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Enhancing Productivity in Navy Schools: The Use of Wall Posters and Computer-based Instruction to Influence Learning

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13. ABSTRACT *(Maximum 200 words)*

This project was conducted as part of the Navy Personnel Research and Development Center's involvement in the Chief of Naval Education and Training's (CNET) Model School program at the Electrician's Mate "A" School at Great Lakes, IL.

One project objective was to create and evaluate a learning environment in the school outside the classrooms by developing a variety of posters that related to the classroom instructional topics and to the equipment that an electrician encounters on the job. A second objective was to apply and evaluate technologies in night study to improve the remediation process. This was accomplished by using available self-paced study materials on basic electricity and by tutoring and counseling by instructors. To enhance this process, computer-based instruction (CBI) was added to the night study classroom.

To evaluate student attitude/responsiveness to the CBI programs and the posters, students were administered a questionaire. The results suggests that, overall, both posters and CBI programs were used and found to be useful.

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FOREWORD

The evaluation of posters and computer-based instruction was conducted at the Electrician's Mate (EM) "A" School at the Naval Training Center, Great Lakes, IL. The work was performed under the Schoolhouse Productivity subproject of Program Element Number 0603720N, Education and Training (Work Unit Z1172-ET102). This work was done as part of the Model School program of the Chief of Naval Education and Training (CNET) and sponsored by the Chief of Naval Personnel (PERS-11). The EM "A" School was the first Model School designated by CNET.

The goal of this study was to determine how EM "A" school students responded to the posters and computer programs. The results of this work are for use by Navy schoolhouse managers, instructors and other Model Schools.

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SUMMARY

Introduction

This project was conducted as part of the Navy Personnel Research and Development Center's involvement in the Model School program of the Chief of Naval Education and Training (CNET). The focus of this project was to explore possible technologies that could affect student learning outside of the classroom. The project was conducted at the Electrician's Mate (EM) "A" school at Great Lakes, IL, which was the first model school designated by CNET. The project's focus is a considerable departure from traditional military training research which has tended to focus on methods for improving course curricula through instructional systems design of the primary course.

Objectives

The objectives of this project were to create and evaluate a learning environment in the school outside of the classrooms and to apply and evaluate technologies in night study to improve the remediation process.

Approach

To create a learning environment outside the classrooms, it was decided to develop and hang in the hallways a variety of posters related to the classroom instructional topics and to the equipment that an electrician encounters on the job. The goal was to have students engage in some incidental learning from the posters that related to their school classes.

In night study, students were remediated by using available self-paced study materials on basic electricity and by tutoring and counseling by instructors. To enhance this process, computer-based instruction (CBI) was added to the night study classroom.

Evaluation

To evaluate student attitude/responsiveness to the CBI programs and the posters, 269 EM "A" school students were administered a questionnaire. The first part of the survey dealt with student reactions to the posters; and the second part, with reactions to the CBI programs used in night study. Students were divided into three groups based on how long they had been in training at the EM "A" school.

Results

As expected, students who had been in training longer recalled more of the posters than students in earlier phases of the school. The posters most likely to be recalled were those dealing with general information about course content and motivational information rather than those dealing with specific course content and problem solving. Further, students rated the posters easy to understand, useful, and interesting.

For the CBI programs, the data indicate that students were likely to have attended either mandatory or voluntary night study in the two weeks preceding the survey. Further, they were more

likely to have used the CBI programs than texts or videotapes, although they made most use of instructors. The CBI programs dealing with basic skills were not used as much as the course related programs.

Generally, as with the posters, students tended to use the CBI programs alone rather than with others, though about a quarter did work with other students or instructors on some of the programs.

Most students found the programs useful and interesting, and relevant to their EM "A" school studies; thought that other programs would be useful; and would like to have the opportunity to use CBI programs as part of their night study.

Recommendations

1. The use of wall posters is an effective technique for improving students' learning. Schools in the Navy Education and Training Command (NAVEDTRACOM) should develop and display posters when possible. Hallway wall space is recommended for displaying posters with general information about course content and motivational information. However, posters dealing with more specific classroom topics should be displayed within classrooms where the topics are being taught. In this context, they could be the basis of some instructor comment.

2. CNET should assist NAVEDTRACOM schools in identifying course content areas where CBI may be developed and in acquiring the appropriate CBI.

Further, programs currently in use that are not directly related to course content should be reviewed to determine if they should be dropped from inventory or if additional programs should be developed/acquired to teach the topics within the context of the course content.

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Background

Training is a large undertaking in the modern Navy. Over 7000 courses are offered in Navy schools ranging from beginning orientation to Navy life in Recruit Training Centers to highly advanced technical courses such as jet engine maintenance and radar repair "C" schools. Navy technical training involves over 300,000 personnel each year (Montague, 1986, p. 122). Because of this large investment in training, the Navy is always seeking ways to improve training quality and efficiency. One such effort is the Model School program of the Chief of Naval Education and Training (CNET). In June 1987, CNET designated the Electrician's Mate (EM) "A" School at Great Lakes, Illinois as the first model school. The intent was to make this school "one which every other Navy school will seek to emulate." The goal was "to apply the best techniques and instructional technologies available...so that we will have in place curriculum, technologies, and management techniques which reflect the very best we currently know about teaching and learning" (CNET MSG 252158Z JUN 87). The Navy Personnel Research and Development Center (NPRDC) was asked to participate in the model school effort as part of the model school working group established by CNET in 1987.

NPRDC's focus for the first model school project was to explore possible technologies that could affect student learning outside of the classroom. This approach is a considerable departure from traditional military training research which has tended to focus on methods for improving course curricula through instructional systems design of the main course (Ellis, 1986).

Students are in the EM "A" schoolhouse, but not in their classrooms when they arrive at school before classes have started or are on breaks between classes. During these times, they are in the hallways outside the classroom, in the student lounge, or passing through the corridors. They are also not in their formal class when they are assigned to (or volunteer for) night study. Night study is required for students who are performing poorly on classroom tests and laboratory activities. Students may also attend night study voluntarily to have questions answered, to use self-study materials, or just to have a quiet place to work on their assignments. The NPRDC's first model school project investigated methods for influencing student learning and motivation during daytime, out-of-class intervals between classes and for enhancing learning during night study.

