The Relationship of Information System Training Methods and Cognitive Ability to End-user Satisfaction, Comprehension, and Skill Transfer: A Longitudinal Field Study

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This study compares traditional and nontraditional training techniques with regard to computer-related training. Its purpose was to determine which training methods could best be utilized in computer-related training to maximize a trainee's retention of material and transfer of learning. A field experiment was conducted using two hundred members of active duty U.S. Naval Construction Battalion as subjects. Evaluation of trainees included a pre-training screening, post-training evaluation (immediately after training), and a follow-up session (four weeks after the post-training session) utilizing previously validated instruments. Training treatments included instruction (lecture), exploration (independent study), and a nontraditional technique—behavior modeling (an enhanced combination of the other two methods). Performance outcomes were operationalized using hands-on task performance and comprehension of the computer system as dependent variables. End-user satisfaction with the computer system was also measured. Two covariates, cognitive ability and system use, were also introduced into the study. The use of hands-on training methods, especially behavior modeling, resulted in superior retention of knowledge, transfer of learning, and end-user satisfaction. Cognitive ability failed to be a good predictor of trainee success but a connection was established between training methodology, system use, and end-user satisfaction.

(Computer Training; End-user Satisfaction; Behavior Modeling)

1. Introduction

There is a direct correlation between profits and the success of a company with the level of worker training.
(Robert Reich, Secretary of Labor, January 11, 1995).

The rise of end-user computing and the increasing training budgets of businesses prompted practical reasons as well as research motives to investigate the topic of effectiveness of computer related training. The arrival
of the information age has created an increasing number of subjects and individuals requiring training, as computer use by nonprogramming end users continues its rapid growth. Projections indicate that IT training will exceed $18 billion dollars by the end of this century (International Data Corporation 1995). A recent survey of U.S. government employees indicated that 94% of workers rely on computers to accomplish their jobs, almost 85% viewed lack of training as a barrier to computer use, and 95% are interested in additional computer training (GSA Office of Personnel Research and Development, U.S. Government 1995).

Information system managers need to insure that users acquire computing skills in the most effective and efficient ways possible. One way to achieve this goal is through the use of training programs (Davis and Davis 1990, Harrison and Rainer 1992, Davis and Bostrom 1993, Santhanam and Sein 1994, Compeau and Higgins 1995). Training end-users to utilize software tools and to build their own applications has been identified as a critical factor and the most effective mechanism for ensuring the success of end-user computing (Zmud and Lind 1985, Dickson et al. 1984, Hartog and Herbert 1986, Harrison and Rainer 1992). Cheney et al. (1986) link the availability of end-user training programs to the success of end-user computing satisfaction. Although a number of training approaches are used in practice (Wolman 1986), the MIS literature provides little guidance for designing effective end-user training. Some researchers and computer software vendors have argued that software is easy to learn and use. However, numerous examples from the literature indicate otherwise. Users often experience difficulty in recalling and using command syntax (Michard 1982, Borgman 1986) or may find it difficult to apply software to specific tasks (Carroll et al. 1987). This suggests the need for effectively designed training programs which develop and encourage computer-literate end users, even in an information technology environment permeated with menu-driven, point-and-click programs associated with a Windows-type interface.

The objective of this study is to furnish a more complete understanding of which training methods provide the trainee with the optimal learning situation. Maier (1973) suggests that the result of training is a multiplicative product of an individual’s ability, motivation levels, and training environment. Taking into consideration the fact that certain characteristics of the trainee and training method influence the training process, this study conducted a large-scale field experiment utilizing two hundred subjects, testing three training treatments: instruction, exploration, and behavior modeling, as well as a “no training” control group. The instruction treatment represents the traditional lecture methodology, widely used in classroom learning/training. The exploration method is an inductive technique which gives the trainee control over the learning environment and is operationalized in the form of an independent self-paced manual. The third training treatment, behavior modeling, is a nontraditional technique which combines the advantages of both instruction and exploration while providing the trainee with constant feedback during the training process. To ensure that the main aspects of computer training are explored, this study combines both abstract knowledge (general concepts) and procedural knowledge during each training session.

Prior to inclusion in the experiment subjects were prescreened to determine levels of computer-literacy, and cognitive ability was measured to insure their equality. To determine the effectiveness of the training treatments, subjects were evaluated immediately after training and then again four weeks later. Evaluation of retention and transfer of learning included two hands-on measures and two types of trainee comprehension. Supplementary measures of system use and end user satisfaction were also conducted. This study further links scientific investigation and solutions to real-world situations while establishing the groundwork to answer some persistent questions in the research realm on a key factor in the success of information systems.

The rest of the paper is organized as follows. Sections 2 and 3 review the literature. The former reviews the MIS training literature, while the latter provides the theoretical framework for the experiment. Section 4 presents the hypotheses to be tested. Section 5 reviews the research design, subjects, experimental procedures, variables, and controls. In §§6 and 7, we introduce the dependent variables used to evaluate trainees, training outcomes, and user satisfaction and the experiment’s covariates. Statistical methods are reviewed in §8. In §9, results of the analysis are evaluated. We conclude the
paper by suggesting future research directions and practical implications.

2. Background on Computer Training
The MIS literature has identified training as a critical factor in the success of decision support systems (Fuest and Cheney 1982, Sanders and Courtney 1985), strategic innovation (Kotter and Schlesinger 1979, Kim and Lee 1991), and implementation (Bronsema and Keen 1983, Nelson and Cheney 1987, Grover and Teng 1994). A number of IS training studies have been reported which have improved our understanding of the subject. Davis and Bostrom (1993) explored training based on different user-computer interfaces, Olman and Mandviwalla (1994) ascertained that graphic user interface (GUI) training provided insights into multiple information types, and Santhanam and Sein (1994) found that performance can be enhanced through training methods that provide good conceptual models. Many studies concentrated on the computer as a tool that is utilized in the “classroom,” addressing children in primary schools or students in post-secondary education, and not as a tool to be used in future work-related situations.

Leidner and Jarvenpaa’s (1993) work on electronic classrooms sought to understand the use of computer-based technology in a college electronic classroom and how the instructor’s style might be affected. They discovered that student preference for teaching method served as a moderating variable and that there was a dependency between the type of material covered during the class and the teaching method. Their findings prompted the researchers of this study to wonder if there would also be performance differences based on the training treatment employed. Their work also raises questions about the relationship between the teaching method and the retention of procedural and general knowledge. The current study extends the previous work by investigating both procedural and general knowledge under multiple training conditions while using manipulation and reaction instruments to determine trainee awareness of the treatment and satisfaction with the training experience.

Davis and Bostrom (1993) investigated the roles of the computer interface and training methods with regard to end users. Their work examined instruction and exploration training treatments as they interacted with command and direct manipulation interfaces, evaluating subjects through hands-on tasks and perceived ease of use. They suggested that future researchers examine the processes through which individuals learn to use computers by using subjects other than their student sample and evaluating subjects over time as opposed to post-test only designs. The authors of this study adopt their suggestions but expanded upon their work by including the behavior modeling training treatment in addition to the instruction and exploration methodologies, including a follow-up evaluation four weeks after the post-test evaluation, and the selection of subjects drawn from a nonstudent population.

Gist et al. (1989) and Compeau and Higgins (1995) also explored training in classroom settings while employing the behavior modeling technique to understand self-efficacy. Gist et al. (1989) compared an exploration technique, computer-aided instruction, with behavior modeling in a study to determine the effects of training methods on self-efficacy. They found that modeling trainees were more satisfied with the training, reported more effective cognitive working styles, and were less frustrated. Unfortunately, their research design did not permit testing of transfer of training. Compeau and Higgins (1995) compared the instruction (lecture) technique with behavior modeling in a study of self-efficacy and outcome expectation using two specific software packages. Their sample included managers and professionals as subjects. The results of two hands-on exercises indicated that modeling, in some cases, can alter self-efficacy and performance. Both studies relied on sample sizes of approximately 100, with Compeau and Higgins suggesting that future studies use larger samples.

This study enhanced the work of both of the aforementioned studies by combining all three treatments plus a control group into a single study with a sample of 200. Additionally, the study was designed as a field experiment to determine the optimum training treatment for the retention of training knowledge and uses both general knowledge (comprehension) and procedural knowledge as it relates to computer training. Included in the study are two covariates, cognitive ability and computer use. The inclusion of these covariates
serves as a control to validate that external factors were not influencing the results of the experiment. In concert with the follow-up evaluation, trainees were evaluated as to their satisfaction with the newly installed computer system. This study took the in-depth analysis of the training literature’s techniques out of the classroom and conducted an experiment in a real-world setting. To our knowledge, no MIS study to date examines training techniques, including behavior modeling and a control group, under field conditions while ascertaining multiple training outcomes over time and computer user satisfaction.

