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19. ABSTRACT (*Continue on reverse if necessary and identify by block number*)

This report addresses reading grade levels (RGL) of course materials within "A" schools compared to reading grade levels of "A" school students.

A total of 74 schools were examined. These were divided into two groups: group 1 (47 schools) supplied both course material and student RGLs; group 2 (27 schools) supplied only course material. Student RGLs were predicted from mean Armed Forces Qualification Test (AFQT) scores.

Based on a weighted mean reading grade level for all schools examined, it was determined that no overall literacy gap exists between the student RGL and the course material RGL. Some literacy gap was found in a few specific "A" schools.

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Included as variables for a correlation analysis were setback and attrition rates, AFQT scores, course length, literacy gap, student RGL, and school RGL. Significant correlations were found between literacy gap and both student RGL and school RGL. Literacy gap did not correlate significantly with any other variable studied.

TECHNICAL REPORT - 86-015

READABILITY GRADE NORMS FOR "A" SCHOOL TRAINING MATERIALS

August 1986

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CNET
COMBATSYSTECHSCOLCOM
SERVSCOLCOM Great Lakes
SERVSCOLCOM Orlando
SERVSCOLCOM San Diego
FLEASWTRACENPAC
NATTC Memphis
NATTC Lakehurst
NAVTECHTRACEN Meridian
NAVTECHTRACEN Treasure Island
NAVTECHTRACEN Corry Station
NAVCONSTRACEN Port Hueneme
NAVSUBSCOL
NAVGMSCOL
NAVNUPWRSCOL
SCHOOL OF MUSIC
Keesler AFB (RP)
SSCD Chanute AFB
DINFOS Ft Benjamin Harrison
COMTRALANT
COMTRAPAC

Certainly not to be overlooked are the instructors, administrative personnel, and others upon whom the "A" schools depend. The schools responsible for the ratings listed in appendix B are commended for their cooperation and contributions. We express our appreciation and gratitude to all of those who contributed to the completion and success of this project.

EXECUTIVE SUMMARY

PROBLEM

The level of reading difficulty of Navy training materials varies widely. There is a need to establish readability grade levels (RGLs) for guidance and use in the development of technical training curriculum materials. These RGLs must be compatible with the reading comprehension of enlisted personnel receiving technical training.

OBJECTIVE

Conduct a comprehensive assessment of training materials used at Navy "A" schools to:

1. Determine readability level of school curriculum materials.

2. Determine average reading grade level of enlisted personnel attending "A" schools.

3. Identify readability grade level norms for "A" school curriculum materials.

APPROACH

Rate training manuals and course material from 74 "A" schools were analyzed to determine the RGL of each school's training material. These RGLs were then compared to the RGLs of students within the "A" schools. In 47 of the 74 schools, student RGLs were obtained from the Gates-MacGinitie reading tests; in 27 schools, student RGLs were predicted from mean Armed Forces Qualification Test (AFQT) scores. The resulting two school groups were analyzed separately and together. Weighted mean RGLs were computed for each school and across all schools. Mean RGL of students' reading scores was computed within each school and across all student scores. Correlations using student and school RGLs, literacy gap, attrition and setback rates, course material RGL, rate training manual RGL, course length, and AFQT scores as variables were also computed.

FINDINGS

The 47-school group had an overall mean school RGL of 11.31 while overall student RGL was 11.52. The 27-school group had an overall mean school RGL of 10.54 with an overall mean predicted student RGL of 11.43. Since literacy gap was defined as a difference of more than one grade level between school RGL and student RGL, the final results indicate that no overall literacy gap exists between the current "A" schools' course materials and the student population. Of the 74 schools examined, only 11 were found to have literacy gaps between school and student RGLs.

CONCLUSIONS

No overall literacy gap exists in the "A" schools examined; no correlation exists between school and student RGLs; literacy gap does not

correlate with attrition, setback rate, course length or AFQT scores; and rate training manual RGL correlates moderately with attrition, although the overall school RGL does not correlate with attrition.

These findings must be tempered with the realization that as shifts occur in the recruit population, the reading abilities of the recruits may also shift. Important to note is that although overall means do not indicate a literacy gap, there are many instances of materials written at either a higher or lower RGL than the student population.

Finally, it is noted that readability formulas are limited in their use, inasmuch as technical knowledge, meaningfulness, or other cognitive processes are not considered.

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INTRODUCTION

PROBLEM

The NAVTRASYSCEN was tasked jointly with CNET by the CNO to assess the RGL of course materials from 86 "A" schools and the RGL of trainees enrolled in those schools.

OBJECTIVES

The purpose of this study was to establish reading grade level norms for development of training material at Navy "A" schools. The objectives of the study were to:

1. Determine the readability level of school curriculum materials.

2. Determine the average reading grade level of enlisted personnel currently attending the school.

3. Identify readability grade level norms to identify the schools where curriculum materials are inconsistent with student reading grade levels.