Objective

The objectives of this project were to create and evaluate a learning environment in the school outside of the classrooms, and to apply and evaluate technologies in night study to improve the remediation process.

APPROACH

To create a learning environment outside the classrooms, it was decided to develop a variety of posters related to the classroom instructional topics and the equipment that an electrician encounters on the job. The goal was to have students engage in some incidental learning related to their EM "A" school classes.

In night study, students were remediated by using available self-paced study materials on basic electricity and by tutoring and counseling provided by instructors. To enhance this process, computer-based instruction (CBI) was added to the night study classroom. This second focus of the NPRDC project concentrated on assisting the school with acquiring or developing CBI programs to remediate students on the more difficult course content areas.

The use of posters for incidental learning and the use of CBI programs for intentional learning in night study occurred during the same time period.

Managing Incidental Learning Through the Use of Posters

The Navy, other services, and institutions such as museums have long used adjunctive training aids or exhibits to influence incidental learning. Such learning occurs in the course of day-to-day life in many settings. For example, if one drives through a town, locations may be learned without (conscious) effort.

In the design of museum exhibits, numerous studies have been conducted to determine the effects of posters and other types of displays on the learning and attitudes of visitors (Griggs & Manning, 1983; Eason & Linn, 1976). For instance, Eason and Linn (1976) used questionnaires and interviews to determine whether grade-school students visiting the Lawrence Hall of Science learned from exhibits of optical principles. They concluded that:

> Students visiting the optic exhibits were able to recall non-vocabulary optical information and were also able to solve optical problems using manipulative skills gained from these exhibits better than controls who did not visit the exhibits. Thus, the optics exhibits were able to provide the student with information in a nontraditional (that is, not like school), unstructured learning situation. (p. 61)

The present study followed the methods developed in the study of museum exhibits. A number of posters, both observational and manipulative were developed (Table 1). An observational poster is looked at and read only for information, while a manipulative poster has parts that can be manipulated to make something happen or requires some form of active problem solving. Many of the posters presented major principles in written and visual form and were designed to act as scaffolds for organization and memory. These posters were relevant to course content and distilled important information in a visual mapping format considered effective in comprehension instruction. All posters were displayed on the walls of the EM "A" schoolhouse halls outside of the classrooms. Then, questionnaire techniques were used to determined student opinions of the posters.

Table 1 groups the posters developed by the staffs of the EM "A" school and NPRDC in four categories (examples of some of these are in Appendix B). The posters were introduced into the schoolhouse over a period of approximately 1 year.

Two categories of posters, Knowledge Question (KQ) and Problem Solving (PS), dealt with specific topics taught in the course. For instance, the AC Power Factor PS poster provided practice in using the formulas used to determine alternating current (AC) power as part of the course work on AC fundamentals.

Table 1

Poster Titles Listed by Type of Poster

Knowledge Question (KQ) Posters	
Compound Generator	Gaylord Hood
"Not" Inverter	Valve Operators
Voltage Regulator	Wye-Delta Windings
DC Motor Mix & Match	DC Generator
Boat Charging System	Oven
Deep Fat Fryer	Degaussing Coil
Problem Solving (PS) Posters	
Automatic Bus Transfer	Two Speed Controller
Tell Tale Panel	Search Light
Series Circuit Computations	AC Power Factor
Information About Course Content (IC) Posters	
Ohm's Law in Action	Electric Fields
Units of Measurement	Series Circuit (demonstration)
Parallel Circuit Demo	AC & DC Generator Diagrams
DC Motor Cross Section	Electricity Generation Diagram
DC Motor Types	Simple Series & Parallel Circuits
Motivational Information (MI) Posters	
Ohm History	Voltage History
Ampere History	

The Information About Course Content (IC) and Motivational Information (MI) posters provided more general information than the specific course content addressed by the KQ and PS posters. For instance, the IC poster, AC and DC Generator Diagrams, provided an overview of these two types of generally used generators, while all three MI posters, Ohm, Ampere, and Voltage History, showed pictures of the men whose names are given to these fundamental concepts and briefly described their work in historical context. On some of the posters, students could manipulate circuits by throwing switches (e.g., the Series Circuit), but most of the posters were observational. For this reason, student reactions to these manipulative or observational posters were not analyzed separately.

Managing Intentional Learning Using CBI Programs

As a part of the model schools project, the EM "A" school installed and implemented the use of Zenith 248[1] computers for night study remediation of students having trouble during their regular daytime classes. For the present effort, attention was centered on obtaining or developing CBI that addressed major learning difficulties of students.

Content areas in which students had learning problems were identified by analyzing course attrition, setback, and test data. The major problems areas identified included (1) mathematics (e.g., whole numbers, fractions, ratios, rates, percentages, etc.), (2) technical vocabulary, (3) direct current (DC) theory and application, and (4) AC theory and application.

In DC theory and application, students had difficulty solving problems in which they had to analyze combination (series and parallel) circuits to respond to questions such as "What happens if...?" or "What caused the effect?" They also had difficulty with problems in which they had to determine paths of least resistance in a complex circuit, to solve series circuit problems (i.e., current, voltage, resistance, and power) using mathematics, and to understand series circuit theory and concepts, including the basic concepts of a circuit (i.e., source, conductor, and load).

In AC theory and application, students had difficulty solving problems involving RL (resistor-inductor) and RLC (resistor-inductor-capacitor) series and parallel circuits using mathematics.

To meet the needs for CBI addressing these learning problems, personnel at NPRDC, CNTT, and the EM "A" school used computer authoring software developed by NPRDC, the Computer-Based Educational Support System (CBESS) authorware (Wetzel & Wulfeck, 1991). A few commercially available programs were also used. Questionnaires were used to determine the extent of usage and reactions of students to the CBI programs.

