Chapter Two
Results of the Environmental Control System Tutor Experiment

2.0 INTRODUCTION

This study investigates the effect of presentation methods on computer-based training effectiveness. The experiment was conducted at the technical operations training center of a major airline in the Fall of 1992. Subjects used the Environmental Control System Tutor with both instructor-led and individual-use teaching methods. The experiment found no significant difference in overall performance between the two groups, although the instructor-led group did perform slightly better on the part identification section of the examination. Also, the experiment found no significant difference in the preference of the presentation method between the two groups. This report also covers shortcomings in the design of the experiment.

2.1 PURPOSES OF THE EXPERIMENT

The study had two motivations: verification of the effectiveness of the tutor and comparison of computer-based training (CBT) methods. First, we wanted to ensure that the use of the Environmental Control System (ECS) Tutor will improve the students' performance in diagnostic tasks. We have already conducted several informal usability studies that looked at the compatibility and understandability of the tutor as described in Pearce (1992), and felt it necessary to perform a formal effectiveness study of the tutor for final evaluation. By comparing the performance of technicians who have used the tutor with the performance of subjects who have been taught with traditional methods, we were able to get a better idea of the strengths and weaknesses of the ECS Tutor. In addition to testing, we also collected data on the opinions of the subject concerning the tutor, to see if there are problems with the design or implementation of the tutor.

Second, we wanted to compare the effectiveness of presentation methods for CBT systems. The two top-level classifications for presenting CBT systems are the instructor-led and individual-use methods. The instructor-led method is the traditional mode of teaching, in which the teacher controls the presentation of material. In the individual-use method, each student controls his or her own learning process. Several studies have compared the efficiency of these two methods for general instruction (Charney and Reder, 1986; Czaja et al., 1986), but no studies could be found that have compared these methods for teaching troubleshooting. The information obtained from these results will help to determine specific components of CBT systems that improve student performance. The data from this study will also be useful in the evaluation of the cost effectiveness of computer-based training systems.

2.2 ENVIRONMENTAL CONTROL SYSTEM OVERVIEW

The ECS, found in all modern airliners, controls the pressure and temperature of air in the airplane. The ECS of the airliner that the tutor simulates consists of three control and display panels in the cockpit, several electronics modules in the avionics bay, the distribution system, and the two cooling packs located in the fuselage. The ECS is a very complex system and consists of electrical, mechanical, and air flow subsystems that interact to provide the cool, pressurized air. It was chosen for the training domain of the tutor because the ECS is fairly common across airliner types, and therefore the training could be generalized across airliner types. Built-in test equipment (BITE) of modern airliners makes the job of the technician easier, since it tests some components with the push of a button. Not all components are tested by the BITE, so the technician must know when and how to use external test equipment to isolate malfunctions.

2.2.1 The Flightline Technician

The flightline technician must quickly diagnose and repair malfunctions on the aircraft on which they are certified to work. Technicians must know about the systems of several different types and models of aircraft. Their task is time constrained, since most flights have about 40 minutes on the ground between landing and takeoff. Also, some repairs take more than 40 minutes, and the technician must find these faults quickly to minimize delays in the flight schedules.

It is standard procedure for the flightline mechanic to use the Fault Isolation Manual (FIM), which is a logic tree used to diagnose malfunctions. The technician follows the branches of the FIM based on the outcomes of tests and inspections. The FIM specifies a "minimal path" of actions to repair a failure, from the high-level description of the malfunction to the malfunctioning component. In some cases, it is possible to diagnose malfunctions with a single test (for example, by looking for abnormal temperatures in the airflow path), so in practice the FIM is not always used.

2.2.2 Overview of ECS Tutor

The ECS Tutor is a computer-based training (CBT) system that trains aircraft technicians to diagnose and repair malfunctions of the ECS of the Boeing 767 (Figure 2.1). The tutor contains a deep simulation model of the ECS, which allows the user to see the consequences of his actions on the system down to the sensor level. The user can change switch settings to observe the values of various system parameters. The tutor is also highly graphical, allowing for direct manipulation of ECS components, and contains realistic pictures and animations of system components and schematics.