BACKGROUND

While the need for basic skills enhancement within the Navy enlisted ranks has been addressed by programs such as the Job Oriented Basic Skills (JOBS) and Academic Remedial Training (ART), the need exists to further identify the differences (if any) between "A" school trainee reading grade levels and school material reading grade levels. In a report issued by the Naval Audit Service, a recommendation was made that the Chief of Naval Education and Training (CNET) "establish for inclusion in the development of training materials, readability grade level (RGL) targets compatible with the reading comprehension of the individuals for whom the material is designed to facilitate the orderly progression of learning throughout a member's career."[1] It was further noted that the existing RGL targets for training materials "are neither consistently applied nor related to the aptitude requirements of the career field the member is entering."

In response to the audit report, the Chief of Naval Operations (CNO) promulgated an instruction which addresses the issue of RGL targets for instructional materials. OPNAV Instruction 1510.11 states that the CNET has the responsibility to: (1) determine the skills needed to comprehend technical information in Navy training courses and (2) establish readability standards for developing technical training curriculum materials.[2] To aid in meeting these requirements, CNET tasked the Training Analysis and Evaluation Group (TAEG) (now Training Analysis and Evaluation Department),

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[1]Naval Audit Service Report A41110 of 17 Oct 80.

[2]OPNAVINST 1510.11 Enlisted Fundamental Skills Training of 19 Aug 82.

Orlando, Florida, to conduct a pilot study. The RGL of training materials for 11 Navy "A" schools and the reading ability of Navy recruits, using FY 82 data supplied by the Management Information and Instructional Systems Activity (MIISA) (Losa, Aagard, and Kincaid, 1983), was assessed.

The 11 schools were selected for the pilot study on the basis of high throughput, academic attrition, and setback rates. Samples from course materials were analyzed using the Computer Readability and Editing System (CRES). Mean school RGL ranged from 12.6 to 8.1 with an overall mean of 10.6. This was compared to FY 82 figures on the average reading ability level of Navy recruits who were found to have a mean RGL of 9.8, a median of 10.9, and a range from 4.0 to 12.0+ (Form D, Gates-MacGinitie).

A conclusion of the pilot study was that a literacy gap did not exist between the materials from courses sampled and RGLs of the recruit population at that time. However, it was noted that the level of difficulty of the reading material varied, with some materials having considerably higher reading levels than others. Recommendations from that study provided the basis for the present study. As a consequence, the Naval Training Systems Center (NAVTRASYSCEN) was tasked jointly with CNET by the CNO to assess the RGL of course materials from 86 "A" schools and the RGL of trainees enrolled in those schools.[3]

ORGANIZATION OF THE REPORT

In addition to this Introduction, this report contains six major sections. The Approach section describes the division of tasks between CNET and NAVTRASYSCEN; the Method section describes the subjects, materials, and procedures used; the Group I Results section (including tables) reports the findings for that group of "A" schools submitting both course samples and student RGL scores; Group II Results section (including tables) reports the findings for that group of schools submitting course material samples only (student RGLs were predicted from AFQT scores); the Combined Groups Results section reports the results of analyses completed when combining Groups I and II into a single subject set; the Conclusions section discusses the overall findings. In addition to the six major sections, there are two appendices: appendix A includes statistical tables for the combined group analyses; and appendix B lists the "A" schools sampled in this study.

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[3]CNO ltr Ser 01B7D/367882 of 13 Apr 84.

APPROACH

Responsibility for the tasks was divided between CNET and NAVTRASYSCEN as follows:

CNET

Collected samples of course material and rate training manuals from the designated "A" schools. Material was sampled according to MIL-M-38784A.

Entered sampled material as documents into the WANG VS Word Processing system.

Collected Gates-MacGinitie reading test scores from the "A" schools current enrollment. The request was for 50-100 individual scores per school.

Sent word processing tapes and reading scores to NAVTRASYSCEN for analysis.

Provided mean Armed Forces Qualification Test (AFQT) scores for "A" schools (to NAVTRASYSCEN).

NAVTRASYSCEN

Provided necessary training to CNET clerical personnel who entered the course samples into the WANG system.

Conducted CRES analyses of the sampled course materials.

Calculated means, medians, and standard deviations for the Gates-MacGinitie reading scores.

Performed statistical analyses of the data collected.

Reported the findings.

METHOD

SUBJECTS

Eighty-six Navy "A" schools were requested by CNET to submit course materials and reading test scores for currently enrolled students. Of those, 74 responded with course material, 59 submitted student reading test scores, and 52 submitted both. Of the 52 submitting both course material and student reading test scores, 5 schools were dropped due to small sample size for student scores ($\underline{N}$ = 20); 47 schools were designated as group 1 and used in the initial analysis. The 27 schools with course materials but no student reading data were designated as group 2 and analyzed separately. The two groups were then combined and analyzed as a single group (N = 74).