The various CBI programs addressed the problems of basic skills, DC, and AC. The CBI programs permitted interactive responses with the users, provided feedback for correct and incorrect responses, and maintained records of student performance that could be reviewed by instructors.

EVALUATION

To evaluate student attitude/responsiveness to the posters and CBI programs, students were administered a questionnaire (see Appendix A). The first part of the survey deals with student reactions to the posters; and the second part, with reactions to the CBI programs used in night study.

Poster Survey

The poster survey contains three parts. The first one asked students to place a check by the posters they had seen. This provided a simple indication of recall of posters by students in each of the three phases of the school.

[1]Identification specific equipment is for documentation only and does not imply endorsement.

The second part of the poster survey asked the students to indicate whether they strongly agreed (5), agreed, had no opinion, disagreed, or strongly disagreed (1) with 11 statements about their use and reactions to the posters as a group.

The third part of the poster survey asked students the following three questions about each poster: Did they think the poster was useful, interesting, and easy to understand. Students responded by selecting one of the five responses ranging from strongly agree (5) to strongly disagree (1).

Computer-based-instruction Program Survey

As with the poster survey, the CBI program survey consisted of three parts. The first part asked the students seven questions regarding participation in night study, such as whether they attend night study, use the computer programs, or use other materials.

The second part of the CBI survey asked students to check on a given list the computer programs that they had used. The next part asked them to indicate their opinion of 13 statements using the same 5-point scale used earlier that ranged from strongly agree to strongly disagree.

SUBJECTS

The same 269 EM "A" school students, were the subjects for the study of posters and CBI programs. They were divided into three groups based on the three phases of the EM "A" course.

Phase I students were in the first 8 weeks of training and were learning basic electricity theory. Because they were in the earliest portion of the course, they had the least opportunity for exposure to the posters and CBI programs. Phase II students were in weeks 9 through 17, where they received hands-on practice on systems that EMs encounter on the job. Phase III students were in the last 4 weeks of training, where they received an introduction to solid state electronics. These students had the most opportunity for exposure to the posters and CBI programs.

RESULTS

The results of the survey of student reactions to the posters and CBI programs are presented in Tables 2 through 7. In these tables, the 5-point scale (strongly agree, agree, no opinion, disagree, strongly disagree) has been collapsed to the 3-point scale (agree, no opinion, disagree) reflecting the relatively few responses at the extremes of the 5-point scale.

Poster Survey

A 4 (poster category) by 3 (phase of course) analysis of variance (ANOVA) was performed on the percent of posters each student reported seeing from each poster category to answer the question, "Were EM students aware of and reading the posters?" There were significant differences for poster category, $F(3,798) = 91.1$, $p < 0.00$, and for course phase, $F(2,266) = 9.7$, $p < 0.00$. There was also a significant interaction $F(6,798) = 3.9$, $p < 0.00$. Table 2 indicates that Phase III students recalled more of the posters than students in Phases I and II, students recalled IC and MI posters more frequently than KQ and PS posters, and the largest differences in recall between Phase I and Phase III students was for KQ posters. Interestingly, the posters most likely to be recalled were those dealing with general information (IC and MI posters).

Table 2

Response Frequencies: Recall of Posters in Each Phase of Instruction

Poster Type	Response Frequency (%) Phase I	Phase II	Phase III
Knowledge Question (KQ)	10	20	37
Problem Solving (PS)	23	25	33
Information About Course Content (IC)	41	47	50
Motivational Information (MI)	44	49	50

In Table 3, the responses of students in the three phases of the EM "A" school to questions about each of the 31 posters listed in Table 1 have been aggregated into the four major categories of posters. The survey asked students to indicate if they thought the posters were useful, easy to understand, and interesting.

As indicated in Table 3, the responses to these questions parallel the findings for the recall of posters in Table 2. That is, the posters dealing with general information (IC and MI posters) were rated as more useful, easier to understand, and more interesting than the posters that focus on specific course topics (KQ and PS posters). For the KQ and PS posters, the most frequently selected response was no opinion, which is consistent with the data in Table 2 in which a majority of student did not recall seeing these posters.

Table 4 shows that students tended to interact with or observe the posters alone rather than with other students. Also, only about a third of the instructors discussed the poster problems. Responses to Questions 5 through 10 indicate that most of the students thought the posters interesting, related to the course content, and generally useful. And, while students tended to think more posters would be useful, they were not interested in participating in the development of additional posters (Questions 9, 10, and 11).

Table 3

Response Frequencies to the Poster Opinion Survey

Type of Poster	Survey Question	Response Frequency (%) (*N* = 269) Agree	No Opinion	Disagree
Knowledge Question (KQ)	I thought this poster was:			
	Useful	22	77	1
	Easy to Understand	21	78	1
	Interesting	22	77	1
Problem Solving (PS)	I thought this poster was:			
	Useful	33	65	2
	Easy to Understand	33	65	2
	Interesting	33	65	2
Information About Course Content (IC)	I thought this poster was:			
	Useful	48	52	0
	Easy to Understand	48	52	1
	Interesting	50	50	0
Motivational Information (MI)	I thought this poster was:			
	Useful	51	47	2
	Easy to Understand	54	46	0
	Interesting	54	45	2

Note. Percentages do not always total 100 due to rounding.

Table 4

Response Frequencies to Poster Questions

Question	Response Frequency (%) ($N = 269$) Agree	No Opinion	Disagree
1. I stopped to read and work out the problems presented on some of the posters.	76	12	12
2. I worked on some of the poster problems by myself.	64	18	18
3. I worked on some of the poster problems with other students	56	21	23
4. My instructor(s) discussed some of the poster problems.	32	27	41
5. In general, I thought the posters were interesting.	83	13	4
6. There were posters on topics covered in my course.	91	8	1
7. There were posters on topics covered in previous courses.	92	7	1
8. I could work through the problems on some of the posters.	81	17	2
9. I felt the poster(s) were useful.	76	27	4
10. I think more posters would be useful.	71	26	3
11. I would like to help develop more posters.	24	55	21

Note. Percentages do not always total 100 due to rounding.

