrade: ordered probit model corrected for sample selection[a]

	Marginal effect (percentage points)[b]						
	E1	E2	E3	E4	E5	t-ratio[c]	Average
Deck	-0.06	-0.10	-1.43	-8.21	9.79	2.30**	0.02
General detail	0.10	0.17	2.49	14.35	-17.12	-6.26***	0.28
Hull, mechanical, electrical	-0.06	-0.10	-1.43	-8.22	9.80	3.22***	0.04
Medical	0.14	0.22	3.24	18.67	-22.27	-7.23***	0.09
Musician	0.13	0.20	3.00	17.28	-20.61	-0.82	0.00
Submarine	-0.06	-0.10	-1.41	-8.10	9.67	2.43**	0.02
Supply	0.00	0.01	0.11	0.63	-0.75	-0.26	0.07
Surface operations	-0.05	-0.07	-1.11	-6.38	7.61	2.79***	0.08
Surface operations (combat systems)	-0.16	-0.26	-3.77	-21.72	25.90	8.28***	0.06
Correction for sample selection	-0.03	-0.05	-0.69	3.98	4.75	5.40***	0.00

a. Five-year survivors only. Dependent variable is last paygrade observed. Number of observations = 8,113. Log likelihood function = -5,872. Chi-squared test (37) = 2,550. Regression confidence level = 99.99 percent.
b. Partial derivatives computed at the averages of the explanatory variables.
c. *** Statistically significant at 99-percent confidence level.
** Statistically significant at 95-percent confidence level.
* Statistically significant at 90-percent confidence level.
d. In a separate specification, we included the square value of the college credits but it was not statistically significant. Without correction for sample selection, the marginal effect of college credits on paygrade is -0.01, -0.01, -0.12, -0.69, and 0.82 percentage points for E1 through E5, respectively (statistically significant at the 99-percent confidence level). The marginal effect of the other variables are not much different from those presented in this table.
e. Reference educational background group is high school graduates.
f. Reference accession program is school guarantee 5YOs.
g. Rating group at 24 months of service or latest. Reference rating group is surface engineer.

Appendix E: Regression estimates of retention

Table 9 shows the factors that determine the probability of participating in the Voluntary Education Program. We used the results of this regression to estimate a correction factor for selection bias in the decision to participate in VOLED. The analysis is based on the FY92 cohort of active-duty enlisted Sailors with 4-year contracts.

Table 10 shows the factors that determine the probability of reenlisting. To control for sample selection in the decision to participate in the Voluntary Education Program, we included the correction factor (Inverse Mills Ratio) from the first regression as an explanatory variable.

Table 9. The probability of participating in the Voluntary Education Program: probit estimates[a]

Variable	Marginal effect (percentage points)[b]	t-ratio	Average
Orientation	12.94***	9.69	0.02
AFQT score	0.13***	9.77	55.64
Education at accession[c]			
No high school degree	-7.50*	-1.74	0.01
Nontraditional high school	-2.05	-1.45	0.03
College experience	-6.22	-0.60	0.01
Individual and career			
Female	6.00***	10.73	0.18
African American	-0.39	-0.66	0.18
Hispanic	3.31***	5.12	0.11
Asian Pacific Islander	8.40***	7.18	0.03
Married	-0.65	-1.48	0.34
Age (at accession)	-2.21***	-50.52	19.53
Demoted	-7.11***	-9.75	0.13
Sea duty (% of career)	-0.01	-0.24	47.43

Table 9. The probability of participating in the Voluntary Education Program: probit estimates[a]

Variable	Marginal effect (percentage points)[b]	t-ratio	Average
Rating group[d]			
Administration	22.43***	7.00	0.01
Surface engineer	8.42***	7.49	0.06
Aviation maintenance	13.64***	13.95	0.07
Aviation operations	16.59***	21.26	0.11
Aviation supply	15.98***	17.44	0.08
Construction battalion	21.90***	20.69	0.04
Cryptology	23.18***	26.49	0.06
Deck	16.93***	13.64	0.03
Hull, mechanical, electrical	15.21***	16.67	0.08
Medical	23.07***	28.79	0.08
Musician	25.69***	22.42	0.03
Submarine	17.49***	13.07	0.02
Supply	15.51***	14.35	0.04
Surface operations	12.87***	6.52	0.01
Surface operations (combat systems)	25.86***	4.08	0.01

a. Four-year obligors only. Dependent variable is participation in any of the elements of the Voluntary Education Program (college, academic skills, developmental, and vocational/technical). Average = 0.15. Standard deviation = 0.36. Number of observations = 24,756. Log likelihood function = -9,329. Chi-squared test (27) = 2,313. Regression confidence level = 99.99 percent.

b. Partial derivatives computed at the averages of the explanatory variables.
*** Statistically significant at 99-percent confidence level.
* Statistically significant at 90-percent confidence level.

c. Reference educational background group is high school graduates.

d. Rating group at 24 months of service or latest. Reference rating group is general detail.

