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ABSTRACT

An investigation was made of the job proficiency of the graduates of an experimental job-oriented training program for Electronics Technician (X-ET). This program was designed to train lower-aptitude personnel in a relatively shorter time to assume ET duties in the fleet. The fleet performance capabilities of 51 X-ET's and a matched sample of 43 Class A School graduates (A-ET's) were assessed by performance ratings and structured interviews with the technicians' supervisors after the technicians had experienced approximately 24 months duty in the fleet. The two groups were rated comparable in overall technical performance, but the A-ET's were rated as more capable in the specific areas of electronics troubleshooting and in the use of test equipment. The A-ET's tended to be in higher paygrades than the X-ET's, although the expressed career intentions for both groups were highly similar, and at least 70 percent of both samples had completed one or more electronic training courses beyond their original ET training. Generally, the experimental ET program successfully trained marginally qualified personnel, in a relatively shorter period of time, to perform satisfactorily the duties of the Electronics Technician rating. (BC)

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A PERFORMANCE-ORIENTED ELECTRONICS TECHNICIAN TRAINING PROGRAM
V. FINAL FLEET FOLLOW-UP EVALUATION OF GRADUATES

Nicholas H. Van Matre
Robert J. Harrigan

A LABORATORY OF THE BUREAU OF NAVAL PERSONNEL

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V. Final Fleet Follow-up Evaluation of Graduates

by

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October 1969

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SUMMARY AND CONCLUSIONS

Problem

Follow-up evaluations were needed to determine the overall effectiveness of an experimental course designed to train marginally qualified personnel to serve as Electronics Technicians in the fleet. The present investigation provides a final fleet assessment of the job proficiency of the experimental course graduates (X-ET's), in comparison with the proficiency of concurrently trained A School graduates (A-ET's), after all technicians had served in the fleet for approximately 24 months.

Background and Requirements

A job-oriented experimental course for training Electronics Technicians was conducted by the Navy Training Research Laboratory, San Diego, 1964-66. The orientation, development, and implementation of this training program were described in a previous technical bulletin (1). The assessment information obtained from an initial fleet follow-up of graduates, after six months of fleet service, was presented in references (2) and (3). The present investigation was needed to provide a fleet evaluation of the overall effectiveness of the X-ET's and the comparison group of A-ET's, after all technicians had served about two years in the fleet.

Approach

The fleet performance capabilities of 54 X-ET's, assigned to destroyers in the Cruiser-Destroyer Force, Pacific Fleet, and a matched shipboard sample of 51 A-ET's, were assessed by performance ratings and structured interviews. A training evaluation team obtained the performance ratings from supervisors during interviews conducted aboard ship after the technicians had completed about two years of fleet service.

Findings and Conclusions

Since research limitations prevented the administration of performance tests in the final evaluation, the following summary statements are made on the basis of the supervisors' ratings. After two years of fleet service, the X-ET's were rated by their supervisors as being similar in overall technical performance to the matched sample of conventionally trained technicians. However, the A-ET's were rated as being more capable in the specific areas of electronics troubleshooting and in the use of test equipment. It should be noted that the lowest mean rating assigned to the X-ET sample was within the descriptive rating category comprising "average" performance. Although at least 69% of both samples

completed one or more courses beyond their original ET training and the expressed career intentions for both samples were highly similar, the A-ET's tended to be in higher paygrades than the X-ET's. Generally, the experimental ET program successfully trained marginally qualified personnel, in a relatively shorter period of time, to perform satisfactorily the duties of the Electronics Technician rating.

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V. Final Fleet Follow-up Evaluation of Graduates

A. Introduction

An experimental program for training Navy Electronics Technicians was conducted by the Navy Training Research Laboratory, San Diego, 1964-66. The experimental Electronics Technician (X-ET) course differed from concurrent Navy Class A Electronics Technician (A-ET) Schools in that course content maximized practical work with standard Navy electronic equipment and minimized the mathematics and electronic theory content to that which was directly related to job performance. Student input into the school consisted of Navy recruits with aptitude levels, in terms of Basic Test Battery scores, below the selection requirements for regular Class A ET schools. In addition, allotted training time for the experimental course was substantially shorter than for concurrent Class A ET classes. A detailed description of the development and implementation of the X-ET course was presented in a previously published technical bulletin (1).