Computer-based-instruction Program Survey

The first part of the CBI program survey asked whether students attended night study and, if they did, whether they used the CBI programs, and how their use of the CBI programs compared to their use of other resources such as books, instructors, and videotapes.

Table 5 summarizes the responses of students in each phase of the EM "A" school to the first seven questions. Generally, students were likely to have attended either mandatory or voluntary night study in the two-week period preceding the survey. Further, they were more likely to have used CBI programs than texts or videotapes, although they made most use of night-study instructors.

Table 5

Response Frequencies to Night Study Statements by Course Phase

Statement	Response Frequency (%) ($N = 269$) Phase I	Phase II	Phase III
1. I did not attend any night study.	18	16	5
2. I attended mandatory night study during the last two weeks.	56	40	51
3. I attended voluntary night study during the last two weeks.	41	46	45
4. I used the computer programs as part of my night study.	51	55	51
5. I used the night study booklets.	44	41	44
6. I asked the night study instructor questions.	58	55	63
7. I watched the video tapes.	30	47	30

As indicated in Table 6, the basic skills programs did not receive much use. To further analyze this finding, the programs were divided into two groups based on whether they dealt directly with course content or were adjunctive basic skills programs. The five programs identified as basic skills programs were Signed Numbers (No.13), Trig Functions (No. 14), Fractions (No.15), Home Work Helper (No.17), and Right Triangles (No. 18). The other 14 related directly to the course content. The percent of students using each type of program was calculated for each phase and a 2 (type of program) by 3 (phase of course) ANOVA was performed. There were significant differences for type of program, $F(1,266) = 159.4$, $p < 0.00$, and for phase of course, $F(2,266) = 7.7$, $p < 0.00$. There was also a significant interaction $F(2,266) = 7.6$, $p < 0.00$. The basic skills programs were used significantly less than the course related programs. Further, while students in all three phases of the school made some use of the course related programs, the Phase II students were most likely to use them, which accounts for the significant interaction. Phase II students made greatest use of programs dealing with more complex circuit problems involving resistance, inductance, and conductance. Table 7 presents the percent of each type of program used in each phase of instruction.

Table 6

Student Use of Computer-based-instruction Programs in Night Study by Course Phase

Computer-based-instruction Program	Response Frequency (%) (*N* = 269) Phase I (*n* = 71)	Phase II (*n* = 112)	Phase III (*n* = 86)
1. Vocabulary	25	32	33
2. DC Parallel Variational Analysis	21	24	12
3. DC Series Variational Analysis	20	23	13
4. Blitzer	15	36	15
5. Ohm's Law	15	23	10
6. RL Series	13	42	14
7. Basic Series Circuit	13	16	5
8. RL Parallel	11	41	17
9. Complex Circuits	11	22	8
10. Basic Series Circuit II	10	12	3
11. RC Parallel	10	35	14
12. RC Series	10	37	16
13. Signed Numbers (1&2)	6	06	2
14. Trig Functions	6	12	6
15. Fractions	4	9	2
16. AC Controller Maintenance	4	4	6
17. Home Work Helper	3	1	1
18. Right Triangles	3	11	3
19. Navigational Lights	0	2	3

Table 7

Percent of Each Type of Computer-based-instruction Program Used in Each Phase of Instruction

Program Type	Student Use (%) (*N* = 269) Phase I	Phase II	Phase III
Course Related	45	87	49
Basic Skill	5	10	3

The CBI program survey included 13 questions to determine if students worked with the programs, alone or with someone else; whether they found the programs useful, easy to understand, interesting, and relevant to their EM "A" school studies; and whether they would like to have the opportunity for further use of CBI programs. The results of student reactions to these questions summed over students in all three phases of study are summarized in Table 8. Generally, as with the posters, students tended to use the CBI programs alone rather than with others, though about a quarter did work with other students or instructors on some of the programs (Questions 1, 2, and 3). Most students found the programs useful and interesting (Questions 12 and 4), and relevant to their EM "A" school studies (Questions 5 and 6). Most students thought that other programs would be useful and that they would like to have the opportunity to use the computer programs as part of their night study (Questions 12 and 13).

Table 8

Response Frequencies to Computer Usage Statements

Statement	Response Frequency (%) ($N = 269$) Agree	No Response	Disagree
1. I worked on the programs alone.	53	36	10
2. I worked on the programs with an instructor.	27	50	23
3. I worked on the programs with another student.	24	49	26
4. In general, I thought the programs were interesting.	56	41	3
5. The programs were on topics covered in my course.	61	38	2
6. The programs helped me understand when and how electricians use course information.	47	44	7
7. The programs helped me learn the topics in my course.	58	40	2
8. The programs presented clear explanations.	52	44	4
9. The programs presented clear examples.	53	44	3
10. The programs presented enough practice.	48	42	10
11. When I made an error the programs explained how to work the problems correctly.	44	48	9
12. I think other computer programs would be useful.	57	42	2
13. I would like to have the opportunity to use computer programs as part of my night study.	57	40	3

Note. Percentages do not always total 100 due to rounding.

DISCUSSION AND CONCLUSIONS

The results of the student surveys of the uses of posters and CBI programs suggest the conclusion that, overall, both posters and CBI programs were used and found to be useful.

Poster Survey

The fact that, in general, the frequency of recall of posters (Table 2) increased for students in Phases II and III of the school, who had been in the schoolhouse environment longer than the Phase I students, suggests that student responses actually reflected observation and recall, not just response bias. Further, students appear to have found the posters with general course-related information (IC and MI) more useful, easier to understand, and more interesting than the posters that focused more on specific course topics (KQ and PS) (Tables 3 and 4). This is consistent with the recall data of Table 2 and suggests a possible relationship between the perception that a poster is useful and interesting, and the subsequent recall of the poster.