3. Theoretical Framework
The Lewin Experimental Learning Model (Lewin 1951) and Kolb’s Learning Model (Kolb 1984) are used to anchor this work and the selection of training treatments. Learning is described as a process whereby concepts are derived from and continuously modified by experience. Jerome Bruner, in his book Toward a Theory of Instruction, makes the point that the purpose of education/training is to stimulate inquiry and skill in the process of getting knowledge, not to memorize a body of knowledge: “Knowing is a process, not a product” (1966, p. 72).

Learning by its very nature is a tension and conflict process. The Kolb Learning Model (Kolb 1984) creates two primary dimensions to the learning process (see Figure 1). The first dimension represents concrete experiencing of events at one end and abstract conceptualization at the opposite. The other dimension has active experimentation at one extreme and reflective observation at the other. Learners, to be effective, rely upon four different kinds of abilities. These abilities are represented as the end points of each axis: concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). In the learning process, one moves in varying degrees from actor to observer, and from specific involvement to general analytic detachment. The anchors can be best described as follows. The concrete experience orientation focuses on being involved in experiences and dealing with immediate human situations in a personal way. The emphasis is on feeling as opposed to thinking; concerns include complexities of the present (here and now procedures) as opposed to theories and generalizations.

The approach utilized is intuitive, almost “artistic.” Reflective observation focuses on understanding the meaning of ideas and situations by carefully observing and impartially describing them—the scientific method. The emphasis is on understanding as opposed to practical application. An abstract conceptualization orientation focuses on using logic, ideas, and concepts. It emphasizes thinking as opposed to feeling. The approach utilized is that of general theory building using systematic planning, manipulation of abstract symbols, and quantitative analysis. Active experimentation focuses on dynamically influencing people and changing situations. The emphasis is on practical applications, i.e., what works as opposed to the “absolute truth.” Risk taking is tolerated in order to achieve objectives.

The distinct dimensions of the Kolb Model, concrete experience/abstract conceptualization and active experimentation/reflective observation, represent two dialectically opposed adaptive orientations. The abstract/concrete dimension is one of prehension, representing two different and opposed processes of grasping or taking hold of experience in the world—either through reliance on conceptual interpretation and symbolic representation, comprehension, or through reliance on the tangible, felt qualities of immediate experience,
apprehension. The active/reflective dialectic is one of transformation, representing two opposed ways of transforming that grasp or “figurative representation” of experience—either through internal reflection, intention, or active external manipulation of the external world, extension (Kolb 1984, p. 41).

A rich repertoire of dependent variables can be derived from the Kolb model and the education psychology literature for examination in an IS context. These variables include training retention and transfer, which this study operationalizes as (1) near-transfer tasks (simple tasks similar to those covered during training) and (2) far-transfer tasks (a combination of several near-transfer tasks requiring the trainee to apply problem solving skills). The Kolb model provides distinctive types of knowledge which are a common part of most training situations. Procedural knowledge presents a trainee with specific instructions or operations, while factual or general knowledge provides a universal overview of a topic.

In this experiment, the Kolb Learning Model provides a theoretical foundation for application to the training realm. The dimensions of this model will serve as a framework to interlink the elements of the study. The active/reflective dimension furnishes the continuum for the training methods while the concrete/abstract dimension provides the basis for a dichotomy between the information types. An examination of Figure 2 depicts the horizontal axis representing the continuum of training methods, the traditional instruction method corresponding to reflective observation, a condition where the learner/trainee has a passive role in the preprogrammed training process. In this treatment, the trainee listens and reflects on the ideas presented by the trainer. The independent exploration treatment matches the active experimentation anchor. This training technique emphasizes the concepts of hands-on interaction and practical application as a means to learn material. The third training technique, behavior modeling, is a non-traditional technique occupying the middle of the spectrum. This method seeks to change the environment and conditions through which the trainee understands and grasps material. The delivery is one which uses a combination of the previous concepts, providing a lecture format driven by specific learning points and hands-on experimentation. During the modeling treatment there is continuous feedback between the trainer and the trainees, which encourages trainee participation and experimentation. These three methods also met the objectives of the Navy, which sought to develop computer training which is time and cost effective and could be exported to deployed field units.

The vertical axis, concrete experience/abstract conceptualization, is used to represent the type of information provided to trainees. Kolb suggests that the learning experience is a comprehensive process and this study transfers those ideas to the training model, especially in the computer related training. Figure 2 shows that two types of knowledge were provided to trainees during the training treatments: general and procedural knowledge. General knowledge provided background information about computers—some history, components, and how computers work. Procedural knowledge, on the other hand, is specific knowledge about software commands and machine operations. To test the transfer of knowledge two types of evaluation instruments were selected. The first, a hands-on instrument evaluated procedural knowledge. This instrument was composed of two types of tests. The first tested simple or near-transfer tasks which were composed of questions similar to the training material. The second
tested complex or far-transfer tasks, which combine two or more near-transfer tasks, required trainees to build and expand upon the material covered during the training session. The second instrument was a comprehension, pencil-and-paper exam composed of simulations, multiple choice, and true/false questions. The simulation section of the comprehension evaluation tested procedural knowledge while the multiple choice and true/false sections evaluated general knowledge. The evaluation instruments are similar to those used by Davis and Bostrom (1993) and are reviewed in more detail in §6.

4. Hypotheses

Training Treatments

Instruction-based learning has been characterized as the situation when “the entire content of what is to be learned is presented to the learner in final form” (Ausubel 1963, p. 16). This method offers a traditional approach that is widely accepted and understood. It is appropriate for almost all training needs and can be very dynamic, since the instructor is present to deal with any questions or problems that may arise and give individual attention as needed (Wehr 1988). Instruction-based training implies a deductive approach to learning, where learners proceed from general rules to specific examples. It tends to favor a programmed approach which grants individuals very little control over the processes or content of learning (Glaser 1966). Davis and Davis (1990) found that the instruction mode was superior to self-directed independent study. Instruction-based training leads to quick reinforcement for the instructor and the student. Additionally, instruction based training has the effect of minimizing incorrect responses and allowing learners to apply rules more quickly. Hall and Freda (1982) found that instruction-training was more effective than exploratory training in courses that teach primarily rule or general tasks. Overall the literature suggests that the instruction technique should be superior for retention of information.

Exploration learning has been characterized as “a matter of rearranging or transforming evidence in such a way that one is enabled to go beyond the evidence so reassembled to additional new insights” (Bruner 1966, p. 22). Glaser (1966) describes exploration learning as a process by which individuals are granted the freedom to impose their own structures on learning. Exploration may also involve an inductive process through which an individual learns general concepts by starting with specific tasks or examples (Taba 1963). Bruner (1961) argues that exploration training helps learners organize information, making it more readily available for later application or problem-solving. He suggests that this method motivates the individual. The conclusion is that the individual becomes more self-motivated to solve problems in an independent fashion. It has also been suggested that the information learned using exploration is more readily transferable, because exploration allows the individual to easily accommodate new information, with that information being learned in terms of information already acquired (Taba 1963). The majority of studies on transfer learning tend to be the opposite of those on retention, with the results favoring exploration training over instruction (Guthrie 1967, Hirsch 1977, Haukoos and Penick 1983, Lane et al. 1983). The instruction-based training literature supports this method for learning general facts, but is old and pre-dates the use of PCs. It is clear that there is no strong expectation that instruction-based methods will be particularly effective in the area of PC training. Therefore, no hypotheses associated with instruction-based training were investigated.

The Lewin Experimental Learning Model (Lewin 1951) views the learning process as a continuous loop (see Figure 3). Two aspects of this learning model are particularly noteworthy. The first is the emphasis on the
here-and-now concrete experience to validate and test abstract concepts. The focal point for learning is immediate personal experience, which contributes real-life meanings and texture to abstract concepts while at the same time providing concrete, publicly shared reference points for testing the implications and ideas created during the learning process. The second emphasis, action research and laboratory training, is based on feedback processes. This information feedback provides the basis for the continuous process of goal-directed action and evaluation of consequences of that action. It is that feedback loop which Lewin believed could eliminate ineffectiveness in the organization. The inclusion of the Behavior Modeling treatment is a direct result of this belief.