Following completion of the training course, graduates of the five X-ET classes were assigned to destroyers in the Cruiser-Destroyer Force, Pacific Fleet. An initial fleet follow-up performance evaluation was conducted after the technicians had served six months on board ship. Results of the initial evaluation, presented in earlier reports (2, 3), indicated that the X-ET's generally were performing satisfactorily in the fleet. Although supervisors' rankings and theory test scores favored the A-ET sample, the X-ET's were judged at least comparable on other rating assessments and performed somewhat better than the A-ET's on practical performance tests.

The present report describes the fleet performance of the technicians as determined by a final follow-up evaluation conducted after all X-ET's had served approximately two years aboard ship.

B. Methodology

The initial six-months follow-up evaluation was designed to determine the effectiveness of the experimental course in training Electronics Technicians to perform their job in the fleet. The fleet performance of the X-ET's was compared with the performance of a sample of conventionally trained technicians, since valid absolute scales of technical proficiency are not readily available. Despite efforts to match the two groups of technicians on the basis of length of time in the fleet, sampling restrictions resulted in the A-ET group having, on the average, one month more shipboard duty than the X-ET's. The disparity between ET groups, in amount of time available for performance of technical duties, was also increased due to inequitable shipboard assignments to non-technical duties. During the six month interval prior to the initial evaluation, each

technician spent from one to five months assigned to non-technical tasks, with the X-ET's receiving significantly longer non-electronic oriented assignments than the A-ET's.

In order to assess the practical long-term effects of the X-ET training program, the final follow-up evaluation was conducted after the ET's had experienced about two years of shipboard duty. By setting a two year interval prior to the final evaluation, relatively severe constraints were imposed on the research project. The interval was sufficiently long for normal transfer and discharge processes to occur prior to evaluation, hence, approximately half of the subjects were not personally available for interviews. The wide geographical distribution of subjects prevented the administration of actual performance tests, which require extensive equipment and facilities, thereby limiting the available sources for evaluation data.

1. Subjects

The final follow-up evaluation involved two groups of subjects, the first group was composed of 54 experimentally trained Electronics Technicians (X-ET's) comprising 79% of the 68 students evaluated in the initial assessment. The attrition of 14 X-ET's from the sample was mainly due to operational commitments of destroyers which prevented appropriate research contact.

The second subject group originally consisted of 64 Class A school trained Electronics Technicians (A-ET's) who were selected, at the time of the initial evaluation, as a comparison group, on the basis of having been assigned to the same destroyers as the X-ET's and having served approximately similar amounts of time aboard ship. Attrition, due to operational commitments, eliminated 20% of the original 64 A-ET's, resulting in the present sample of 51 technicians providing data.

2. Procedure

The follow-up evaluation consisted of performance ratings obtained through shipboard contact with the supervisor of each subject technician, and when possible, with the ET himself. A technically qualified evaluation team conducted assessment interviews after the ET's had completed approximately two years of fleet duty. Due to the transfer and early discharge of some of the technicians, data for approximately fifty percent of the subjects were collected after the technician was no longer aboard ship or in the Navy.

Background information from the interviews included data regarding the ET's current rate, expected date of discharge, extensions of obligated service time, and, if the man had already been discharged, whether he had been recommended for reenlistment. Training information included a listing of any additional schools attended since the ET had completed his initial ET training program.

Data regarding future Navy and professional career plans were obtained from the available technicians.