Of course, while the present survey only suggests that the posters may have been useful in helping students learn EM "A" school information in an incidental manner, more direct indicators that the information presented in the posters was learned would be desirable. The present work was unable to include test items reflecting the poster contents in the weekly exams given to students, due to the restrictions on disturbing the existing curriculum. Even greater effect might be expected with posters being both in hallways and in the classroom itself.

Computer-based-instruction Survey

The CBI program survey data supported the poster survey data in suggesting that student responses were based on experience rather than response bias. This was indicated by the fact that, in general, while about the same percentage of students in all three phases reported using CBI programs in their night study (about 50%, Table 5), the students reported more use of specific programs that were appropriate for their phase of study. This was especially true for those programs dealing with the more complex circuit problems of the Phase II segment of the course (Tables 6 and 7).

The data of Table 6 also suggest that some of the CBI programs, especially those dealing with content not directly related to the course (e.g., Signed Numbers, Fractions, Home Work Helper) were not widely used. This suggests there may be a need for programs that embed these topics within the content of the EM "A" school.

The conclusion that CBI programs were successful in meeting student intentional learning needs is suggested by the fact that they reported more use of computer programs than other night study materials (texts, videotapes) (Table 5), that the CBI programs helped them learn their course content, and that they would like to have more opportunity to use CBI programs in their studies (Table 8).

RECOMMENDATIONS

1. The use of wall posters is an effective technique for improving students' learning. Schools in the Navy Education and Training Command (NAVEDTRACOM) should develop and display posters when possible. Hallway wall space is recommended for displaying posters with general information about course content and motivational information. However, posters dealing with more specific classroom topics should be displayed within classrooms where the topics are being taught. In this context, they could be the basis of some instructor comment.

2. CNET should assist NAVEDTRACOM schools in identifying course content areas where CBI may be developed and in acquiring the appropriate CBI.

Further, programs currently in use that are not directly related to course content should be reviewed to determine if they should be dropped from inventory or if additional programs should be developed/acquired to teach the topics within the context of the course content.

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APPENDIX A

QUESTIONNAIRE: STUDENT EVALUATION OF POSTERS AND NIGHT STUDY

Student Evaluation of Posters and Night Study

NAME:______________________________ DATE:_______________

COURSE:____________________________ UNIT/MOD:___________

PHASE:_____________________________ CLASS NO:___________

SSN:_______________________________

POSTERS

Place a check by the posters you saw in the halls:

_____ Compound Generator

_____ Automatic Bus Transfer

_____ Gaylord Hood

_____ Valve Operators

_____ Wye/Delta Windings

_____ The Electric Ship

_____ Two Speed Controller

_____ Series Circuit

_____ Parallel Circuit

_____ Voltage Regulator

_____ 'Not' Inverter

_____ DC Motor Mix & Match

_____ DC Generator Mix & Match

_____ Small Boat Charging System

_____ Oven

_____ Ohm's Law in Action

_____ Electric Fields

_____ Tell Tale Panel

_____ Search Light

_____ Deep Fat Fryer

_____ Degaussing Coil

_____ AC Power Factor

_____ Units of Measurement

_____ Ohm History

_____ Series Circuit Demo

_____ Parallel Circuit Demo

_____ Voltage History

_____ AC & DC Generator Diagrams

_____ DC Motor Cross Section

_____ Electricty Generation Diagram

_____ Ampere History

_____ DC Motor Types

_____ Simple, Series & Parallel

Circle the letters indicating your response to the following statements about the posters:

KEY (SA)- -Strongly agree
(A)- -Agree
(N)- -No opinion
(D)- -Disagree
(SA)- -Strongly disagree

1. I stopped to read and work out the problems presented on some of the posters.	SA	A	N	D	SD
2. I worked on some of the poster problems by myself.	SA	A	N	D	SD
3. I worked on some of the poster problems with other students.	SA	A	N	D	SD
4. My instructor(s) discussed some of the poster problems.	SA	A	N	D	SD
5. In general, I thought the posters were interesting.	SA	A	N	D	SD
6. There were posters on topics covered in my course.	SA	A	N	D	SD
7. There were posters on topics covered in previous courses.	SA	A	N	D	SD
8. I could work through the problems on some of the posters.	SA	A	N	D	SD
9. I felt the poster(s) were useful.	SA	A	N	D	SD
10. I think more posters would be useful.	SA	A	N	D	SD
11. I would like to help develop more posters.	SA	A	N	D	SD

List topics on which you would like posters to be developed.

Voltage Regulator

1. I thought this poster was useful.	SA	A	N	D	SD
2. I thought this poster was interesting.	SA	A	N	D	SD
3. I thought this poster easy to understand.	SA	A	N	D	SD

Voltage History

1. I thought this poster was useful.	SA	A	N	D	SD
2. I thought this poster was interesting.	SA	A	N	D	SD
3. I thought this poster easy to understand.	SA	A	N	D	SD

'Not Inverter'

1. I thought this poster was useful.	SA	A	N	D	SD
2. I thought this poster was interesting.	SA	A	N	D	SD
3. I thought this poster easy to understand.	SA	A	N	D	SD

AC & DC Generation Diagrams

1. I thought this poster was useful.	SA	A	N	D	SD
2. I thought this poster was interesting.	SA	A	N	D	SD
3. I thought this poster easy to understand.	SA	A	N	D	SD

DC Motor Mix & Match

1. I thought this poster was useful.	SA	A	N	D	SD
2. I thought this poster was interesting.	SA	A	N	D	SD
3. I thought this poster easy to understand.	SA	A	N	D	SD

DC Motor Cross Section

1. I thought this poster was useful.	SA	A	N	D	SD
2. I thought this poster was interesting.	SA	A	N	D	SD
3. I thought this poster easy to understand.	SA	A	N	D	SD

DC Generator

1. I thought this poster was useful.	SA	A	N	D	SD
2. I thought this poster was interesting.	SA	A	N	D	SD
3. I thought this poster easy to understand.	SA	A	N	D	SD