Behavior Modeling is a training process developed in the 1970s for building an individual's skills. The behavior modeling method is a combination of the exploration and instruction methods which concentrates on the idea of observing and doing while following a role model. Trainees then imitate and extend the role model's behavior in practice and experimentation. The technique emphasizes learning points in the instruction mode and modeling, practice, and feedback and experimentation in the exploration or hands-on mode. This approach differs from inaction training (Meichenbaum 1971), where trainees engage in increasingly difficult tasks with guidance from a trainer, in that modeling trainees are encouraged to experiment (complete the task in a manner other than the one prescribed by the trainer) as opposed to master a procedure. Behavior modeling teaches flexibility, not rigidity. The objective is to teach new ways of behaving and to broaden an individual's repertoire, not to program or control it (Sorcher and Spence 1982). This approach is anchored in Lewin's (1951) equation \( B = f(P, E) \) (behavior is a function of the person and the environment) and Bandura's (1969) principles of social-learning theory. The learning environment is viewed as so important that this method places extreme emphasis on creating environmental conditions believed to maximize the learning potential. Therefore, the classroom atmosphere and mix of instructional components are designed to minimize learning barriers (negative reinforcement, fear of failure, boredom, anxiety) and to create positive affect among individuals (Bretz and Thompsett 1992). Kolb (1984) extends Lewin's model. Kolb's central idea is that learning, and therefore knowing, requires both a grasp or figurative representation of experience and some transformation of that representation. Neither the figurative grasp or operative transformation alone is sufficient. Kolb suggests that there are indeed different learning styles for different individuals, which are noted by the model's horizontal axis. Behavior modeling combines the figurative representation during the trainer's presentation and the transformation of those abstract concepts into concrete knowledge during the trainer-led hands-on session and extends that concrete knowledge by allowing the trainees the freedom to experiment with the computer, hence its placement in the center of the Extended Kolb Model. These elements, when combined, give the technique greater results than if the elements were utilized independently. McGehee and Thayer (1961) suggest that a technique such as behavior modeling directly addresses the transition from "learning to doing" which best enhances the transfer of learning.

H1. There will be no difference in performance between the behavior modeling group and all other groups in near-transfer tasks.

H2. There will be no difference in performance between the behavior modeling group and all other groups in far-transfer tasks.

H3. There will be no difference in performance between the behavior modeling group and all other groups on all sections of the comprehension test.

End-user Computing Satisfaction

User information satisfaction (UIS) is defined as the extent to which users believe the information system available to them meets their information requirements. Both use and UIS provide meaningful "surrogates" for the critical but evasive measure of effectiveness of an information system (Ives et al. 1983). In the context of this study, users who are more proficient with the system are more likely to be satisfied with the system attributes. Since system use was mandatory in this instance the end user satisfaction instrument has been utilized. The trainees who received "hands-on" training on computer systems should have more complete and correct mental models, which suggest that users more...
completely understand both the concepts and functions of the computer system (Olffman and Mandviwalla 1994, Santhanam and Sein 1994). This experience narrows the gap between how one thinks of a command and how it is specified to the computer system. The enhanced understanding and ability to manipulate the system should lead to users who will be more inclined to use the system and perceive the system in more favorable terms.

H4. There will be no difference in end-user satisfaction between the exploratory-based training group and the instruction-based training group.

H5. There will be no difference in end-user satisfaction between the behavior modeling group and all other training groups.

5. Research Design

Overview

A field experiment methodology was selected to test the hypotheses for two reasons. First, it permits the researcher a higher degree of external validity than the laboratory experiment. Second, the field experiment allows the researcher to systematically manipulate the variables under investigation. In doing so, the possibility of determining the effects of specific changes in any single independent variable, as well as the effects of a combination of independent variables, is created. This is particularly important for this study in that training methods, information type, and trainee characteristics may combine to affect learning outcomes. The setting for the field experiment was a United States Naval Construction Battalion. The experiment was prompted by the advent of Micro-SNAP, an automated system designed to improved logistics operations while reducing costs and time cycles associated with acquiring parts and material. Micro-SNAP is a screen driven, DOS-based, application package designed to facilitate the ordering, tracking, and issuing of material (an explanation of the Micro-SNAP system is found in Appendix A). This system introduced immense changes in daily operating procedures for Naval Construction units. Unfortunately for the Navy, the majority of sailors are functionally computer-illiterate. The Navy, therefore, realized the need to develop a program to determine the optimum means to train their potential users. A field experiment was conducted to determine the optimum training method to insure both retention and transfer of knowledge.

Procedures

The experiment's procedure utilized in this study is outlined in Table 1 and described below.

Recruitment

Subjects were randomly selected from an active duty Naval Construction Battalion. The members selected received no additional pay or monetary benefits for their participation in the experiment. As part of the pre-screening selection procedure, they were asked to complete a background questionnaire. Members with prior computing background were dropped from the selection process. The members (referred henceforth as trainees) selected for participation in the study were then randomly assigned to one of the three treatment groups or the control group. Times were randomly selected for the training treatments and all trainees were excused from their normal duties during their training session. A total of 200 trainees were randomly selected from the battalion. Training treatment groups consisted of 50 trainees per treatment. Two sessions were conducted per treatment, 25 trainees per session, to maintain a manageable number of trainees per trainer. Descriptive trainee information is found in Appendix B.

Table 1  Experimental Procedure Outline

| Phase 1 Recruitment | a) Trainees are randomly selected  
|                     | b) Trainees complete background questionnaire  
|                     | c) Random assignment made to training treatment groups  
| Phase 2 Pretraining Activities | a) Trainees fill out Wonderlic aptitude instrument  
|                           | b) Unique identification number assigned  
| Phase 3 Training | Training sessions conducted  
| Phase 4 Post-training Evaluation | Trainees complete near-transfer, far-transfer, and comprehension testing  
| Phase 5 Follow-up Evaluation | a) Trainees complete near-transfer, far-transfer, and comprehension testing  
|                           | b) Trainees complete end-user satisfaction instrument  

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Pretraining Activities
At the beginning of the training session, the researcher/trainer provided trainees with an overview of the experiment. They were told that the purpose of the study was to determine the best training methods and understand how people learn about computers so that their jobs could be made easier. At this point, trainees filled out the Wonderlic Cognitive Ability instrument. The trainees were then assigned a unique number. This number signified which training group they were assigned to and identified the trainee throughout the experiment. The trainees were given a card with this unique number to keep with their identification papers.

Training
Uniform content of information was provided to all trainees regardless of training treatment with the exception of the control group, which received no training. All training was conducted using a single trainer, providing continuity throughout all training sessions. The instruction treatment was conducted in the traditional classroom mode, utilizing the deductive approach to learning. Specific features of the system and its commands were emphasized rather than overall goals. Trainees were provided with programmed notes and writing material and were free to take notes if desired. Visual materials, in the form of a computer-driven slide presentation, were used to support the trainer. Trainees were encouraged to ask questions at any time during the presentation. All information, both general and procedural, provided to the trainees during this treatment was in the lecture format.

The exploration treatment was conducted in a computer classroom. Trainees were seated in front of PC workstations and were issued a manual at the beginning of the session. From that point on they were instructed to work independently as if they were completing a self-study course and were advised that the trainer was there to help them only if they reached an impasse or failed to understand the material. In this case, the trainer referred them to the part of the manual that contained the information they required. The manual was based on an inductive approach to emphasizing overall tasks rather than specific features. Trainees were instructed to work at their own pace, providing some degree of learner control. In addition to the manual, each trainee was provided with a floppy disk to use while working through the exercises. The disk contained the directories and files required to perform each example. The manual showed the trainees how to properly use the disk.

The behavior modeling treatment was conducted in the same computer classroom as the exploratory training sessions. The general concepts section of the session was conducted utilizing the lecture approach, as was the instruction treatment, but concentrating on learning points. Trainees were provided with the same programmed notes and writing instruments as the lecture group and were encouraged to participate during the presentation if desired. The same visual aids were utilized in this session as those used during the instruction training. For the procedural information section, the trainees were directed first to observe the trainer, who performed the procedures on a computer with the image projected to the screen, then to attempt the same task independently. Trainees were provided a disk with the necessary files and directories—the same information provided trainees in the exploratory session. Upon successful completion of the task, the trainees were instructed to experiment, attempting to complete the task in a manner other than the one prescribed by the trainer. Trainees were also encouraged to demonstrate any new technique to the group utilizing the trainer's computer and overhead.