Table 10. The probability of reenlisting: probit estimates corrected for sample selection[a]

Variable	Marginal effect (percentage points)[b]	t-ratio	Average
Voluntary Education Program			
College credits	0.43***	3.26	1.23
College credits squared	-0.01***	-2.49	24.32
Academic skills participation	35.17***	2.54	0.01
Developmental (remedial) credits	2.25**	2.14	0.06
Developmental credits squared	-0.31*	-1.74	0.27
Vocational/technical coursework	2.34	0.56	0.01
Associate degree (60 or more college credits)	11.00	0.13	0.01
Education at accession[c]			
No high school degree	-1.24	-0.26	0.01
Nontraditional high school	4.30***	2.45	0.03
College experience	4.50	0.47	0.01
Selective reenlistment bonus (SRB)			
Multiple	3.03***	5.65	0.37
Qualified	-0.74	-0.71	0.23
Paygrade (at decision point)			
E1-E2	-31.03***	-26.58	0.32
E3	-12.37***	-16.32	0.23
E5	17.04***	14.00	0.05
Scheduled to advance to next paygrade	14.19***	15.35	0.16
Sea duty (% of career)	0.54	0.73	0.55
Next tour ashore	7.76***	11.68	0.46
AFQT score	0.04***	2.31	55.64
Age (at decision)	3.65***	30.01	19.53
Female	6.35***	7.89	0.18
African American	14.48***	19.36	0.18
Hispanic	6.39***	7.80	0.11
Asian Pacific Islander	11.65***	7.61	0.03
Single parent	-2.12*	-1.75	0.05
Number of dependents	3.40***	8.04	0.27
Military spouse	3.19***	3.05	0.06
Unemployment rate[d]	-19.37***	-44.29	5.89

Table 10. The probability of reenlisting: probit estimates corrected for sample selection[a]

Variable	Marginal effect (percentage points)[b]	t-ratio	Average
Rating group[e]			
Administration	46.52***	9.50	0.01
Surface engineer	14.86***	10.74	0.06
Aviation maintenance	10.74***	7.86	0.07
Aviation operations	21.74***	18.60	0.11
Aviation supply	17.83***	14.17	0.08
Construction battalion	23.90***	16.10	0.04
Cryptology	22.53***	17.14	0.06
Deck	15.15***	9.35	0.03
General detail	22.47***	18.28	0.08
Hull, mechanical, electrical	35.55***	27.97	0.08
Medical	27.21***	15.12	0.03
Musician	17.85***	9.97	0.02
Submarine	16.37***	10.32	0.04
Supply	23.00***	9.74	0.01
Surface operations	40.79***	4.70	0.01
Surface operations (combat systems)			
Correction for sample selection	-2.19***	-3.87	0.00

a. Includes 4-year obligors only. Dependent variable is reenlistment or extension observed. Number of observations = 8,113. Log likelihood function = -5,872. Chi-squared test (37) = 2,550. Regression confidence level = 99.99 percent.
b. Partial derivatives computed at the averages of the explanatory variables.
*** Statistically significant at 99-percent confidence level.
** Statistically significant at 95-percent confidence level.
* Statistically significant at 90-percent confidence level.
c. Reference educational background group is high school graduates.
d. The overall unemployment rate was 6.5 percent in FY92 and declined steadily to 4.2 percent in FY97. The race-specific unemployment rates experienced a similar declining trend. The negative effect of the unemployment rate on reenlistment reflects that a large proportion of the FY92 cohort's attrition occurred in the relatively high unemployment period of FY92 and FY93.
e. Rating group at 24 months of service or latest. Reference rating group is general detail.

Appendix F: Academic skills profile

Table 11 shows the active-duty enlisted Navy population that is in need of academic remediation. This is the population with a combined arithmetic reasoning and paragraph comprehension ASVAB score of 100 or less.

Here is how we assigned individual Sailors to the different Academic Skills Learning Center sites. In the activity file, every UIC has an associated area code, called the ATC. ATCs are generally associated with specific cities or areas. We did most groupings using the ATCs. But in some densely populated areas, such as San Diego, one ATC covered several ASLC sites. To separate the areas in these cases, we first used the geographic location (GEOLOC) code. Where overlap still occurred, we used the activity name in order to perform the final UIC assignment to the ASLC sites. For example, Fleet Anti-Submarine Warfare Training Center, Pacific had the same ATC and GEOLOC as Naval Station, San Diego. To distinguish between the two, we looked for "ASW" or "anti-submarine" in the activity nam e.