Electricty Generation Diagram

1. I thought this poster was useful.	SA	A	N	D	SD
2. I thought this poster was interesting.	SA	A	N	D	SD
3. I thought this poster easy to understand.	SA	A	N	D	SD

Small Boat Charging System

1. I thought this poster was useful.	SA	A	N	D	SD
2. I thought this poster was interesting.	SA	A	N	D	SD
3. I thought this poster easy to understand.	SA	A	N	D	SD

Amphere History

1. I thought this poster was useful.	SA	A	N	D	SD
2. I thought this poster was interesting.	SA	A	N	D	SD
3. I thought this poster easy to understand.	SA	A	N	D	SD

Oven

1. I thought this poster was useful.	SA	A	N	D	SD
2. I thought this poster was interesting.	SA	A	N	D	SD
3. I thought this poster easy to understand.	SA	A	N	D	SD

DC Motor Types

1. I thought this poster was useful.	SA	A	N	D	SD
2. I thought this poster was interesting.	SA	A	N	D	SD
3. I thought this poster easy to understand.	SA	A	N	D	SD

AC & DC Generators

1. I thought this poster was useful.	SA	A	N	D	SD
2. I thought this poster was interesting.	SA	A	N	D	SD
3. I thought this poster easy to understand.	SA	A	N	D	SD

NIGHT STUDY

Check the statement(s) that describes your participation in night study.

1. I did not attend any night study. _____
2. I attended mandatory night study during the last two weeks. _____
3. I attended voluntary night study during the last two weeks. _____
4. I used the computer programs as part of my night study. _____
5. I used the night study booklets. _____
6. I asked the night study instructor questions. _____
7. I watched the video tape(s). _____

Place a check by the computer programs you used.

_____ Ohm's Law

_____ Complex Circuts

_____ Fractions

_____ Vocabulary

_____ RC Parallel

_____ RC Series

_____ RL Parallel

_____ RL Series

_____ Home Work Helpers

_____ Basic Series Circuit

_____ Basic Series Circuit II

_____ Signed Numbers (1 & 2)

_____ Right Triangles

_____ Trig Functions

_____ AC Controller Maintenance

_____ DC Series Variational Analysis (Apple)

_____ DC Parallel Variational Analysis (Apple)

_____ Navigational Lights

_____ Blitzer

Circle the letters indicating your response to the following statements about the computer programs.

1. I worked on the program(s) alone.	SA	A	N	D	SD
2. I worked on the program(s) with an instructor.	SA	A	N	D	SD
3. I worked on the program(s) with another student.	SA	A	N	D	SD
4. In general, I thought the program(s) were interesting.	SA	A	N	D	SD
5. The program(s) were on topics covered in my course.	SA	A	N	D	SD
6. The program(s) helped me understand when and how electricians use course information.	SA	A	N	D	SD
7. The program(s) helped me learn the topics	SA	A	N	D	SD
8. The program(s) presented clear explanations.	SA	A	N	D	SD
9. The program(s) presented clear examples.	SA	A	N	D	SD
10. The programs presented enough practice.	SA	A	N	D	SD
11. When I made an error the program(s) explained how to work the problems correctly.	SA	A	N	D	SD
12. I think other computer programs would be useful.	SA	A	N	D	SD
13. I would like to have the opportunity to use the computer programs as part of my night study.	SA	A	N	D	SD

List topics on which you would like computer programs to be developed.

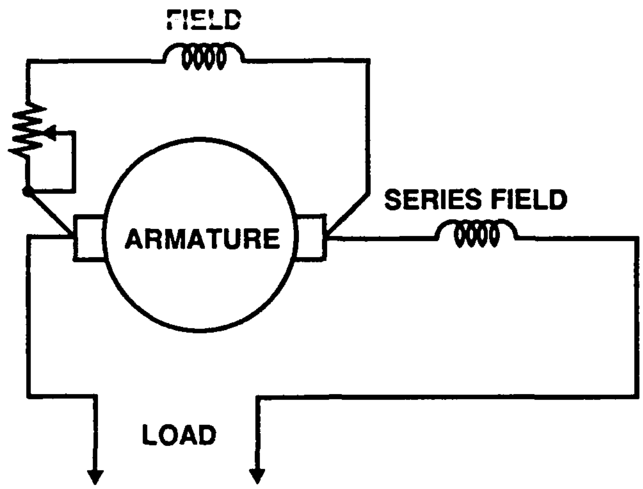
APPENDIX B

EXAMPLES OF POSTERS

Knowledge Question

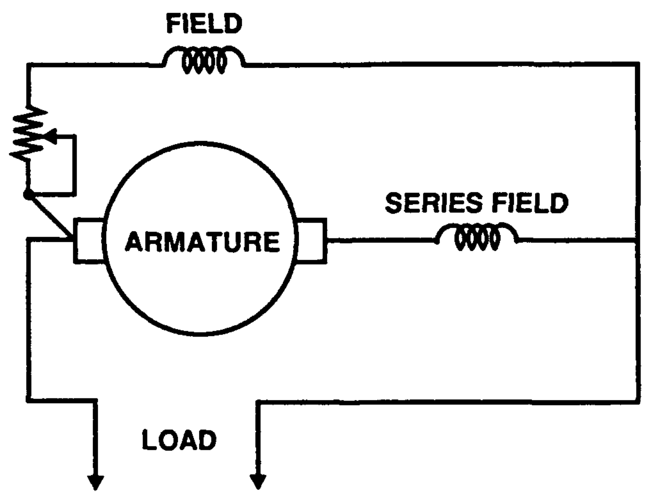
Compound Generator

A.



COMPOUND GENERATORS

B.