Performance evaluations were made by the supervisors regarding the ET's ability to troubleshoot malfunctioning electronic equipment, the proficiency with which the ET used available electronic test equipment, and the ET's overall technical performance ability. It should be noted that the performance evaluations were not actual performance tests, as administered in the initial follow-up, but were ratings of technical ability made by the technician's supervisor. These performance estimates were determined by means of a five-point rating scale of performance descriptions, ranging from "inadequate" to "excellent." Supplemental performance data included a listing by the supervisors of the different types of equipment that the ET maintained on a regular basis. Opportunity was provided the supervisor to note specific differences in job performance between ET's.

C. Results

The results presented include data for the total graduate sample of five X-ET classes. Complete usable data were not available for all subjects due to transfers and early discharges, resulting in variations in the sample size across the assessment variables.

1. Sample Characteristics

a. Transfers and discharges. Table 1 contains the number and percentage of ET's in each sample who had been transferred or discharged from the Navy at the time of the final evaluation.

TABLE 1

Comparison of Number of ET's Transferred or Discharged

At Time of Evaluation	X-ET's (N=54)	A-ET's (N=51)
ET's remaining in sample	23 (43%)	12 (23%)
ET's discharged	25 (46%)	33 (65%)
ET's transferred	6 (11%)	6 (12%)

The fact that a larger percentage of A-ET's (65%) than X-ET's (46%) had been discharged at the time of the final evaluation reflects the longer length of elapsed service time for the A-ET's, which made them eligible for discharge at an earlier date than the X-ET subjects.

b. Enlisted rate at time of evaluation. Distributions of the ET's enlisted rates, determined at the time of evaluation, are presented in Table 2. The A-ET's, as a group tended to be in significantly higher paygrades than the X-ET's (chi-square = 13.15 with df = 2, $p < .01$). Although the majority of both samples were third class petty officers (E-4), only 12% of the X-ET's, compared to 33% of the A-ET's, had advanced to the E-5 level. The higher pay grades of the A-ET's are also reflected in the fact that while no A-ET is lower than E-4, 20% of the X-ET sample are either Seamen or Seamen Apprentice (E-2 or E-3). The smaller

TABLE 2

Comparison of ET's Paygrade Levels

Paygrade/Rate	X-ET's (N=50)	A-ET's (N=43)
E-2/Seaman Apprentice	3 (6%)	0 (0%)
E-3/Seaman	7 (14%)	0 (0%)
E-4/Third Class Petty Officer	34 (68%)	29 (67%)
E-5/Second Class Petty Officer	6 (12%)	14 (33%)

percentage of X-ET's at the higher E-5 level may be due, in part, to the longer length of fleet service of the A-ET's, although, after about two years of fleet duty, the lower X-ET pay grades probably reflect some difficulty experienced by the X-ET's in passing advancement in rate examinations, which are typically theoretical and mathematical in content.

c. Extensions of obligated service. The number and percentage of ET's who extended the length of their obligated service are shown for both samples in Table 3. A chi-square statistical test indicated no significant difference between the two groups in terms of extensions of obligated service. ($x^2 = .39$, df = 1, $p > .05$).

TABLE 3

Number of ET's Extending Length of Obligated Service Time

	X-ET's (N=50)	A-ET's (N=42)
Did extend length of obligated service	4 (8%)	2 (5%)
Did not extend length of obligated service	46 (92%)	40 (95%)

d. Recommendations for reenlistment. Table 4 shows, for both samples, the number and percentage of ET's who were recommended by their supervisor for reenlistment. Recommendation for reenlistment is contingent upon acceptable job performance and satisfactory adjustment to Navy life on the part of the ET. The majority of ET's from both samples were recommended for reenlistment. A chi-square statistical test indicated no significant differences between groups, in fact, over 80% of both samples were recommended for reenlistment. ($X^2 = 2.16$, df = 1, $p > .05$).

TABLE 4

Number of ET's Recommended for Reenlistment

	X-ET's (N=47)	A-ET's (N=43)
Number of ET's Recommended for Reenlistment	39 (83%)	40 (93%)
Number of ET's Not Recommended for Reenlistment	8 (17%)	3 (7%)

2. Training

The number of additional electronics training courses satisfactorily completed by each ET were recorded during the evaluation interviews. Frequency distributions of the number of courses the ET's completed are included in Table 5 for both research samples. Although a chi-square test indicated that the distributions of the numbers of courses completed differed for the two groups, ($X^2 = 30.02$, df = 6, $p < .01$), it is apparent from the table that the majority of both samples (at least 69%) did successfully complete one or more technical courses beyond their original ET training.