MATERIALS

Text material samples were identified as course material (CM) or rate training manual (RTM). Student scores were primarily from the "E" and "F" levels of the Gates-MacGinitie test, although some "D" level scores were identified. An artificial ceiling occurs at the high end of the scores inasmuch as the test norms do not include RGL scores above 12.9. AFQT scores were used to predict student RGL for the 27 schools that did not provide student reading test scores.

PROCEDURE

Course materials were sampled according to MIL-M-38784A which delineates number and frequency of pages to be sampled as well as approximate number of words for each sample. These samples were entered manually into a WANG VS Word Processing system for further analysis by CRES.

CRES, based on the Flesch-Kincaid Readability Formula (Kincaid, Fishburne, Rogers, and Chissom, 1975), computes the RGL for the sample (based on syllables per word and words per sentence) as well as denoting such things as uncommon words, long sentences, excess prepositions, double negatives, and passive voice. The system was developed for the Navy by the Training Analysis and Evaluation Group, Orlando, Florida (Kincaid, Aagard, and O'Hara, 1980). For purposes of the present analysis, RGL and total number of words in the sample were the only output required.

The Gates-MacGinitie Reading Tests (MacGinitie, 1978) are standardized reading achievement tests of written vocabulary and comprehension normed on students in the 4th through 12th grades. Test level D, E, or F corresponds to the various norm groups. The comprehension section is administered to all Navy recruits as an aid in identifying candidates for remedial training programs. The test level administered to each recruit is determined by scores on the verbal subtests of the Armed Services Vocational Aptitude Battery (ASVAB). The maximum obtainable comprehension RGL is 12.9 (Form F), corresponding to the end of the 12th grade. Upon request from CNET, test scores for the enrolled "A" school students were submitted by the schools for use in this study. Attrition and setback rates for "A" schools in FY 84 were obtained from CNET to assess the possible impact of literacy gap on student progress.

The AFQT is administered to all service applicants. Three of the four subtests in AFQT have been found to correlate highly with Gates-MacGinitie RGL (Brown & Kincaid, 1982; Mathews & Roach, 1983). Therefore, AFQT was added as a predictor of student RGL. Average AFQT percentile scores for FY 85 were obtained from records at CNET for all ratings.

The CRES reading grade levels were entered into a data base for further analyses. For each "A" school, the average, median, and standard deviation of student test scores were computed from the individual scores submitted by the schools. These descriptive statistics became part of the data base for further analyses. A combination of Lotus 1-2-3 and Microstat software was used in the data analyses. In addition to the descriptive statistics, Pearson Product Moment Correlation Coefficients were computed among key variables. Literacy gap, as defined by Hooke, DeLeo, and Slaughter (1979), is "a situation where a text is written at an RGL too high for its intended readers." In the present study, literacy gaps were computed by subtracting the mean student RGL from the mean text RGL. Therefore, if the result is zero or negative, no literacy gap exists. A gap of one RGL was selected as a minimal value for concern (Hooke et al., 1979).

GROUP 1 - RESULTS

A weighted average RGL was computed for each school based upon the number of words in each sample and the sample RGL as determined by the CRES analysis. The number of samples from each school ranged from 1 to 5, with a total across schools of 105 samples. The weighted average of each school was then used as a basis for further comparisons. Table 1 identifies the 47 schools, the weighted average for all material (course material and rate training manuals), the mean and median student RGL, and the literacy gap.

The overall mean RGL for all "A" schools in the sample is 11.31 (range 6.5 to 14.79) while the student mean RGL for the same "A" schools is 11.52 (range 10.21 to 12.66), and the literacy gap is -.21.

The overall median student RGL is 11.95, about one-half a grade higher than the mean. This difference can be attributed to the ceiling effect on student RGLs. It can be generally expected that the ceiling effect inherent in the student RGLs would underestimate the student mean, but not affect the median score. This underestimation of student mean RGL could result in an overestimation of literacy gap.

Attrition and setback rates for FY 84 were obtained and included with the RGLs for analyses. The mean attrition rate ($\underline{N}$ = 44) is 9.72 percent, and the mean setback rate ($\underline{N}$ = 37) is 21.05 percent. These findings are summarized in table 2.

Five schools were found to have material samples with RGLs above 13.5 (EN, EW, HM, AC, and OT). Three of the samples contained less than 1,000 words (small sample sizes may lead to sampling error which could result in a higher RGL). The HM material consists of a set of learning objectives with actions, conditions, and standards often within the same sentence. Making actions and conditions separate statements would result in a more readable format, with a likely result of a drop in RGL to less than 12.0.

Six schools had mean text RGLs higher than 12.4; another six schools had mean student RGLs equal to or less than 10.75. These 12 schools accounted for six of the eight mean literacy gaps larger than one RGL (OT, YN, and CTM had high text RGLs; AK, SK, and CTR had low student RGLs).

The correlations between text material and student RGL with literacy gap; student RGL and attrition rate with course length; and attrition rate and course length with setback rate are significant (.05). Table 3 summarizes these results for group 1.