The control group received no training. Members of this group completed the WPT and were assigned a number, the purpose of the experiment was explained, they were given two hours to familiarize themselves with the computers using the standard computer manuals available in the computer lab but received no training. They were then given the post-training evaluation. This group formed a "baseline." Other than training, this group experienced the same set of influences as the experimental subjects. The failure to include a control group in training experiments has been cited as a shortcoming by the training literature (Goldstein 1991, Wexley and Latham 1991).

Post-training Evaluation
Treatment groups were administered the post training evaluation upon completion of the training treatment. Each trainee was given a packet which contained (1) the

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comprehension exam, (2) the hands-on exam, and (3) a disk required for the hands-on exam. Before the testing began each trainee completed a training evaluation form. This form served as a manipulation check and reaction measure to insure that the groups recognized the difference between training treatments and the role of the trainer and to confirm their feelings toward the training (see Appendix C). The results of the manipulation check correspond to the concept of trainee’s reaction in the psychology and training literature (Kirkpatrick 1967, Baldwin and Ford 1988). Once testing began, trainees first completed the comprehension test and then proceeded to the hands-on exam. The hands-on exam contained both near-transfer and far-transfer tasks to be performed. On the provided disk were the necessary files and subdirectories to perform the required tasks. All exam materials, including disks, were labeled with the trainee’s unique identification number. Upon conclusion of the testing, the trainees were thanked for their participation and informed that they would be retested in the near future.

**Follow-up Evaluation**

Approximately four weeks after the training, follow-up testing was conducted. Treatment groups were reassembled and retested following the exact methodology and materials used in post training testing. In addition to the follow-up evaluation, trainees were queried as to the amount of time spent interacting with the computer on a weekly basis. It was expected that those trainees who spent more time using the system would have superior follow-up scores and greater retention of information. Additionally, trainees were queried to provide the numbers of hours of system use and end user computing satisfaction instrument was administered. All material was controlled using the unique identification number assigned to the trainees during the initial session. At the conclusion of the satisfaction instrument, the trainees were thanked for their participation and informed that the study was finished, and told that a list of the participants will be sent to the commanding officer for recognition.

**Experimental Controls**

**Training Material.** Training materials were carefully monitored during the preparation and delivery of the training treatment sessions to insure the uniform content of information across training treatments. Each training treatment session was created using a standard outline (see Table 2), and all training sessions were conducted using a single trainer. Although each treatment utilized a different presentation/training method, the information in both procedural and general concepts sections was created with great care so that trainees were exposed to exactly the same material. The general concepts section provides the trainees with important background information on the ideas of computing. This information is as important to the understanding of the computer system as is the procedural information required to operate the machine.

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<td>F. How It All Works Together</td>
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<tr>
<td>6. checkdisk</td>
<td></td>
</tr>
<tr>
<td>B. Micro-SNAP II Procedures</td>
<td></td>
</tr>
<tr>
<td>1. entering requisitions</td>
<td></td>
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<tr>
<td>2. processing requisitions</td>
<td></td>
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<tr>
<td>3. verifying requisitions</td>
<td></td>
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<tr>
<td>4. tracking material</td>
<td></td>
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<tr>
<td>5. material order status</td>
<td></td>
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<tr>
<td>6. material accounting</td>
<td></td>
</tr>
</tbody>
</table>
Prior Computer Experience. All trainees were classified as "beginning" computer users. The term "beginning" is defined as a person with minimal experience with computing. Novice users or users with absolutely no computer experience are difficult to find in the military because almost all members have some computing exposure. The trainees were assessed through the use of a background questionnaire (see Appendix D), which was sent to their battalion before selection of trainees. The questionnaire asked for demographic information including age, rate, rank, years of formal education, as well as questions on various aspects of individual computing knowledge. A score of greater than 30% correct answers caused the member to be rejected for participation. Only individuals who indicated that they had very limited knowledge of operating system commands were selected to participate.

Motivation. Controlling for motivation insured that all trainees had the same incentive to perform. Since the trainees are members of a military organization, their participation was not voluntary. Each trainee did have incentives to participate and to perform to standards. First, the members were required to obtain knowledge about computing and specifically the Mirco-SNAP system to perform well on their upcoming advancement exams. Second, a recent survey of sailors determined that basic computing skills are widely desired (Reserve Naval Construction Force Flex Drill Survey, 1992). Finally, a report of trainee participation was to be forwarded to their commanding officer listing sailors who performed at or above expected standards. Motivation was not statistically controlled in the experiment but given the factors cited above, the authors believed that motivation would be high for all trainees.

Training Session Length. Since the trainees utilized in this study are novice computer users, the length of exposure to the computer or varying training times might affect their performance. This was a criticism of the Wexley and Baldwin (1986) study. Therefore, this study has a fixed time period of all treatments of two hours. The two-hour figure was derived as the longest period for completion of a training treatment during the pilot testing. While two hours may seem short for a training session, given the well-defined domain of the tasks, the two-hour session was deemed appropriate.

6. Dependent Variables

Manipulation Check Instruments
Two manipulation check instruments were employed during post-training evaluations. The first of these instruments queried the trainees using eight questions to determine if the trainees perceived the differences in training treatments and was adapted from Werner et al. (1994). The second instrument sought to ascertain the trainees' reaction to the training by summing their responses to six questions. Only groups that received training completed these instruments, with the control group excluded. The sample size of this analysis equals 150. The Cronbach alpha for this instrument was computed as $r = .92$.

Training Effectiveness/Outcomes
A major goal of computer training is to instill a certain level of competency in new users. The typical method of measuring competency is through learning performance. The instruments utilized to evaluate training effectiveness in this study were developed directly from previous studies which measured learning performance along a number of dimensions. Borgman (1986) recorded the number of responses for an on-line retrieval system for both near-transfer and far-transfer tasks. Trainees were also evaluated on their comprehension of the system. Sein (1987) evaluated performance by recording the number of correct responses on near and far-transfer tasks and comprehension. This study utilizes a combination of hands-on learning evaluation and comprehension questions to determine training outcomes and the Doll and Torkzadeh (1988) instrument to measure end user satisfaction.

Computer Tasks (Hands-on Evaluation)
The most common method of measuring learning performance is through the use of hands-on tasks to assess a trainee's ability to apply system concepts. This technique is widely used throughout the computer training and education literature (Michard 1982, Carroll and Mack 1985, Raban 1988). An important question for task design was how many near-transfer and far-transfer
questions to include. The final design includes two far-transfer tasks. This number of far-transfer tasks is similar to what was used by Sein (1987) in his study of E-Mail systems and Santhanam and Sein (1994) in their study of improving end-user proficiency.

Near-transfer Tasks. One method of assessing task performance is simply to provide trainees with tasks that are similar to those covered during training. This method yields a general understanding of the trainees’ level of competency. In this study, the near-transfer (simple) tasks are similar to the tasks covered in the training sessions. These tasks could be considered as common, basic tasks that would be performed while working with a computer. Examples of near-transfer tasks include making directories, changing directories, copying and deleting files, and performing specific routines.

Far-transfer Tasks. Far-transfer tasks combine two or more near-transfer tasks. They typically require trainees to apply problem-solving skills in order to arrive at a solution. The tasks are structured so that instead of providing step-by-step instructions, they present only the desired end result. It is left to the trainees to determine which combination of near-transfer tasks are required to complete the task. For instance, the trainee is told only the final arrangement of files desired. To create the desired arrangement the trainee is required to (1) create the directory, (2) find the required files on the disk, and (3) copy a series of files into the directory. The trainee will have to decide what sequence to perform the functions in, and finally list the file structure to determine the accuracy of his/her work.

Comprehension Test. Campbell and Stanley (1966) recommend the use of multiple measures of dependent variables in studies of training methods. This prompted the use of a second test to measure trainee’s overall comprehension of computer systems. Unlike the hands-on tests, the comprehension test is strictly a paper-and-pencil measure intended to measure what Kirkpatrick (1967) terms learning. This test is designed in two parts to contrast information types: (1) to measure the trainee’s ability to grasp the general concepts section of the presentations and (2) to measure the trainee’s grasp of the procedural information presented.