TABLE 5

Additional Training Courses Completed

Number of Courses Completed Since Graduation from Initial ET School	X-ET's (N=51)	A-ET's (N=43)
0	16 (31%)	7 (17%)
1	15 (29%)	22 (51%)
2	13 (26%)	5 (12%)
3	3 (6%)	4 (9%)
4	3 (6%)	3 (7%)
5	1 (2%)	1 (2%)
6	0 (0%)	1 (2%)

A large part of the difference between groups stems from the fact that 31% of the X-ET's and only 17% of the A-ET's did not complete any additional courses beyond their original training.

3. Technical Performance Capabilities

a. Equipment maintained by ET's. A list of the specific types of electronics equipment generally maintained by each ET was obtained from the supervisors. Table 6 summarizes, for both samples, the equipment types generally maintained by ET's in both the radar and

TABLE 6

Comparison of Electronic Equipment Maintained by ET's in Communication and Radar Specialties

Communications Specialty			Radar Specialty		
	Number of ET's Regularly Maintaining Equipment			Number of ET's Regularly Maintaining Equipment	
Equipment	X-ET's	A-ET's	Equipment	X-ET's	A-ET's
Transmitters	19 (47%)*	17 (41%)	Search	8 (20%)	15 (36%)
Receivers	20 (49%)	15 (37%)	Recognition	3 (7%)	3 (7%)
Teletype	1 (2%)	7 (17%)	Indicators	13 (33%)	11 (26%)
Portable Communications Gear	1 (2%)	2 (5%)	Navigational Aids	9 (23%)	3 (7%)
			Electronics Counter-Measures	7 (17%)	10 (24%)

Note.--

* Percentages listed for each equipment type are the percentages of the total number of checks for a particular equipment specialty for each sample.

communication specialties. The distributions of ET's maintaining particular types of equipment are highly similar for both ET groups in the two equipment areas. In the communications equipment specialty, the presence of a relatively small percentage of ET's from either sample having been checked as maintaining the "portable communications gear" reflects, in part, the comparatively small amount of portable equipment retained aboard a destroyer. Teletype equipment was the one type of gear for which the A-ET's received a notably larger percentage of checks (17%) than the X-ET's (2.%). Maintenance of complex teletype equipment typically requires extensive special training which the X-ET sample did not receive during their initial training program or during their shipboard duty. The X-ET and A-ET samples maintained, on the average, 2.1 and 2.0 different types of electronic equipment. The mean difference was not statistically significant.

b. Performance ratings. The supervisors rated each ET on his ability to troubleshoot electronic equipment, ability to use electronic test instruments, and his overall technical performance relative to similarly rated men with equal time in the service. The performance ratings were based on a five-point scale with descriptive levels ranging from "inadequate" to "excellent." The distributions of performance ratings, and significance test results for all three variables are presented in Table 7. The A-ET's were rated significantly higher than the X-ET's on troubleshooting and in the use of test equipment, although there was no significant difference between ET groups on overall technical performance ability. While the X-ET's were rated lower by their supervisors in troubleshooting and use of test equipment, this is in direct contrast to the practical performance test results reported in the initial follow-up technical bulletins (2, 3), but is in direct agreement with the supervisors' ratings also previously reported. It should be noted that the lowest mean group rating (3.20), received by the X-ET sample, falls within that category of performance descriptions comprising "slightly above average" performance. Neither sample, as a group, was rated below "average" on any of the performance variables.

4. Career Intentions

The future career intentions of the technicians are summarized in Table 8. Since about 50% of the subjects from both samples had already been discharged, the responses are those expressed by the technicians remaining aboard the destroyers at the time of the final evaluation. Of the 24 X-ET's and 13 A-ET's available for interviews, only one X-ET and one A-ET indicated an intention of staying in the Navy beyond their current enlistment period. The electronics career intentions of the two samples were also similar. Almost 40% of both samples intended to continue working in the field of electronics in civilian life.