The high correlation between text material RGL and literacy gap is as expected; i.e., the higher the RGL, the higher the literacy gap. Conversely, the relationship between literacy gap and student RGL is negative, indicating that as student RGL increases the literacy gap decreases. It would be expected that these two correlations would be similar in magnitude. That they are not can be explained by the large amount of variance present in the text material RGLs compared to the student RGLs.

Table 1

Group 1

Student and School Mean RGL, Student Median RGL, and Literacy Gap for Each "A" School

School	Text Material Weighted Avg. RGL	Student Reading Grade Level		Literacy Gap (RGL)*
		Mean	Median	
OT	14.79	12.28	12.86	2.51
CTM	13.36	11.60	12.86	1.76
HM	13.06	12.19	12.86	0.87
STG	12.96	11.98	12.85	0.98
YN	12.94	10.90	11.45	2.04
IS	12.88	12.26	12.87	0.62
SK	12.40	10.34	10.47	2.06
STS	12.35	12.46	12.69	-0.11
CTR	12.32	10.72	11.12	1.60
EN	12.29	11.05	11.45	1.24
AME	12.28	11.24	11.52	1.04
EW	12.26	11.98	12.54	0.28
AE	12.12	11.53	11.95	0.59
EM	12.08	11.42	11.12	0.66
AK	12.01	10.21	10.25	1.80
AT	11.97	12.29	12.90	-0.32
RP	11.83	11.41	11.80	0.42
AO	11.66	10.86	11.10	0.80
IM	11.55	11.78	11.74	-0.23
GMT	11.52	11.08	11.50	0.44
AC	11.38	11.55	11.63	-0.17
AG	11.36	11.85	12.86	-0.49
TM	11.35	11.63	12.69	-0.28
BT	11.25	11.25	11.96	0.00
AMH	11.19	11.33	11.55	-0.14
AW	11.18	12.08	12.85	-0.90
QM	11.13	11.43	11.45	-0.30
DK	11.13	11.03	11.78	0.10
SH	11.05	10.65	10.70	0.40
AMS	10.99	11.43	11.55	-0.44
PN	10.98	10.75	11.65	0.23
AD	10.92	10.65	11.02	0.27
DP	10.87	12.30	12.75	-1.43
DS	10.81	12.66	12.90	-1.85
ET	10.57	12.04	11.95	-1.47
FTG	10.52	11.54	11.69	-1.02
ASE	10.45	11.83	12.65	-1.38
SM	10.27	11.71	12.71	-1.44
DT	10.22	12.19	12.87	-1.97
AV	10.14	11.54	11.95	-1.40

Table 1 (Continued)

School	Text Material Weighted Avg. RGL	Student Reading Grade Level		Literacy Gap (RGL)*
		Mean	Median	
ASM	10.12	11.87	12.67	-1.75
AZ	10.06	11.21	11.55	-1.15
GM	9.84	11.80	12.86	-1.96
OM	9.74	11.75	11.70	-2.01
MM	9.65	11.43	12.03	-1.78
HT	9.40	11.44	11.99	-2.04
BASHEL	6.50	11.15	12.05	-4.65

*Text Weighted Average - Mean Student RGL = Literacy Gap.

Table 2

Group 1

Overall Mean, RGL, Literacy Gap, Attrition Rate, Setback Rate

Variable	N	Mean	Median	Range
School RGL	47	11.31	11.25	6.50-14.79
Student RGL	47	11.52	11.95	10.21-12.66
Literacy Gap*	47	-.21		
Attrition Rate	44	9.72		
Course Length (Days)	42	74.62		
Setback Rate	37	21.05		

*Mean School RGL - Mean Student RGL = Literacy Gap.

Table 3

Group 1 Correlation Matrix

Relationships Between School RGL, Student RGL, Literacy Gap, Course Length, Setback Rate, and Attrition Rate

	SCHRGL	STURGL	LITGAP	ATTR	CLENGTH	SETBACK
SCHRGL	1.0000					
STURGL	-.0337	1.0000				
LITGAP	.8894*	-.4868*	1.0000			
ATTR	-.1064	.1428	-.1583			
CLENGTH	-.1143	.3443*	-.2574	.5888*	1.0000	
SETBACK	-.0635	.2371	-.1454	.6192*	.4791*	1.0000

*$p < .05$.
N = 42 (except for correlations with setback rate where N = 37). Values greater than +/- .30 are significant, $p < .05$.

Attrition and setback rates correlated with each other as well as with course length which might also be expected. Student RGL correlates moderately (.34) with course length. This is reasonable if course length reflects job complexity, since higher aptitude students are selected for the more demanding ratings.

Text RGL and literacy gap do not correlate significantly with any variable except each other. In the pilot study (Losa et al., 1983), text RGL correlated .49 with setback rate. With N = 11, that result was not significant, reflecting only sampling error. This is consistent with the present study in which the corresponding correlation is not significant (N =37, setback rates were not obtained for all schools).