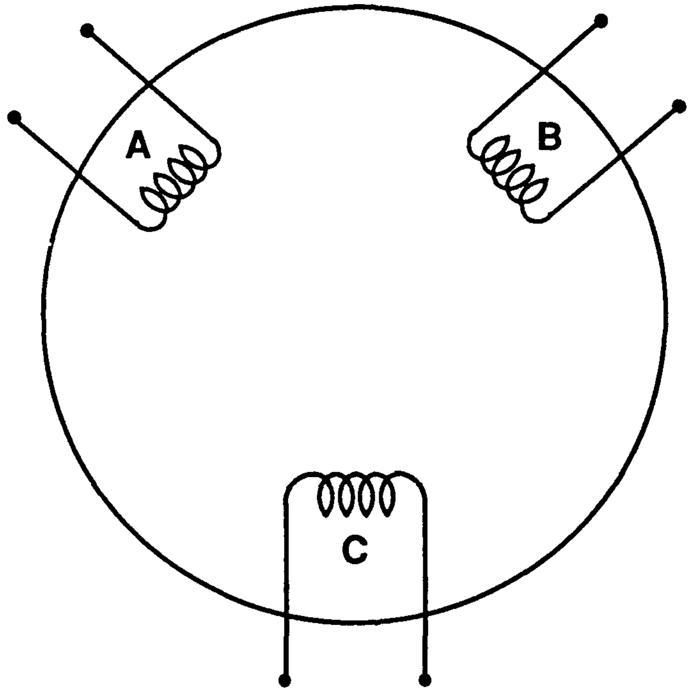
TYPE

A. ______________________________

B. ______________________________

Knowledge Question

Wye-Delta Windings



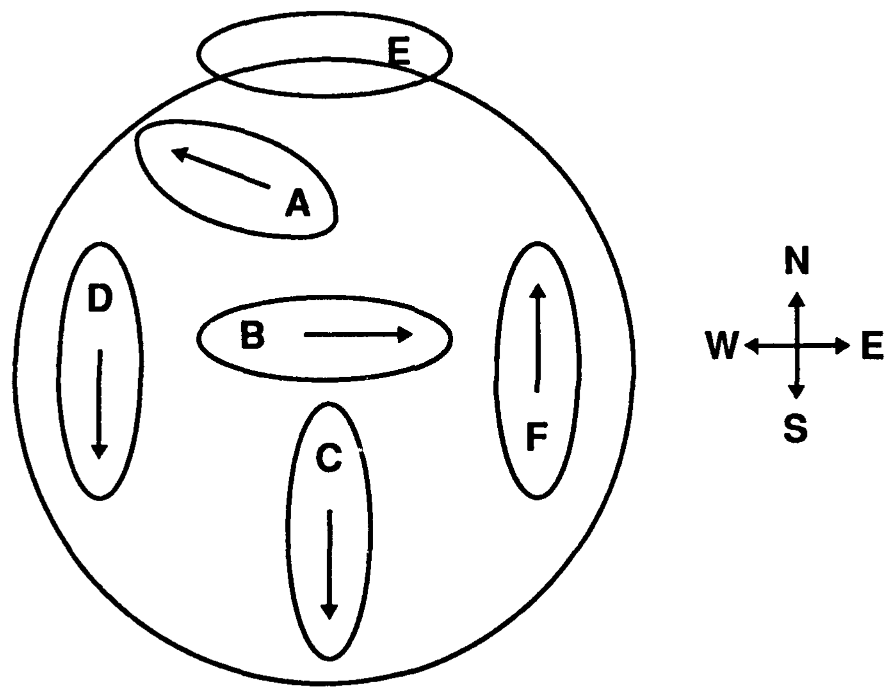
WHAT IS THE
SEQUENCE OF HOOK-UP
FOR

A. WYE

B. DELTA

Knowledge Question

Degaussing Coil



WHICH SHIP(S) WILL HAVE A READING ON ALL DEGAUSSING COILS

Problem Solving Poster

AC Power Factor

1. $\frac{\text{VOLTS X AMP X 1.73}}{\text{W}}$

2. $\frac{\text{AMP X 1.73 X VOLTS}}{\frac{1000}{\text{KW}}}$

3. $\frac{\text{W}}{\text{VOLTS X AMP X 1.73}}$

4. $\frac{\text{KW X 1000 X 3}}{\text{VOLTS X AMP X 1.73}}$

WHICH FORMULA IS CORRECT TO USE TO FIGURE POWER FACTOR FOR A GENERATOR RATED AT

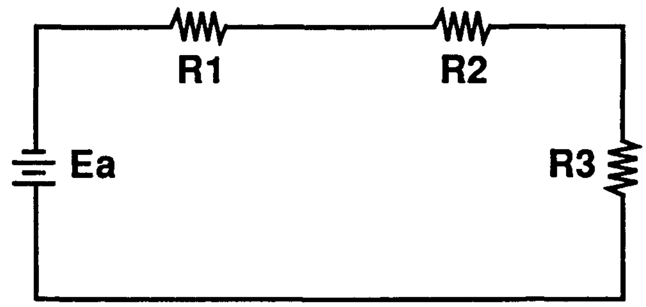
450 VOLTS / 1202 AMPS / 750 KW

POWER FACTOR IS _____

Problem Solving Poster

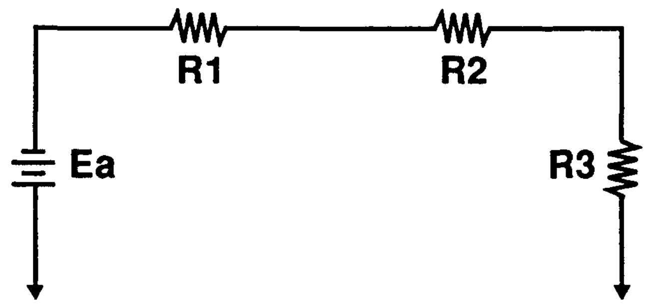
Series Circuit Computations #2

4. COMPUTE FOR THE UNKNOWN



	P	I	E	R
R1		20mA		5KΩ
R2			30V	
R3			5V	
Total	900mW			

5.