TABLE 7

Technical Performance Ratings for ET Groups

Performance Variable	Sample N	Percent of Sample in Each Rating Category (Inadequate 1 / 2 / Average 3 / 4 / Excellent 5)					Mean Rating	t-value	Significance Level
Electronic Trouble-shooting Ability	X-ET 50	4	16	46	24	10	3.20	3.72	p<.05
	A-ET 43	0	7	23	37	33	3.95		
Use of Electronic Test Equipment	X-ET 50	0	8	46	28	18	3.55	3.33	p<.05
	A-ET 43	0	0	23	40	37	4.14		
Overall Technical Performance	X-ET 50	8	20	22	34	16	3.30	1.78	Not significant
	A-ET 43	0	14	30	26	30	3.72		

TABLE 8

Technicians' Career Intentions

Career Intentions	X-ET's (N=24) N	X-ET's (N=24) %*	A-ET's (N=13) N	A-ET's (N=13) %*
Plan to remain in Navy	1	(4%)	1	(8%)
Plan to leave Navy	23	(96%)	12	(92%)
Totals	24	(100%)	13	(100%)
Plan to work in electronics	9	(37%)	5	(38%)
Plan to leave electronics field	14	(59%)	6	(46%)
Undecided about career	1	(4%)	2	(16%)
Totals	24	(100%)	13	(100%)

Note.--

*Percentages are rounded to nearest whole number.

D. Summary and Conclusions

This investigation was designed to provide a final fleet assessment of the overall job proficiency of the graduates of an experimental ET training course conducted by the Navy Training Research Laboratory, San Diego, 1964-66. The total X-ET project represents a fairly unique and significant research effort. In this research an innovative training course, incorporating job-oriented training philosophy, methods, and objectives was developed, implemented, and objectively evaluated in a series of realistic assessments. The purpose of the course was to train input of marginally qualified personnel, in a shorter time period than concurrent A Schools, to be fully able to assume ET responsibilities in the fleet. Accordingly, both the training content and the achievement evaluations emphasized performance skills actually required on the job and minimized the

theoretical and mathematical knowledge not directly needed for job performance. The fleet assessment of X-ET's, described in this report, provides a final, but limited, appraisal of the overall effectiveness of the experimental training course in meeting the training goals established for it.

While the fleet evaluation involved assessments of the capabilities of 54 X-ET's and of a contemporary shipboard sample of 51 A-ET's, the primary purpose was not to make direct comparisons of the proficiency of the X-ET's and A-ET's, but rather to determine, whether or not the X-ET's were performing satisfactorily in the fleet. In appraising the performance of the X-ET group, one should take into account the lower aptitude levels and the shorter initial training of the X-ET's relative to the A-ET's in the sample. It is assumed that with an overall length of fleet service of 24 months, prior to the final evaluation, any effect on technical performance, due to the original difference between samples in shipboard duty time, would have been minimized.

The assessment information showed considerable variation in the proficiency ratings within each of the ET groups, as well as intra-individual variations with respect to the different aspects of ET job performance. However, based on the composite assessment data, the following summary statements may justifiably be made.

(1) In general, the experimental ET program successfully trained marginally qualified personnel in a shorter period of time to perform satisfactorily in the fleet the duties of the Electronics Technician rating.

(2) After 24 months shipboard duty, the X-ET's tended to be in lower paygrades than the A-ET's, with 20% of the X-ET's at the E-2 and E-3 levels, while no A-ET was lower than the E-4 level. In the A-ET sample, 33% of the ET's were at the E-5 level, and only 12% of the X-ET's were at that higher level.

(3) Over 90% of the ET's in both samples did not intend to extend their current period of obligated service. In fact, at the time of the evaluation less than 7% of the combined sample had actually extended their obligated service time.