GROUP 2 - RESULTS

Using AFQT scores and Gates-MacGinitie reading scores from the group 1 schools, a regression analysis was completed producing a formula which was then used to predict mean reading grade level of students for each school that had not supplied reading test scores. To verify the strength of AFQT scores as a predictor of reading grade level, a Pearson Product Moment Correlation between mean AFQT scores and mean reading grade levels was computed for the group 1 schools with available data.

Of the 47 schools, AFQT scores were not available for 5 schools (HM, IS, DT, AV, and BASHEL). For the remaining 42 schools, the correlation between AFQT scores and mean reading grade levels was .56. Despite being significant, this correlation is considerably smaller than expected from previous research. The data were inspected to see if a few schools were producing an inconsistent relationship. A scatterplot showed three schools with scores more than one RGL from an otherwise narrow band around a line indicating a strong relationship between AFQT and student RGL. These three schools all had low RGLs and were "clerical" ratings. The three other clerical schools in the study also had lower RGLs than predicted by AFQT. It is speculated that students selected for clerical schools have above average scores on the Numerical Operations (NO) subtest of AFQT. This clerical speed test (NO) has a low correlation with RGL. For these schools, then, AFQT would not predict RGL. With these schools deleted, the correlation based on 36 schools is .767 ($p < .01$). The regression analysis for the 36 schools resulted in the formula RGL = (.0419) (AFQT score) + 9.01. This formula was applied to 27 schools which had supplied course material samples for analysis, but for which student reading test scores were not available. Substituting the mean AFQT score for each school in turn into the formula resulted in a predicted RGL score for the students within each school. Table 4 displays these results. (To predict RGL for clerical schools, a different prediction formula would be needed.)

The predicted RGL scores were then used exactly as were the student RGL scores from the 47 schools in group 1. As with group 1, literacy gap was computed by subtracting predicted student RGL from course material weighted average RGL. A negative result indicates no literacy gap exists, and a gap of 1.0 or greater is considered significant. Three schools display a literacy gap greater than 1.0 (CTA, CTO, and RM). These results can be seen in table 5.

Means for the 27 schools in group 2 were computed and are displayed in table 6. The mean predicted student RGL is 11.43 which compares favorably with the mean student RGL for group 1 of 11.52. T tests were computed to test the significance of the differences between the means; results are displayed in table 7. As expected, the difference between the mean student RGL and the mean predicted student RGL was not significant. The lower mean school RGL for the 27 schools is somewhat surprising--10.54 compared to 11.31 in sample 1. A significant difference also exists between the setback rates of the two groups. Mean setback rate for sample 1 was 21.05 compared to 7.85 for sample 2. The literacy gap for sample 2 was also less, -.88 compared to -.21 for sample 1. It is possible that schools not supplying

student data were less concerned about potential reading problems because they had low reading requirements and low setback rates.

Table 4

Group 2

Predicted Student Reading Grade Levels from Mean AFQT Scores by School

School	AFQT Score	Predicted RGL
ABE	43	10.82
ABF	45	10.90
ABH	47	10.99
AFFR	46	10.94
AQ	66	11.77
AX	75	12.15
BU	54	11.27
CE	57	11.40
CM	49	11.07
CTA	61	11.57
CTO	70	11.94
EA	72	11.99
EO	50	11.16
GSM	70	11.94
IC	63	11.65
JO	74	12.11
ML	58	11.44
MR	62	11.61
MS	46	10.94
OS	63	11.65
PC	67	11.82
PH	66	11.77
PM	58	11.44
PR	50	11.11
RM	50	11.11
SW	49	11.07
UT	49	11.07

Table 5

Group 2

School RGL, Student RGL (Predicted), and Literacy Gap

School	SCHRGL	STURGL	LITGAP
CTO	13.41	11.94	1.47
CTA	12.88	11.57	1.31
RM	12.35	11.11	1.24
CE	12.28	11.40	.88
PH	11.24	11.77	- .53
PC	11.23	11.82	- .59
AQ	11.08	11.77	- .69
AX	11.04	12.15	-1.11
UT	10.78	11.07	- .29
JO	10.74	12.11	-1.37
IC	10.71	11.65	- .94
OS	10.70	11.65	- .95
ABF	10.49	10.90	- .41
ABH	10.48	10.99	- .51
MS	10.37	10.94	- .57
CM	10.33	11.07	- .74
SW	10.20	11.07	- .87
ABE	10.11	10.82	- .71
GSM	10.11	11.94	-1.83
ML	9.98	11.44	-1.46
PM	9.67	11.44	-1.77
EO	9.58	11.11	-1.58
EA	9.55	12.03	-2.44
PR	9.54	11.11	-1.57
AFFR	9.33	10.94	-1.61
BU	8.51	11.27	-2.76
MR	8.01	11.61	-3.60

Table 6

Group 2

Means for Text Weighted Average, Predicted Student RGL, Literacy Gap, Attrition, Course Length, and Setback Rates

Variable	N	Mean	Range
Text Weighted Average (School RGL)	27	10.54	8.01-13.41
Predicted RGL (Student RGL)	27	11.43	10.82-12.11
Literacy Gap*	27	- .88	
Attrition Rate	27	6.98	
Course Length	27	67.96	
Setback Rate	18	7.85	

*School RGL - Student RGL = Literacy Gap.