The first section of the comprehension test presents to the trainee a series of frames depicting typical inputs to the system and corresponding outputs. Questions that followed the frames query the trainee as to what took place at a certain point and what would happen as the last command is performed. Since the final output is a function of all the commands that had occurred before it, trainees need to understand what the commands did in order to answer the question correctly. The second section of the comprehension test is composed of seven questions adapted from the Winter et al. (1992) Computer Literacy Instrument. These questions reflect the material covered in the general concepts section of the training sessions. The questions are structured as multiple choice with the trainee selecting the most appropriate response. The reliability computed using Cronbach’s alpha for the comprehension instrument equaled 0.83.

End-user Satisfaction
User satisfaction measures focus on a broad range of computer functions (Zoltn and Chapanis 1982). End-user satisfaction has been utilized in the IS literature as a surrogate for system success, especially in situations where use is mandatory. Baroudi and Orlikowski (1988) suggest that end user satisfaction can be evaluated in terms of knowledge or the user’s understanding of the system and its applications. The more effective the training, the more a trainee would be expected to be satisfied with the system. The Doll and Torkzadeh instrument, utilized in this study, is constructed employing twelve questions that utilize a five point Likert-type scale. Cronbach’s alpha reliability for this instrument was $r = 0.98$. A copy of the instrument is found in Appendix E.

7. Experiment Covariates
Learner Characteristics
The study examines the relationship of learner aptitude to training and information treatments, as measured by the Wonderlic Personnel Test (WPT), which has been

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1 The Wonderlic instrument tests cognitive ability, which establishes the subject’s aptitude, through questions that target specific areas including: (1) ability to understand instructions, (2) potential for
widely used (2.5 million testings annually) in industry since 1937. Utilized by organizations large and small, as well as the federal government, the instrument does not simply measure what someone has learned. Rather, cognitive ability measures a person's aptitude for learning as well as that person's capacity to draw from what he or she has learned and apply it to new situations. Ree and Earles (1991) reported that general cognitive ability was the best predictor of training success. Hunter (1989) found that ability testing using the Wonderlic instrument to be an effective predictor of training and hiring success in 80% of cases studied. More common techniques—experience, education, and interviews—predicted success at a rate of just over 50%.

Computer Use
System use, the experiment's second covariate, can be a surrogate indicator of system success (Ives et al. 1983). This study considered system use as a moderating variable for the period between the post-training and follow-up evaluations. Despite the fact that system use was required for the trainees to complete their duties, it was recognized that some trainees might have the opportunity or be more inclined to use the system more than others. If there was a large degree of variance among individual users or treatment groups the results would be unduly influenced.

8. Data/Statistical Analysis
Since the four dependent variables were correlated, a multivariate analysis of covariance (MANCOVA) was initially conducted. Univariate analyses for each of the four dependent variables were conducted only after the results of the multivariate analysis revealed that there were significant differences attributable to the three training methods. A measure of each subject's cognitive ability was used as a concomitant variable (covariate) since cognitive ability was expected to account for a significant amount of variation in each of the evaluation measures. A second covariate—system use—was added to the model for the analysis of the follow-up evaluation data to make the analysis more precise. To check that the assumptions for the ANCOVA model were met, tests for normality, independence, and constant variance of the error terms were conducted, as well as tests to determine that the covariates did not interact with the treatments (training methods).

The analysis for the effects of training methods on training evaluation was conducted using the regression approach. F-tests were based on the appropriate full and reduced regression models. All tests were conducted at the $\alpha = 0.01$ level of significance. In cases where the F-test indicated statistical significance, Scheffe's multiple comparison was used to conduct hypothesis tests that examined the exact nature of the difference.

9. Discussion
Results of Manipulation Checks
Table 3 shows that there are clearly significant differences in the responses between the groups as to their perceptions of the training treatments. Analysis of specific responses indicate that the treatment groups perceived the training as was anticipated. For instance, the responses on questions one, two, and seven clearly indicate that the behavior modeling trainees strongly agreed with these statements when compared to the responses of their counterparts in the other treatment groups. The three questions were representative of the style of the behavior modeling treatment. The responses for questions three and five, which represent the instruction treatment style, are significantly higher for the trainees in that treatment. Similar results are seen for the exploration treatment trainees who scored significantly higher on questions four, six, and eight, the questions which represented the exploration treatment's style.

The reaction measure fails to show any significant differences between the groups. Scores ranged from 23.28 to 25.08 out of a possible 30 (see Table 4). It can be assumed that the trainees did indeed have a positive reaction to the training and that reaction did not vary across training treatment.

Results of Training Treatment Evaluation
MANCOVA testing revealed that only main treatment effects were present in both post-training and follow-up
evaluations. The results of the MANCOVA are shown in Table 5. Analysis of ANCOVA and confidence intervals, testing specific hypotheses, indicated that a non-traditional approach such as behavior modeling best addresses the transition from “learning to doing” which enhances the transfer of learning in the real world environment as suggested by the classroom oriented literature (McGehee and Thayer 1961, Parry and Reich 1984). The results of Scheffé’s procedure testing specific hypotheses follow.

**Near-transfer.** The results of Scheffé’s procedure for Hypothesis 1 indicated that there is a significant difference for near-transfer tasks scores between the behavioral modeling group and all other groups (p-value ≈ 0). Thus, Hypothesis 1 is not supported.

**Far-transfer.** The results for Hypothesis 2 showed that the scores on far-transfer tasks were significantly higher (better) for subjects in the behavior modeling group compared to those for subjects in the other three training groups (p-value ≈ 0). Thus, Hypothesis 2 is refuted.

Comprehension. The questions comprising the comprehension test relate to procedural and general knowledge. The results of this analysis indicated significant differences in overall comprehension among the training methods. Scheffé’s procedure also led to the rejection of Hypothesis 3 (p-value ≈ 0), indicating that the behavior modeling group performed better than all other groups with respect to overall comprehension.

Outcomes of both post-training and follow-up evaluations found that the behavior modeling trainees significantly outperformed their counterparts in all evaluation measures (see Tables 6 and 7). Results indicate that both exploration and behavior modeling experienced a slight decrease in scores between the post-training and follow-up periods. Despite this decrease, the evaluations of both treatment groups were significantly higher than instruction or control, with behavior modeling trainees significantly outperforming their exploration counterparts. Latham and Saari (1979) found that behavior modeling trainees enjoyed superior performance ratings a year after training when compared to other training groups. Synergy is the cooperative action of the discrete training methodologies (instruction utilizing learning points and experimentation and feedback with guided exercises provided by the role model trainer), such that the total effect is greater than the sum of the effects taken independently. The synergistic condition of the behavior modeling treatment created a situation which allowed trainees to excel in evaluation tasks, and as a result, perceive greater satisfaction with the system. The superior results of behavior modeling,
in this experiment, can also be attributed to the continuous and instantaneous trainer provided feedback throughout both abstract presentation and hands-on experimentation.

The hierarchy of evaluation scores indicates that at a minimum computer training programs should include hands-on exercises under all circumstances. Although behavior modeling is the preferred method, the treatments that included hands-on training scored much better than treatments without hands-on training. The exploration trainees performed significantly better than their instruction counterparts in three of the four evaluations (differences in general comprehension were not significant). These findings agree with Johnson et al. (1982), that exploration training was superior to instruction based training in terms of trainee written and performance tests and dispute the claims of some education-based researchers that suggest the instruction-based approach is a more effective technique (Ausubel 1963, Friedlander 1965, Glaser 1966). The superiority of the exploration trainees also confirms the results of Davis and Bostrom’s (1993) experiment of computing interfaces. Exploration trainees in the command interface treatment—most similar to this experiment—scored better than their instruction counterparts in far-transfer tasks and perceived ease of use of the system.

The control group’s performance indicates that the tasks were structured so that without the training provided to the treatment groups it would have been impossible for a novice computer user to perform these tasks successfully. The conclusion can be drawn that the control group members were at a distinct disadvantage with regard to utilizing the system when compared to the trainees who received the various training treatments.

Table 7 recaps the results by training treatment groups for each evaluation task and end-user computing satisfaction (the group found superior is posted in each cell):

**End-user Computing Satisfaction**

This study found that the trainees receiving hands-on training were generally more satisfied with the system.