Table 11. Population in need of academic remediation[a]

ASLC site	Status (as of March 1998)	Population in need of remediation (percentage)
Atlanta	TBD	41
Atsugi	In operation	37
Bangor, WA	In operation	13
Bremerton, WA	TBD	32
Brunswick, ME	TBD	22
China Lake, CA	TBD	30
Corpus Christi	Opening in FY98	30
Earle, NJ	TBD	42
Everett, WA	Proposed opening in FY99	31
Fallon, NV	TBD	30
FASWTCP San Diego	Proposed opening in FY99	14
Ft Worth/Dallas	TBD	32
Great Lakes, IL	In operation	28
Guam	Opening in FY98	33
Guantanamo	In operation	34
Gulfport, MS	Proposed opening in FY99	38
Hueneme/Mugu, CA	Proposed opening in FY99	35
Ingleside, TX	Proposed opening in FY99	35
Jacksonville, FL	In operation	32
Keflavik, IC	In operation	30
Key West, FL	Proposed opening in FY99	30
Kings Bay, GA	TBD	14
Kingsville, TX	TBD	32
Lemoore, CA	Proposed opening in FY99	31
Little Creek, VA	In operation	35
Mayport, FL	Opening in FY98	34
Meridian, MS	TBD	37
Millington, TN	TBD	31
Misawa, Japan	TBD	26
NAB Coronado, CA	In operation	29
Naples, Italy	Proposed opening in FY99	29
NAS Oceana, VA	Opening in FY98	30
New London, CT	Opening in FY98	16
New Orleans, LA	TBD	32
Newport, RI	In operation	21
Norfolk, VA	Proposed opening in FY99	33
North Island, SD CA	Proposed opening in FY99	32

Table 11. Population in need of academic remediation[a]

ASLC site	Status (as of March 1998)	Population in need of remediation (percentage)
NS San Diego, CA	Proposed opening in FY99	35
Okinawa, Japan	TBD	27
Oklahoma City, OK	TBD	27
Pascagoula, MS	TBD	35
Pax River, MD	TBD	28
Pearl Harbor	In operation	25
Pensacola, FL	Proposed opening in FY99	22
Roosevelt Roads, PR	In operation	37
Rota, Spain	Opening in FY98	23
Sasebo, Japan	In operation	39
Sigonella, Italy	Opening in FY98	31
SUBASE Pt. Loma	TBD	29
Washington, DC	In operation	25
Whidbey Island, WA	Proposed opening in FY99	26
Yokosuka, Japan	In operation	36

a. Active-duty enlisted Sailors.

Appendix G: Regression estimates of the probability of passing a PACE course

Table 12 shows the factors that determine the probability of receiving technology instruction (as opposed to instruction from an instructor). The analysis focuses on college-level PACE courses taken by active-duty enlisted Sailors during July 1995–May 1996. We used the results of this regression to estimate a correction factor for sample selection in the choice of instruction method.

Table 13 shows the factors that determine the successful completion of college PACE courses. To control for sample selection in the choice of method of instruction, we included the correction factor (Inverse Mills Ratio) from the first regression as an explanatory variable .

The marginal effects reflect the percentage-point change in probability associated with a unit change in the variable in question. For example, in table 2, the marginal effect of E1-E2 paygrade is -17.25 (significant at the 99 percent level). This means that E1s and E2s, after controlling for subject area and individual characteristics, among others, are associated with a completion probability that is 17.25 percentage points lower than E7-E9s, the reference paygrade group.

Table 12. The probability of receiving technology instruction (college-level PACE): probit estimates[a]

Variable	Marginal effect (percentage points)[b]	t-ratio	Average
ASVAB (AR+PC) score	0.78***	15.00	111.11
Previous college credits			
Tuition Assistance	0.15***	2.80	2.04
Instructor PACE	-1.23***	-14.00	4.71
Technology PACE	12.02***	15.70	0.21
East coast	-11.32***	-12.13	0.51
Years of service	0.84***	10.02	6.29
Ship type[c]			
Carrier	-34.18***	-28.22	0.32
Cruiser or destroyer	0.77	0.73	0.27
Subject area[d]			
English	-24.59***	-14.08	0.17
History	-5.06***	-3.54	0.25
Math	18.41***	7.67	0.04
Social sciences	10.70***	7.29	0.17
Other	22.61***	15.35	0.19

a. Dependent variable is selection of technology PACE. Average = 0.34. Standard deviation = 0.47. Number of observations = 11,101. Log likelihood function = -5,220. Chi-squared test (12) = 3,751. Regression confidence level = 99.99 percent.
b. Partial derivatives computed at the averages of the explanatory variables. *** Statistically significant at 99-percent confidence level.
c. Reference ship type comprises amphibious ships, frigates, and support ships. We did not include submarines because they only offer technology courses.
d. Reference subject area is business.