Table 7

Comparison of Means Between Groups 1 and 2

	Group 1		Group 2				
	N	Mean	N	Mean	Diff.	t Test	Prob.
School RGL	47	11.31	27	10.54	.77	2.48	.02
Student RGL	47	11.52	27	11.43*	.09	.73	NS
Literacy Gap	47	-.21	27	- .88	.67	2.11	.04
Attrition Rate	44	9.72	27	6.98	2.73	1.58	NS
Course Length (Days)	42	74.62	27	67.96	6.66	.74	NS
Setback	37	21.05	18	7.85	13.20	2.21	.03
AFQT	42	62.31	27	57.78	4.53	2.00	.05

*Predicted Student RGL.

Table 8 displays the group 2 correlation matrix for variables with no missing data. Significant correlations ($p < .05$) existed among attrition, AFQT scores, predicted RGL, and course length. The correlations for AFQT and predicted (student) RGL scores are identical because they are linear transformations. In group 1, the correlation between attrition and student RGL was not significant.

The correlations of AFQT with both attrition and course length can be attributed to relationships with rating complexity. Aptitude requirements are based partly on complexity, and both course length and attrition are appreciably correlated with complexity.

Table 8

Group 2 Correlation Matrix

Relationships Between School RGL, Literacy Gap, Attrition Rate, Course Length, AFQT, and Predicted RGL

	SCHRGL	LITGAP	ATTR	CLENGTH	AFQT	PREDRGL
SCHRGL	1.0000					
LITGAP	.9416*	1.0000				
ATTR	.0522	-.0978	1.0000			
CLENGTH	.0900	-.0537	.5724*	1.0000		
AFQT	.2439	-.0967	.4373*	.4215*	1.0000	
PREDRGL	.2439	-.0967	.4373*	.4215*	1.0000	1.0000

*$p < .05$.
$N = 27$. Values greater than +/- .38 are significant ($p < .05$).
Note. Setback rate deleted due to small sample ($N = 18$).

COMBINED GROUPS - RESULTS

Groups 1 and 2 were combined to assess overall trends. The 5 schools without AFQT scores were deleted, leaving a total sample of 69. Descriptive statistics for this group are in appendix A, table A-1.

Statistical comparisons were made between RGL variables (table A-2). The mean difference between pairs of school and student RGLs (literacy gap) was -.40, significant at the .01 level, indicating a negative gap. There were 49 schools for which both RTM and CM RGLs were obtained. The difference between pairs of RTM and CM RGLs (.93) was significant ($p < .01$). The manuals averaged almost one RGL higher than the course materials for the same schools.

Intercorrelations for the combined groups are in table A-3. The only independent variable which correlated with school RGL was AFQT (.29, $p < .05$). The RGLs from RTMs correlated with attrition (.36) and AFQT (.28). Corresponding coefficients of CM RGL with attrition and AFQT were not significant. The RTM and CM RGLs were not related to each other. When RTM and CM RGLs were combined to obtain weighted school RGL, the relationship with attrition disappeared.

Student RGL correlated somewhat with course length (.37) but not attrition. Mean AFQT correlated .39 with attrition and .40 with course length. Since the intercorrelation of attrition and course length is .59, the different patterns of relationships with RGLs and AFQT are notable.

To determine the degree to which combinations of selected variables could predict attrition as a criterion, multiple and partial correlations were computed for schools with the necessary data. Squared multiple and partial correlations are shown in table A-4. AFQT was used in place of student RGL since group 2 did not have student RGLs and AFQT correlated higher than RGL with attrition. Course length and RTM RGL both made highly significant contributions in predicting attrition and the multiple correlation (MR) was .81 (set 4). When AFQT and/or course material RGL are included as predictors, the multiple correlation does not increase appreciably (sets 1-3). Even when course length and AFQT are statistically controlled with partial correlation, RTM RGL correlates with attrition (set 3). The squared partial correlation was .31. This was a positive relationship as higher RTM RGLs were associated with higher attrition rates. The corresponding partial for AFQT was zero.

If course length is not considered (table A-4, sets 7-10), AFQT made a significant contribution with a squared partial of .17. The covariance between AFQT and attrition can be accounted for by course length which correlates with both variables. This was confirmed when a combination variable, attrition/course length, was generated. Only RTM RGL (.39) correlated significantly with attrition per unit course length.