	P	I	E	R
R1	7.5W			
R2		.5A		
R3			15V	
Total				70Ω

Information about Course Content

Units of Measurement

COMMON UNITS OF MEASUREMENT

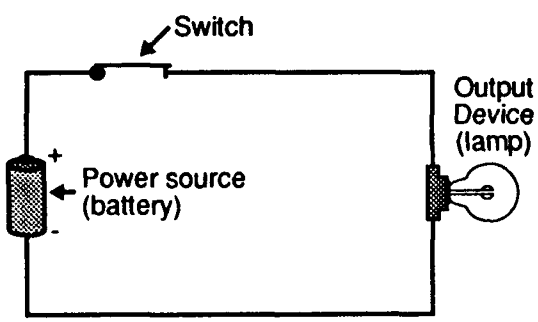
PREFIX	PREFIX	PREFIX	DECIMAL EQUIVALENT
MEGA	M	10^6	1,000,000
KILO	k	10^3	1,000
MILLI	m	10^{-3}	.001
MICRO	μ	10^{-6}	.000001

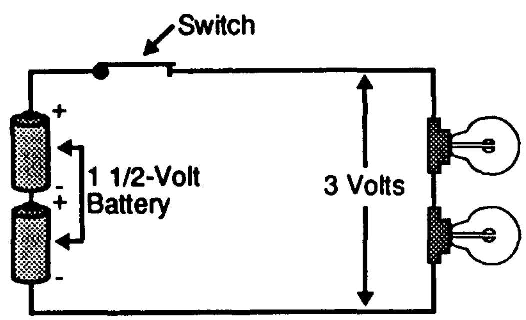
Information About Course Content

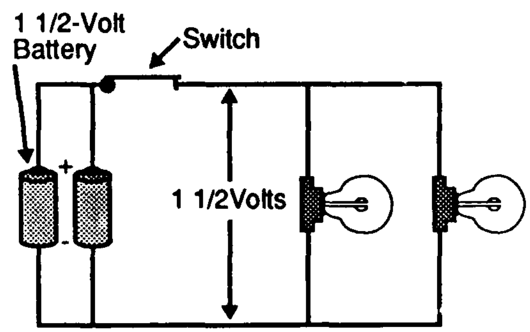
Simple Series and Parallel Circuits

A. SERIES CIRCUITS AND PARALLEL CIRCUITS

All circuits except the simplest are (1) series, (2) parallel, or (3) complex (a combination of the two). Series circuits have their parts connected in a single path. Parallel circuits have more than one path.







The simplest Circuit consists of a source of electricity, an output device, and connection between them. It may also include a switch.

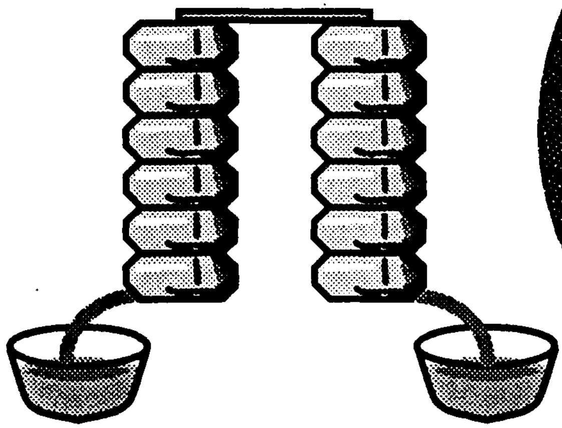
A Series Circuit has a varying voltage, depending on the number of its power sources. Two 1 1/2-volt batteries produce 3 volts when connected in series.

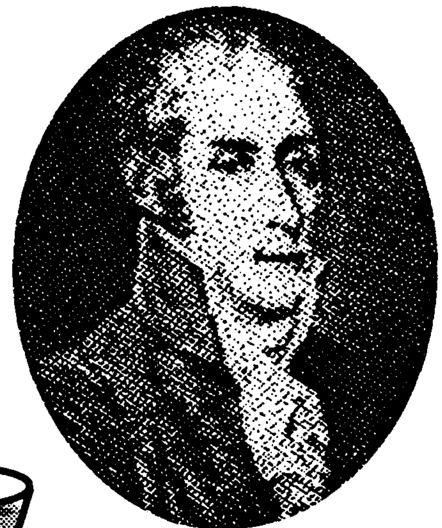
A Parallel Circuit has a uniform voltage, no matter how many power sources. Two 1 1/2-volt batteries produce 1 1/2 volts when connected in parallel.

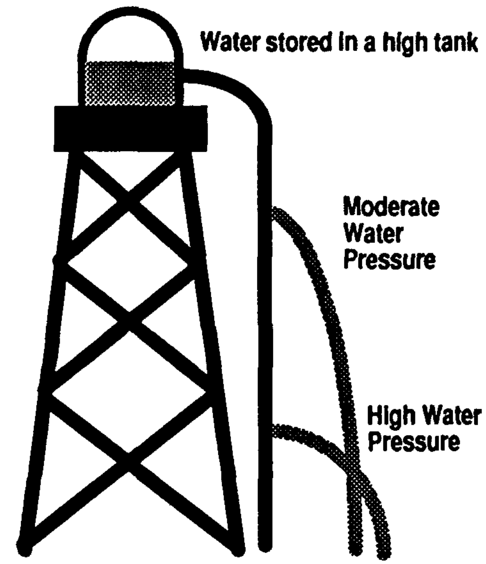
Motivational Information

Voltage History

THE VOLT
A Unit
of Pressure







ELECTRICITY PILED HIGH

Volta's batter (above) called a "Voltaic pile" consists of two stacks of paired zinc and silver disks packed between layers of brine soaked pasteboard. When the columns were connected at the top, current flowed between them, arising from chemical reaction of the paired metals.

THE FORCE OF CURRENT

In honor of Alessando Volta, who sometimes judged a battery by the flash he saw as he touched its wires to his eyelids, electric force is now measured in volts. Voltage is a measure of the electrical "pressure" with which current flows through a wire. This potential is akin to that of water stored in a high tank, ready to pour down through a pipe. The farther water drops down a pipe, the greater will be the pressure of its spurt from a spigot (above, right). Similarly, the greater the voltage of a battery, the greater will be the force of current produced.