Table 13. The probability of passing a PACE college course: probit estimates corrected for sample selection[a]

Variable	Marginal effect (percentage points)[b]	t-ratio	Average
Technology instruction	-7.16***	-2.48	0.34
Failed same course before	-13.18***	-3.87	0.01
Received orientation	4.48***	4.25	0.18
Education[c]			
Accessed without HS degree	-2.28	-1.41	0.06
Accessed with college experience	6.86**	2.14	0.02
Recent college credits	0.17***	6.49	6.96
Individual and career			
AFQT score under 50	-2.86***	-2.73	0.18
E1-E2[d]	-17.25***	-8.07	0.09
E3-E4	-10.80***	-6.56	0.45
E5-E6	-6.20***	-3.95	0.37
Female	-0.11	-0.06	0.06
African American	-1.16	-1.03	0.14
Hispanic	1.35	1.03	0.09
Asian Pacific Islander	4.81**	2.35	0.04
Married	1.38	1.60	0.50
Ship type[e]			
Carrier	4.40***	3.42	0.32
Cruiser or destroyer	3.51***	3.36	0.27
Submarine	14.34***	8.09	0.09
East coast	-2.99***	-3.60	0.51
Subject area[f]			
English	-5.94***	-4.20	0.17
History	-6.09***	-4.93	0.25
Math	-18.99***	-9.90	0.04
Social sciences	-5.72***	-4.27	0.17
Other	-2.16	-1.49	0.19

Table 13. The probability of passing a PACE college course: probit estimates corrected for sample selection[a]

Variable	Marginal effect (percentage points)[b]	t-ratio	Average
Rating group[g]			
Administration	-3.82	-1.29	0.08
Aviation maintenance	1.85	0.61	0.07
Aviation operations	-2.29	-0.75	0.07
Aviation supply	0.75	0.20	0.03
Construction battalion	3.69	0.28	0.01
Cryptology	-1.32	-0.36	0.02
Deck	-6.17**	-2.03	0.05
General detail	-3.67	-1.29	0.09
Hull, mechanical, electrical	-5.19	-1.50	0.03
Medical	-5.71*	-1.91	0.06
Supply	-1.18	-0.41	0.12
Surface engineering	-4.09	-1.47	0.10
Surface operations	-3.94	-1.44	0.14
Surface operations (combat systems)	-6.39**	-2.20	0.11
Correction for sample selection	-6.99***	-4.11	0.00

a. Dependent variable is completion of a PACE course with a passing grade. Average = 0.80. Standard deviation = 0.40. Number of observations = 11,101. Log likelihood function = -5,108. Chi-squared test (39) = 904. Regression confidence level = 99.99 percent.
b. Partial derivatives computed at the averages of the explanatory variables.
*** Statistically significant at 99-percent confidence level.
** Statistically significant at 95-percent confidence level.
* Statistically significant at 90-percent confidence level.
c. Reference educational background group is high school graduates.
d. Reference paygrade group is E7-E9.
e. Reference ship type comprises amphibious ships, frigates, and support ships.
f. Reference subject area is business.
g. Reference rating group is submarine.

References

[1] Office of Management and Budget. *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, Feb 1997 (Circular No. A-94)

[2] Defense Finance and Accounting Service, Cleveland Center. *FY98 Navy and Marine Corps Composite Standard Military Rates*, Oct 1997

[3] Scott W. Dunlap et al. *Program for Afloat College Education (PACE): A Cost-Effectiveness Analysis*, Jan 1989 (Naval Training Systems Center, Special Report 89-003)

[4] David Boesel and Kyle Johnson. *The DOD Tuition Assistance Program: Participation and Outcomes*, May 1988 (Defense Manpower Data Center)

[5] Malcolm Gillis et al. *Economics of Development*. New York: W. W. Norton and Company, 1992

[6] Martha E. Koopman and Dan D. Goldhaber. *Return on Quality-of-Life Investment*, Mar 1997 (CNA Research Memorandum 96-147)

[7] John Kantor, Michael Ford, and Murrey Olmsted. *Navy-wide Personnel Survey (NPS) 1996: Statistical Tables for Enlisted Personnel*, Feb 1997 (Navy Personnel Research and Development Center, NPRDC-TN-97-4)

[8] William H. Greene. *Econometric Analysis*. Upper Saddle River, NJ: Prentice Hall, 1997

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