CONCLUSIONS

No overall literacy gap was found between RGLs of "A" school materials and students. Of 74 schools, only 11 had literacy gaps of as much as one or more reading grade levels. The average school RGL was 11.1 with six schools above 12.9. The average student RGL was 11.5, and seven schools had student averages below 10.9. The lowest student averages were found in the "clerical" ratings SK, AK, and PN.

No relationship (correlation) existed between school and student RGLs. Literacy gap was determined mostly by school RGL, as there was much more variation between text samples than between student samples. Of the two types of materials comprising school RGL, rate training manuals had significantly higher RGLs on the average with the difference being almost one RGL. There was no relationship between RTM and course material RGLs.

Literacy gap was not related to attrition, setback rate, course length, or AFQT average. School RGLs were related only to AFQT and this correlation (.29) was marginally significant ($p < .05$). The RTM RGLs were related to attrition (.39) and AFQT (.28). When course length and AFQT are statistically controlled, the correlation with attrition remains. The higher the RTM RGL, the higher the attrition rate.

Average AFQT percentile can be used to estimate average student RGL for most "A" schools. The correlation between RGL and AFQT is .77 when the clerical schools are deleted. A different predictor would be needed to estimate RGL for clerical schools.

The finding that, based on mean school RGL and mean current student RGL, an overall literacy gap does not exist within the "A" schools must be tempered with the realization that as shifts occur in the recruit population, the reading abilities of the recruits may also shift. Also important is that although the mean and the median readability levels of the course materials are within the reading range of the current student population, there are many instances of course material written at either higher or lower levels. The implications are twofold. If the RGL of text material within a school results in a literacy gap (defined as more than one grade level), some of the trainees may have difficulty in successfully completing the course. However, if the student RGL is much higher than that of the text material, a problem of boredom and resulting loss of interest could occur.

The moderate correlation between RTM RGL and attrition rate cannot confidently be interpreted to mean that high RGL causes high attrition. It is quite possible that a third factor such as rating complexity leads to high RGL and high attrition rate. The few high text material RGLs tend to come from relatively short training documents. If the CRES results are deemed valid and adjustments seem warranted, long sentences could be broken into shorter statements, and word substitutions suggested by CRES could be made.

Not addressed by readability formulas are the cognitive processes involved in reading and comprehension. There is no way to assess (with these formulas) the individual's motivation to learn, the amount of job

knowledge possessed, or other external environmental factors which influence learning. Conclusions drawn from the use of readability formulas should be very general in nature and placed in perspective.

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APPENDIX A

STATISTICAL TABLES FOR COMBINED GROUPS

Table A-1

Combined Groups 1 and 2

Descriptive Statistics for School and Student RGLs, Literacy Gap, Attrition Rate, Course Length, AFQT Scores, RTM and CM RGLs, and Predicted Student RGLs

Name	N	Mean	Std. Dev.	Minimum	Maximum
SCHRGL	69	11.0664	1.2028	8.0100	14.7900
STURGL	69	11.4642	.5095	10.2100	12.6600
LITGAP	69	-.3980	1.2710	-3.6000	2.5100
ATTR	69	8.6725	7.2149	.0000	31.7000
CLENGTH	69	72.0145	36.5704	10.0000	180.0000
AFQT	69	60.5362	9.3755	43.0000	76.0000
RTMRGL	59	11.4129	1.3686	9.4000	16.7800
CMRGL	59	10.6119	1.9876	4.8400	17.1200
PREDRGL	69	11.5465	.3928	10.8117	12.1944

Table A-2

Comparisons Between RGL Means for Combined Groups 1 and 2

RGL Variable	N	Mean	Diff.	t Test	Prob.
School Text	69	11.06			
Students*	69	11.46	-.40	-2.60	.01
Rate Training Manual	49	11.39			
Course Materials	49	10.46	.93	2.85	.01

*For students from 27 schools, RGL was estimated from AFQT scores.

Table A-3

Combined Groups 1 and 2 Correlation Matrix

Relationships Between School and Student RGLs, Literacy Gap, Attrition Rate, Course Length, AFQT Scores, and RTM and CM RGLs

	SCHRGL	STURGL	LITGAP	ATTR	CLENGTH	AFQT	RTMRGL	CMRGL
SCHRGL	1.00000							
STURGL	.07346	1.00000						
LITGAP	.91700*	-.33041*	1.00000					
ATTR	.02255	.22777	-.06976	1.00000				
CLENGTH	-.00660	.36667*	-.15292	.58798*	1.00000			
AFQT	.28659*	.68828*	-.00347	.38751*	.40405*	1.00000		
RTMRGL	.734*	.048	.660*	.364*	-.031	.283*	1.000	
CMRGL	.604*	-.003	.554*	-.171	-.076	.131	.140	1.000

*$p < .05$.
$N = 69$ ($N = 59$ for correlations with RTM and CM RGLs; $N = 49$ for correlation between RTM and CM RGLs).
Values +/- .24 are significant ($p < .05$) at $N = 69$.
Values +/- .26 are significant ($p < .05$) at $N = 59$.