### Table 5

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
<th></th>
<th>F-Value</th>
<th></th>
<th>P-Value</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Post-test</td>
<td>Follow-up</td>
<td>Post-test</td>
<td>Follow-up</td>
<td>Post-test</td>
<td>Follow-up</td>
</tr>
<tr>
<td>Wilks’ Lambda</td>
<td>0.0336</td>
<td>0.0243</td>
<td>87.372</td>
<td>23.676</td>
<td>0.0001</td>
<td>0.0001</td>
</tr>
<tr>
<td>Pillai’s Trace</td>
<td>1.4423</td>
<td>0.9577</td>
<td>35.649</td>
<td>18.054</td>
<td>0.0001</td>
<td>0.0001</td>
</tr>
<tr>
<td>Hotelling-Lawley Trace</td>
<td>15.9544</td>
<td>2.2999</td>
<td>200.320</td>
<td>28.877</td>
<td>0.0001</td>
<td>0.0001</td>
</tr>
<tr>
<td>Roy’s Greatest Root</td>
<td>15.2085</td>
<td>1.8847</td>
<td>585.530</td>
<td>72.559</td>
<td>0.0001</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

### Table 6

<table>
<thead>
<tr>
<th></th>
<th>Near-transfer Tasks</th>
<th>Far-transfer Tasks</th>
<th>Procedural Comprehension Tasks</th>
<th>General Comprehension Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Post-training</td>
<td>Follow-up</td>
<td>Post-training</td>
<td>Follow-up</td>
</tr>
<tr>
<td>Control</td>
<td>0.00</td>
<td>2.75</td>
<td>0.00</td>
<td>0.63</td>
</tr>
<tr>
<td>Instruction</td>
<td>3.92</td>
<td>5.88</td>
<td>0.63</td>
<td>1.38</td>
</tr>
<tr>
<td>Exploration</td>
<td>20.96</td>
<td>17.54</td>
<td>3.58</td>
<td>2.58</td>
</tr>
<tr>
<td>Behavior Modeling</td>
<td>23.71</td>
<td>22.79</td>
<td>5.50</td>
<td>5.54</td>
</tr>
</tbody>
</table>

(Maximum scores: near-transfer = 24, far-transfer = 6, procedural comprehension = 70, general comprehension = 55)
that the behavior modeling group did better than all other groups (p-value = 0). Thus, both Hypothesis 4 and Hypothesis 5 are rejected. Additionally, random interviews with trainees at the completion of the program indicated that behavior modeling training were encouraged to experiment with the system. Behavior modeling trainees indicated that they felt confident after having experimented with the computer during the training session.

Overall, the behavior modeling trainees achieved significantly higher satisfaction scores trainees in any other treatment group. It is assumed that their superior understanding of the system allowed them to manipulate the system with greater ease and accuracy resulting in their higher satisfaction with the system and its output. Gist et al. (1989), in a study of self-efficacy and mastery of a computer software program, found that participants in the behavior modeling treatment reported more effective cognitive working styles, more ease and less frustration with the task, and higher satisfaction than trainees in other treatment groups; while Compeau and Higgins (1995) reported similar results for self-efficacy and outcomes. The results of this experiment extend their findings to multiple outcome measures while directly comparing a wider range of training treatments.

**Discussion of Cognitive Ability**

Cognitive ability, the experiment's first covariate, did not have the expected predictive power suggested by the literature, nor did the covariate greatly affect trainee performance. The mean of our trainees was 18.20, with a standard deviation of 5.15. This is similar to the national mean score for male high school graduates aged 16–30 (Mean = 18.0; Standard Deviation = 6.39). See Table 10 for scores by treatment. During the post-training evaluations cognitive ability was not found to be a significant predictor of evaluation scores ($F_{(3,196)} = 0.04, P = 0.9874$). This result is inconsistent with the literature which indicates that cognitive ability should be the best predictor of training success (Ree and Earles 1991). Apparently, the fact that many training studies were "classroom" oriented and utilized abstract concepts and materials might provide one explanation for this contradiction. This study, which concentrated on structured computer related tasks, demonstrated that hands-on experimentation of abstract concepts seems to compensate for the cognitive ability factor. Yet, an

<table>
<thead>
<tr>
<th>Table 7</th>
<th>Consolidated Training Treatment Performance</th>
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<tbody>
<tr>
<td></td>
<td>Instruction Versus Control</td>
</tr>
<tr>
<td>Near-transfer</td>
<td>Instruction**</td>
</tr>
<tr>
<td>Far-transfer</td>
<td>Instruction**</td>
</tr>
<tr>
<td>General Information Procedural Information End-user Computer Satisfaction</td>
<td>Instruction**</td>
</tr>
</tbody>
</table>

** Indicates significant at the 0.01 level.

(see Table 8). Scheffé's procedure revealed that the exploration group performed significantly better than the instruction group with respect to end user satisfaction (p-value = 0.012) and that the behavior modeling group did better than all other groups (p-value = 0). Thus, both Hypothesis 4 and Hypothesis 5 are rejected. Additionally, random interviews with trainees at the completion of the program indicate that behavior modeling training were encouraged to experiment with the system. Behavior modeling trainees indicated that they felt confident after having experimented with the computer during the training session.

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analysis of cognitive ability as a covariate with the follow-up evaluation scores indicated a slight, but not significant, interaction with far-transfer tasks and general comprehension tasks. At least in the context of computer training explored in this experiment, cognitive ability would seem to be a better predictor of general comprehension tasks which require more abstract thinking and less procedural knowledge.

Discussion of Computer Use
The analysis of the self-reported usage showed that there was no significant difference among the groups, suggesting that trainees used the system equally across training treatment groups (see Table 11). Further examination did reveal that there was interaction between system use and the follow-up evaluation score (Near-transfer $F_{(3,196)} = 10.61, \alpha = 0.001$; Far-transfer $F_{(3,196)} = 8.76, \alpha = 0.001$; Procedural comprehension $F_{(3,196)} = 8.56, \alpha = 0.001$; General comprehension $F_{(3,196)} = 2.99, \alpha = 0.05$). This interaction suggests that trainees utilizing the system to a greater extent trended towards higher evaluation scores. Intuitively, one would expect that trainees who utilized the system to a greater degree would be more proficient in the operation of the system.

Limitations
Trainees were members of the U.S. Navy whose participation in this study was not voluntary. The trainees were dispersed with regard to age, and all had a minimum high school education. Yet it could be argued that any homogeneous group of individuals brings certain biases to a learning or testing situation. All trainees were computer novices, which could have influenced their learning desire or performance as well as their attitude toward computers. These factors were not investigated during pre-screening. Most of the computer training studies have shown a clear advantage for exploration training. However, the subjects in those studies were mostly career professionals with several years of work experience, including problem solving experi-

### Table 9: Summary of Hypothesis Tests

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Condition</th>
<th>$p$-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: There will be no difference in performance between the behavior modeling group and all other groups in near-transfer tasks.</td>
<td>Reject</td>
<td>0.0000**</td>
</tr>
<tr>
<td>H2: There will be no difference in performance between the behavior modeling and all other groups in far-transfer tasks.</td>
<td>Reject</td>
<td>0.0000**</td>
</tr>
<tr>
<td>H3: There will be no difference in performance between the behavior modeling group and all other groups on all sections of the comprehension test.</td>
<td>Reject</td>
<td>0.0000**</td>
</tr>
<tr>
<td>H4: There will be no difference in end user satisfaction between the exploratory-based training group and the instruction-based training group.</td>
<td>Reject</td>
<td>0.0120*</td>
</tr>
<tr>
<td>H5: There will be no difference in end user satisfaction between the behavior modeling group and all other training groups.</td>
<td>Reject</td>
<td>0.0000**</td>
</tr>
</tbody>
</table>

* Indicates significant at the 0.05 level.  
** Indicates significant at the 0.01 level.

### Table 10: Cognitive Ability Scores by Treatment Group

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>18.38</td>
<td>4.48</td>
<td></td>
</tr>
<tr>
<td>Instruction</td>
<td>19.28</td>
<td>5.49</td>
<td>$F = 0.1144$</td>
</tr>
<tr>
<td>Exploration</td>
<td>16.08</td>
<td>5.61</td>
<td>$p = 0.9515$</td>
</tr>
<tr>
<td>Behavior Modeling</td>
<td>19.04</td>
<td>4.84</td>
<td>No significant difference</td>
</tr>
</tbody>
</table>

### Table 11: System Usage Means and Standard Deviation (Hours Per Week)

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>9.25</td>
<td>5.25</td>
<td></td>
</tr>
<tr>
<td>Instruction</td>
<td>9.63</td>
<td>6.16</td>
<td>$F = 0.145$</td>
</tr>
<tr>
<td>Exploration</td>
<td>9.33</td>
<td>5.20</td>
<td>$p = 0.703$</td>
</tr>
<tr>
<td>Behavior Modeling</td>
<td>9.65</td>
<td>5.67</td>
<td>No significant difference</td>
</tr>
</tbody>
</table>
ence, and those studies did not consider the behavior modeling technique.