(4) There was no significant difference between samples on the basis of the number of ET's who were recommended for reenlistment. Over 80% of the ET's in both samples were recommended by their supervisors for reenlistment.

(5) At least 69% of both ET samples successfully completed one or more technical courses beyond their original ET training.

(6) There was no appreciable difference between samples on the types of equipment which they generally maintained. Similar percentages of ET's from both samples maintained the different pieces of equipment in both the radar and communications specialties.

(7) The A-ET's were rated by their supervisors as being significantly better in troubleshooting equipment and in using electronic test equipment than the X-ET's. It should be noted, however, that there was no significant difference between samples in an overall technical performance rating, and for all performance ratings both samples were rated as performing at least satisfactorily.

(8) Approximately 40% of both ET samples intended to continue working in the electronics profession.

In summary, the X-ET course was generally successful in training marginally qualified personnel to perform ET rating duties in the fleet at an acceptable level of competence. The job capabilities of X-ET's were comparable to those of A-ET's in many respects, although they rated relatively lower on a few of the assessment criteria. It may be noted that some relevant performance criteria, such as shipboard assignments, rate of advancement, and supervisory evaluations, may be influenced to an undetermined degree by the unintentional bias of fleet personnel and fleet standards toward the theoretical, verbal, and mathematical capabilities more characteristic of the conventionally trained ET.

APPENDIX A

Troubleshooting Performance Rating Scales

1. Inadequate 2. Weak 3. Average 4. Good 5. Excellent

	A. SYMPTOMS	B. ASSUMPTIONS	C. CASUALTY LOCATION	D. TESTER'S GRADE
5	Recognized all the symptoms making full use of front panel controls, in less than the allotted time.	Deduced, from symptoms and technical aids, all logically possible faulty circuits. Localize the fault to smallest area or areas.	Followed logical sequence of appropriate checks and measurements leading to isolation of the casualty in minimum time.	Steps A, B, C, Excellent. Excellent use of test equipment and technical aids; did not violate safety precautions. Knowledgeable and confident approach.
4				
3	Recognized the important symptoms, used some of the front panel controls.	Made some correct assumptions about possible faulty circuits and specific casualty locations.	Isolated casualty within allotted time with few unnecessary or inappropriate checks and measurements.	Steps A, B, C, Average. Average in use of test equipment and technical material. Observed most safety precautions.
2				
1	Failed to recognize the symptoms in the allowed time. Did not properly utilize front panel controls.	Made incorrect assumptions concerning casualty location (rejected logical possibilities or accepted illogical possibilities).	Failed to locate casualty. Did not follow logical test sequence.	Steps A, B, C, Inadequate. Inadequate in use of test equipment. Violates safety precautions. Lacks confidence.

Note.--

All steps are scored on the basis of the examinee's performance with NO ASSISTANCE. For Steps A and B, complete information for that stage is provided to the examinee after the allotted time has elapsed. After Step B, no information or assistance is provided.

APPENDIX B

Test Equipment Rating Scales

1. Inadequate 2. Weak 3. Average 4. Good 5. Excellent

	SELECTION (of test equipment for task.)	CONTROL SETTINGS (function switches, zeroing knob, multiplier.)	METER INTERPRETATION (scope presentations, dial scale.)	GENERAL PROCEDURES
5	Selects most appropriate test instrument for task.	Sets all controls accurately in minimum time.	Interprets all readings accurately in minimum time.	Observes all safety precautions, protection of equipment, excellent facility handling equipment, confident.
4				
3	Selects acceptable but not most appropriate test instrument.	Sets primary controls accurately in reasonable time.	Interprets all readings within ± 10% accuracy in reasonable time.	Observes most safety precautions, handles instrument properly, completes measurement procedures in reasonable time.
2				
1	Selects an inappropriate test instrument for task.	Sets primary controls incorrectly, requires excess time.	Interprets many readings incorrectly (error > ± 10%) and requiring excess time.	Violates safety precautions, improper handling of instruments, slow in measurement procedures, lacks confidence.

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