Table A-4

Combined Groups 1 and 2

Multiple and Partial Correlations (R) Between Attrition as Criterion and Various Predictors

	Partial R Square				Multiple R	
Set #	CLENGTH	AFQT	RTMRGL	CMRGL	Square	R
1	.51	.00	.34	.06	.68	.82
2	.59	-	.36	.06	.67	.82
3	.52	.00	.31	-	.65	.81
4	.59	-	.33	-	.65	.81
5	.38	.03	-	-	.50	.71
6	.48	-	-	.01	.49	.70
7	-	.17	.14	.09	.34	.59
8	-	.15	.11	-	.28	.53
9	-	.21	-	.05	.23	.48
10	-	-	.18	.06	.21	.46

Sets 1-6 include course length (CLENGTH).
Dashes (-) indicate variables not included as predictors.

APPENDIX B

LISTING OF SCHOOLS SAMPLED

Table B-1

Complete Listing of Schools Sampled

School	Abbrev.	Words in Sample	Number of Student RGLs
Aviation Boatswain--Equipment	ABE	598	*
Aviation Boatswain--Fuels	ABF	3,514	*
Aviation Boatswain--Handling	ABH	9,153	*
Air Traffic Controller	AC	9,671	100
Aviation Machinist's Mate	AD	9,428	43
Aviation Electrician's Mate	AE	7,899	100
Aircraft Firefighting and Rescue	AFFR	2,089	*
Aerographer's Mate	AG	6,366	125
Aviation Storekeeper	AK	6,525	100
Aviation Structural Mechanic--Safety Equip.	AME	19,124	50
Aviation Structural Mechanic--Hydraulics	AMH	13,753	50
Aviation Structural Mechanic--Structures	AMS	9,444	50
Aviation Ordnanceman	AO	11,631	71
Avionics Tech--Aviation Control Technician	AQ	12,235	*
Aviation Support Equip. Technician--Elec.	ASE	14,111	89
Aviation Support Equip. Technician--Mech.	ASM	7,460	50
Avionics Technician	AT	21,379	35
Non-Navy--Avionics Technician	AV	5,571	100
Aviation Anti-Submarine Warfare Operation	AW	5,756	69
Avionics Tech. Aviation Anti-Submarine War.	AX	5,089	*
Aviation Maintenance Administration	AZ	23,467	50
Basic Helicopter	BASHEL	1,071	45
Boiler Technician PSI	BT	18,533	53
Builder	BU	15,489	*
Construction Electrician	CE	2,921	*
Construction Mechanic	CM	17,585	*
Cryptologic Technician	CTA	3,834	*
Cryptologic Maintenance Technician	CTM	3,300	24
Cryptologic Technician O	CTO	589	*
Cryptologic Technician R	CTR	511	84
Disbursing Clerk	DK	18,377	50
Data Processing Technician	DP	8,024	32
Data Systems Technician	DS	10,730	100
Dental Technician	DT	11,232	100
Engineering Aide	EA	6,251	*
Electrician's Mate	EM	6,327	57
Engineman	EN	9,086	54
Equipment Operator	EO	6,456	*
Electronic's Technician	ET	9,879	53
Electronic Warfare Technician	EW	8,441	62
Fire Control Technician Guns	FTG	5,343	61
Gunner's Mate	GM	18,067	116
Gunner's Mate Technician	GMT	7,003	29
Gas Turbine Systems Technician Mechanic	GSM	868	*

Table B-1 (Continued)

School	Abbrev.	Words in Sample	Number of Student RGLs
Hospitalman	HM	10,032	100
Hull Maintenance Technician	HT	6,303	67
Interior Communications Electrician	IC	17,156	*
Instrumentman	IM	8,407	36
Intelligence Specialist	IS	9,751	100
Information Specialist Journalist	JO	11,797	*
Molder	ML	7,080	*
Machinist's Mate	MM	3,908	50
Machinery Repairman	MR	18,894	*
Mess Management Specialist	MS	9,140	*
Opticalman	OM	10,344	21
Operations Specialist	OS	4,215	*
Ocean Systems Technician	OT	2,092	69
Postal Clerk	PC	3,188	*
Photographer's Mate	PH	6,619	*
Pattern Maker	PM	8,772	*
Personnelman	PN	9,282	100
Aircrew Survival Equipmentman	PR	4,262	*
Quartermaster	QM	14,959	92
Radioman	RM	16,777	*
Religious Program Specialist	RP	7,545	20
Ship's Serviceman	SH	5,113	46
Storekeeper	SK	23,949	100
Signalman	SM	10,474	62
Surface Sonar Technician	STG	6,317	94
Sonar Subsystem Technician--Submarine	STS	8,880	64
Steelworker	SW	9,157	*
Torpedoman's Mate	TM	4,725	67
Utilitiesman	UT	15,743	*
Yeoman	YN	5,318	100

*Predicted RGLs (Group 2).

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