The measure of system use was self-reported. It is possible that the trainees failed to correctly report their actual use or did not remember. No attempt was made to track the trainee’s use or to require them to maintain logs. The ability to accurately monitor computer time would have proved beneficial. This could have been accomplished in a network environment by assigning trainees unique ID numbers and would have also allowed the tracking of which specific software was utilized. Additionally, no control was taken to limit the access to information about computers and computing between the post-training and follow-up session. Trainees could have obtained material, in book form, that could have helped them improve their scores, especially general comprehension. Finally, the post follow-up interviews with trainees were randomly conducted and used to gather the trainee’s perceptions and attitudes toward the system (some interviews were initiated by individual trainees).

This study did not address the factors of attitude toward computers or computer related anxiety. A training program utilizing behavior modeling should provide a means through which to change a user’s attitude toward computers and help reduce anxiety. If this supposition is true, additional benefits to the use of the behavior modeling technique could be to change the attitudes of users and create a situation where the anxiety level of users is greatly reduced. This program could be accomplished quite easily using the procedures established during this study and substituting instruments needed for the specific investigation. One such instrument determines a user’s level of computer “playfulness,” which is used to indicate the user’s potential acceptance rate of new computer systems (Webster and Martocchio 1992).

Future researchers may wish to replicate the field experiment while varying the task variables. This study utilized tasks that were very narrow in scope and domain. Future research might manipulate task variables, e.g., task complexity, level of abstract decision making, the level of uncertainty, or even the number of instructors. Extensions of the field experiment could provide additional insights into the computer-related training area using techniques developed in this experiment and measures currently in use in the MIS discipline. Additionally, future research might replicate the experiment in other more “general” types of training inside or outside the computer realm.

Caution should be taken in generalizing the findings of this study to more “advanced” training that presents more abstract concepts and materials. This study used very structured tasks within a narrow domain. Tasks that are more abstract in nature, for instance requiring trainees to make decisions with the assistance of computer programs, might find differences in their results when compared to this study’s findings, especially in the area of cognitive ability. Additionally, computer related training presents some unique factors. This study demonstrated that in the computer realm, procedural or general knowledge alone is sometimes not sufficient, while the two together can provide the trainee with the opportunity to excel. This combination of information may not be necessary for other training situations.

This study was specifically designed to evaluate the performance of the trainees over two points in time: post-training and follow-up approximately four weeks after training. Since computer proficiency thrives with computer use, over time the issue of repeated evaluations is raised. Future studies might consider a controlled situation where users are monitored and evaluated at several point over many months. This would help answer several questions. First, do the trainees’ skills equalize over time based only on training difference, and second, to what extent does usage affect the performance results?

System use was investigated as a secondary covariate. The findings suggested that trainees who used the system scored higher on the follow-up evaluation. The results of the experiment suggest a connection between behavior modeling, use, and end user satisfaction. Studies such as Barki and Huff (1990) have linked use and user satisfaction to implementation success. The establishment of this connection in a controlled environment would strengthen the results of this study and further define parameters to develop training programs.

10. Implications and Conclusions

The study has shown that training technique is an important factor affecting an individual’s ability to
understand the computer system and its functions and to motivate its use (see Table 12). Training method may affect learning performance and affect an individual's performance on specific types of tasks, e.g. near-transfer versus far-transfer. Specific details on the process of computer learning have been highlighted and have created insight as to a more complete understanding of why some individuals learn and perform as they do. The study extends previous research which suggests that the behavior modeling training technique is superior in real-world applications as well as in classroom settings by conducting a field experiment with multiple training treatments and evaluation measures over time. The significance of computer use in improving retention and transfer of learning has been underscored. When designing future training programs, the inclusion of post-training hands-on exercises as part of a program including behavior modeling could contribute to even higher levels of acceptance of the computer system and increased end user satisfaction. The vastly superior performance of the behavior modeling trainees suggests that MIS managers in industry and professors in the classroom can enhance their method of delivering knowledge in highly structured computer related training.

Results of statistical tests provide strong evidence in support of the use of the behavior modeling technique for training novice computer users, especially in areas of general computer introduction and operating systems. The structured nature of the tasks in this experiment are highly representative of tasks found throughout industry which require specific procedures conducted in sequence to correctly accomplish an assignment. Tasks of this nature include routine maintenance of machinery and factory floor production routines. The results may be generalized to training tasks involving highly structured jobs. Computer-oriented training as opposed to computer-based training provides a unique situation. When learning about the computer and its functions, the study has shown that it is critical to understand the system, its operation, and organization rather than just memorize and perform a se-

<table>
<thead>
<tr>
<th>Table 12</th>
<th>Summary of Training Study Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Field Experiment Results</strong></td>
<td><strong>Major Training Study Findings</strong></td>
</tr>
<tr>
<td>2. Trainees in the behavior modeling training treatment were superior in terms of retention of material (ability to recall material introduced during training) and transfer of learning (ability to apply facts or concepts introduced during training).</td>
<td>Combinations of training methods used within a given course for conveying different instructional contents is more effective than use of a single method for an entire course (Hall and Freda 1982).</td>
</tr>
<tr>
<td>3. Behavior modeling trainees scored extensively better than all other trainees on every evaluation task, indicating that behavior modeling is a superior training technique in this context.</td>
<td>Behavior modeling directly addresses the transition from learning (recalling material introduced during training) to doing (applying that material) (McGehee and Thayer 1961).</td>
</tr>
<tr>
<td>4. Behavior modeling trainees had higher levels of end-user computing satisfaction than trainees in any other training treatment.</td>
<td>Behavior modeling trainees reported more ease with tasks and higher user satisfaction (Gist et al. 1989).</td>
</tr>
<tr>
<td>5. Exploration training took more time and effort on the part of the user but the trainees receiving exploration-based training, exploration and behavior modeling, exhibited superior results.</td>
<td>Exploration-based training may require more effort on the part of the user, and the results may be far in the future (Glaser 1966).</td>
</tr>
<tr>
<td>6. Cognitive ability proved to be only a marginal predictor of training success in follow-up, far-transfer, and general comprehension tasks and failed to predict success in all other circumstances.</td>
<td>Cognitive ability should be the best predictor of training success (Ree and Earles 1991).</td>
</tr>
<tr>
<td>7. Behavior modeling trainees were superior in retention of material, their scores remained constant between the post- and follow-up testing.</td>
<td>Behavior modeling results in superior long-term performance (Latham and Saari 1979).</td>
</tr>
</tbody>
</table>
ries of commands. This was evident in the difference in the near- and far-transfer evaluations. The performance advantages for the behavior modeling trainees in the evaluation tasks were substantial confirming the effectiveness of the behavior modeling technique. These findings were additionally supported through end-user computing satisfaction scores and in interviews with trainees. The findings of this study are consistent with the literature as to the effectiveness of the behavior modeling method, in particular the work of Gist et al. (1989) and Compeau and Higgins (1995). Yet this study extends their findings as well as Davis and Boström’s (1993) by comparing a wider range of training treatments with multiple evaluations measures over time and linking the MIS literature to the training and educational psychology disciplines. The results strongly indicate that behavior modeling be included in computer related training and education programs and have implications for highly structured tasks.

The main explanation for this result is the “style” of the behavior modeling presentation. Its ability to merge both a structured instruction program with the freedom to experiment while providing guided examples and continuous feedback created synergy that encouraged trainees to excel. Follow-up interviews discovered that trainees in this session became more excited about working with the system, and as a result they sought to use the system with fewer inhibitions than their counterparts. The exploration treatment contained the same material as did the behavior modeling treatment and also provided the trainees the opportunity to experiment with the system. The key difference was in the presentation, which encouraged trainees to become involved in both the learning of general concepts and, more importantly, provided them with direct feedback from the instructor and experimentation during the hands-on session. The superior performance behavior modeling trainees leads to the belief that the technique influences higher-order learning (as illustrated by far-transfer scores), greater retention, and higher transfer of learning.

The Kolb and Lewin learning models provide a solid platform for future research concerning training effectiveness. The study provided evidence of strong links between particular training inputs and specific, theory-based learning outcomes. The active/reflective and abstract/concrete continua provide a rationale for why different training techniques would be expected to have differential effects on various training outcome measures. We hypothesized and found that behavior modeling was best in this training context, and we argue that these results occurred because this method provided the greatest opportunity for comprehending both the abstract and the concrete elements needed to perform well on this computer task, regardless of cognitive ability.

Training has been considered a critical success factor in many MIS endeavors, yet the research in this area is limited. This study provides the MIS discipline with a wealth of literature from the training and education psychology areas. This literature base and the results of this experiment provide the groundwork to continue the investigation in this critical area of study. The results have shown that certain techniques and procedures are required to make computer related training more successful. George (1989) demonstrated that the availability of technology does not necessarily lead to use. In this study, a connection has been established between training method, system use, and end-user satisfaction, where certain training techniques, in particular behavior modeling, have encouraged trainees to increase their desire to utilize the computer system. It would seem that an understanding of simple computing procedures is not sufficient for the transfer of knowledge in computer-related training and that methods that convey general procedures, e.g., lecture, do not lead to higher levels of end user satisfaction. The suggested link between training method and end user satisfaction and system use create the opportunity for new understanding into the motivational factors behind both computer use and end-user satisfaction.

Appendix A

Micro-SNAP System

In keeping with the “one Navy concept,” the Naval Construction Force (NCF), also known as the Seabees, has been tasked with the implementation of Micro-SNAP II (Shipboard Nontactical Automated Processing) System. The one Navy concept seeks to, among other things, create a unified force structure where most units will perform to the same set of standards utilizing a standard set of guidelines and operating procedures. This concept has been the driving force in the movement toward standardized procurement and accounting systems. This concept also is the catalyst in the movement to integrate U.S. Navy Reserve forces with those of their active duty “gaining commands.” Micro-SNAP II is an
Appendix B

Descriptive Trainee Information by Treatment Group

<table>
<thead>
<tr>
<th>Rank</th>
<th>Control</th>
<th>Instruction</th>
<th>Exploration</th>
<th>Modeling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enlisted</td>
<td>50</td>
<td>49</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Officer</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>40</td>
<td>36</td>
<td>39</td>
<td>42</td>
</tr>
<tr>
<td>Associate</td>
<td>5</td>
<td>9</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>College</td>
<td>5</td>
<td>10</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Graduate</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 25</td>
<td>33</td>
<td>30</td>
<td>32</td>
<td>30</td>
</tr>
<tr>
<td>25–35</td>
<td>14</td>
<td>15</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>36–45</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>46–55</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

(ANOVA yielded no significant differences among the groups at the $\alpha = 0.05$ level).

Appendix C

Manipulation Check Instrument

Trainee number: _______

Please read each of the eight statements shown below, and circle the column which best describes your opinion concerning how the trainer conducted your particular training session.

1. The trainer concentrated on specific learning points during the training session. | Strongly Disagree | Strongly Agree |
2. The trainer provided the opportunity to practice the learning points during the training session. | 1 2 3 4 5 |
3. The training progressed from facts to a general conclusion. | 1 2 3 4 5 |
4. The training encouraged a trial and error approach to learning. | 1 2 3 4 5 |
5. The trainer acted as an instructor, leading through examples, answering questions, and solving problems. | 1 2 3 4 5 |
6. The training progressed from examples to a general conclusion. | 1 2 3 4 5 |
7. The trainer acted as a role model, demonstrating techniques for the trainees to follow. | 1 2 3 4 5 |
8. The trainer acted as an advisor, answering questions when necessary. | 1 2 3 4 5 |

Appendix D

Pretest Questionnaire

NAME ___________________ SSN ____________

The following number is a unique number assigned only to you for identification purposes during this study. Please keep the attached card with your number with your military ID until the final testing is complete. You will be asked to refer to the number later.

Your number ____________

The following are a set of computer terms. Please circle the appropriate number:

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

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Please answer the following questions.

8. Have you ever saved a computer program? (Yes/No)
9. Do you use the operating system commands to perform functions? (Yes/No)
10. Have you ever written a computer program? (Yes/No)
11. Have you ever modified a computer program? (Yes/No)

12. Please indicate your rank:
   a. E1–E3
   b. E4–E6
   c. E7–E9
   d. Officer

13. Please indicate your rate, if applicable:
   a. YN/PN
   b. MS/SK/SH
   c. BU/SW/EA
   d. CE/UT
   e. EO/CM
   f. Other

14. Please indicate your current level of education:
   a. high school
   b. associate degree (two year or technical)
   c. college degree
   d. some graduate work
   e. post graduate degree

15. Please indicate your age:
   a. under twenty five
   b. 25–35
   c. 36–45
   d. 46–55
   e. over 55

Appendix E
End-User Satisfaction Questions

Please circle the number that best represents your perception of the computer system:

<table>
<thead>
<tr>
<th>I know nothing about this</th>
<th>I know a lot about this</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Floppy disk</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2. Software</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>3. Directory</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>4. Modern</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>5. Bit</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>6. Mainframe</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>7. Baud Rate</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

3) The reports provided by the system meet my exact needs. 1 2 3 4 5
4) The information is presented in a timely manner. 1 2 3 4 5
5) The system is accurate. 1 2 3 4 5
6) The information content meets my needs. 1 2 3 4 5
7) The output is presented in a useful format. 1 2 3 4 5
8) The information is presented clearly. 1 2 3 4 5
9) The system provides sufficient information. 1 2 3 4 5
10) The system is easy to use. 1 2 3 4 5
11) I am satisfied with the accuracy of the system. 1 2 3 4 5
12) The system provides up-to-date information. 1 2 3 4 5

During the period between the training and the follow-up testing, did you seek assistance from a person more knowledgeable about computers than your area? Yes/No

If yes, how many times did you seek assistance? _______

How many hours per week did you spend using the computer system during the period between the training and the follow-up testing? _______ hours per week

Appendix F
Sample Trainer-Trainee Interaction from Instruction Treatment Session (Procedural Section)

Trainee: How would you delete the files in the root directory?

Trainer: You would use what is called a wildcard. For this function the wildcard is the star key which can be found over the "8" key. Use it using the shift and the "8" key at the same time.

Trainee: What are the keystrokes that you would use?

Trainer: (explaining while writing on the marker board: A>*.*) From the A prompt or within the subdirectory you wish to delete all the files from you would type the following command: (referring to the board; pointing as he says) A>*.*; this command will delete everything in this part of this disk. The "*" or wildcard eliminates the need to list the files individually. You can also use the wildcard to delete a group of files: (writing on the marker board)
A>*.txt; this command deletes all the files on the disk with the extension tx. Therefore the wildcard ignores all the names and deletes all the files with that extension.

Sample Trainer-Trainee Interaction from Exploration Treatment Session (Procedural Section)

Trainee: How would delete all the files on the disk?

Trainer: You need to refer to the procedural section of the manual for that information.
Sample Trainer-Trainee Interaction from the Behavior Modeling Treatment Session (Procedural Section)

Trainee: How would delete all the files on the disk?

Trainer: You would use what is called a wildcard. For this function the wildcard is the star key which can be found over the "8" key. Use it using the shift and the "8" key at the same time.

Trainee: What are the keystrokes that you would use?

Trainer: (entering the keystrokes on his keypad; the image is displayed on the overhead screen)
The following command deletes all the files in the root directory: A:*.*, then enter. Notice that the computer prompts you to respond if you really want to delete the files. If you respond "Y", (he enters a Y on the screen) the files are deleted. You can check the insures that the files were deleted by using the directory command. Now you try this on your keyboard.

What other combinations using the wildcard can you think of?

Trainee: (after several moments of silence and mumbling) I guess you could delete groups of files the same way.

Trainer: How do you think you would do that?

Trainee: Use the wildcard somehow. (laughing)

Trainer: Use this procedure. (entering on the keyboard as it is displayed on the overhead) The wildcard can be used different ways. For instance, let's delete all the files with the extension .txt. We would use the wildcard (typing *.txt) in place of the file name and the extension name after the period. This command would delete all the files with the extension .txt. We could also delete all the files with the name navy regardless of extension by entering (navy.*).

Try these combinations or any others while working with the disk in A drive.

References
Gist, M. E., C. Schwoerer, and B. Rosen, "Effects of Alternative Training Methods on Self-Efficacy and Performance in Com-


Reich, R., Transcript from “This Week With David Brinkley,” NBC, New York, January 11, 1995.


Rebecca Grant, Associate Editor. This paper was received April 1995, and has been with the authors 12 months for 2 revisions.