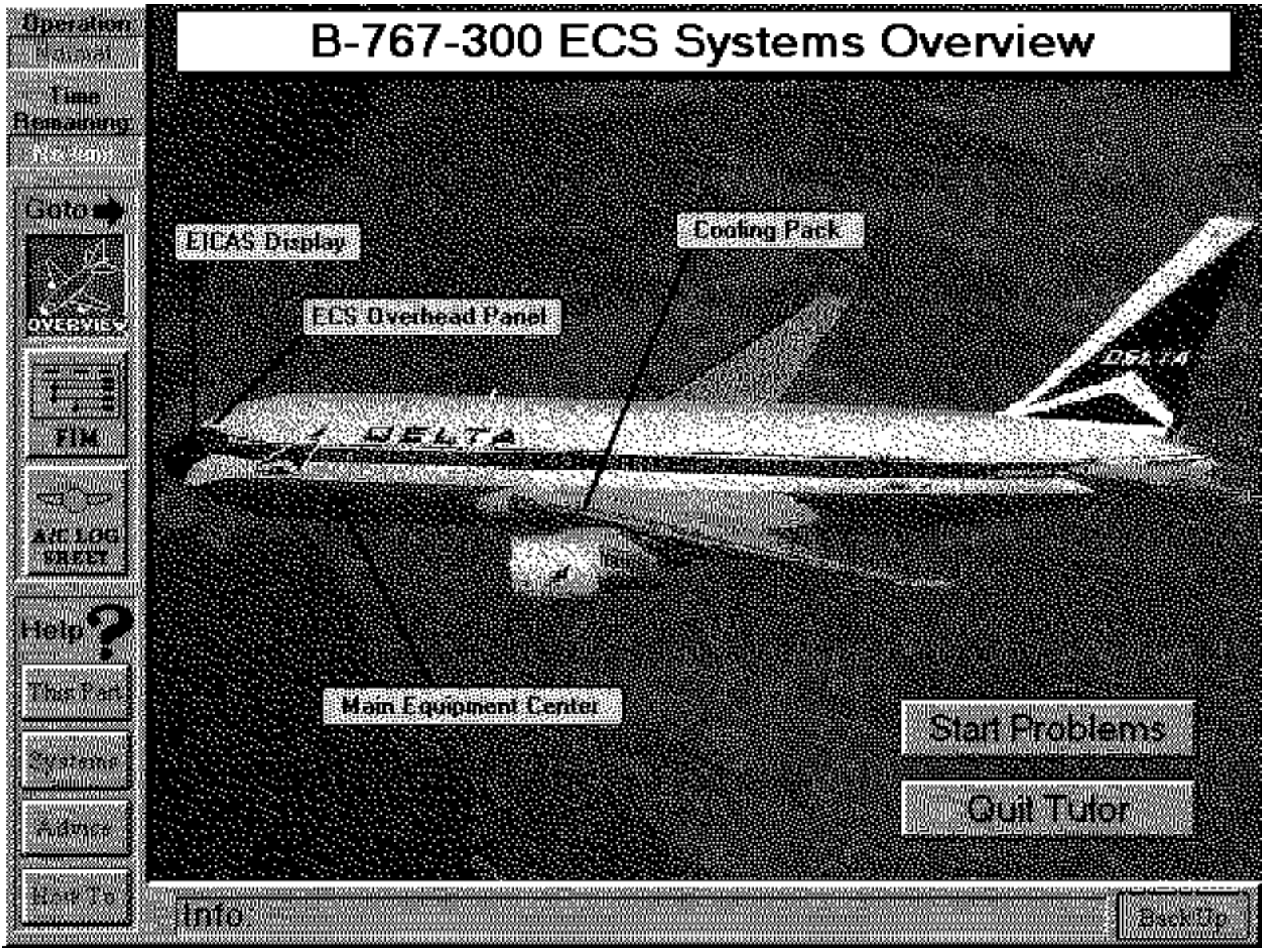

Figure 2.1 A Sample Screen from the ECS Tutor

The tutor allows four types of actions on the components of the ECS: operate, inspect, test, and replace. The first is to *operate* the ECS equipment. For example, the student can change switch settings of the cockpit control panels. The second action is to *inspect* a component; this action includes reading of display values on control equipment or looking for visible failures in pack components. The next action, *test*, differs from inspection in that the technician has to perform some type of action, usually operating some internal or external test equipment, rather than just observing a component.

One example of this activity is when the technician tests the pack controller by operating the BITE. The last action, *replace*, allows the user to swap out line replaceable units (LRU's) with working components.

2.3 METHOD

The experiment was designed to measure differences in performance between students taught to troubleshoot using a "traditional" instructor-led training method and an individual-use training method. Because the participating airline does not give a formal course that explicitly teaches troubleshooting skills, we had to design a short instructor-led CBT session based on traditional teaching methods. To standardize the information that was being presented in both groups, the instructor for the instructor-led group presented the same version of the tutor that was used by the subjects in the individual-use group. The only difference between the two groups was in the method of presentation; the individual-use group interacted directly with the tutor, while the instructor-led group had this information presented by an instructor. Thus any differences in performance could be attributed to the method of presentation, rather than any differences in content.

2.3.1 Subjects

The subjects participating in the experiment consisted of 10 ground training instructors and 10 flightline technicians. All of the subjects had some level of general knowledge of the operation of ECS, from either troubleshooting experience or courses on the ECS's of other aircraft. None of the subjects had worked on the Boeing 767 ECS. Instructor experience ranged from two to 19 years as instructors, while all of the flightline technicians had less than two years experience as aircraft technicians. Subjects were randomly assigned to one of the experimental groups, with half the instructors and half the technicians going to each experimental group.

2.3.2 Procedure

The experiment was divided into three phases: introductory lesson, tutor usage, and testing (shown in Figure 2.2). All of the subjects participated in an introductory lesson on the basic operating principles of the B-767 ECS. This course, developed by an instructor of the technical operations training department of the participating airline, covered the general operation of the B-767 ECS, modes of operation of the ECS, and the functions of the sensors, valves, and electronics that control ECS operation. All subjects went through this one-hour course before participating in the tutor usage portion of the experiments.

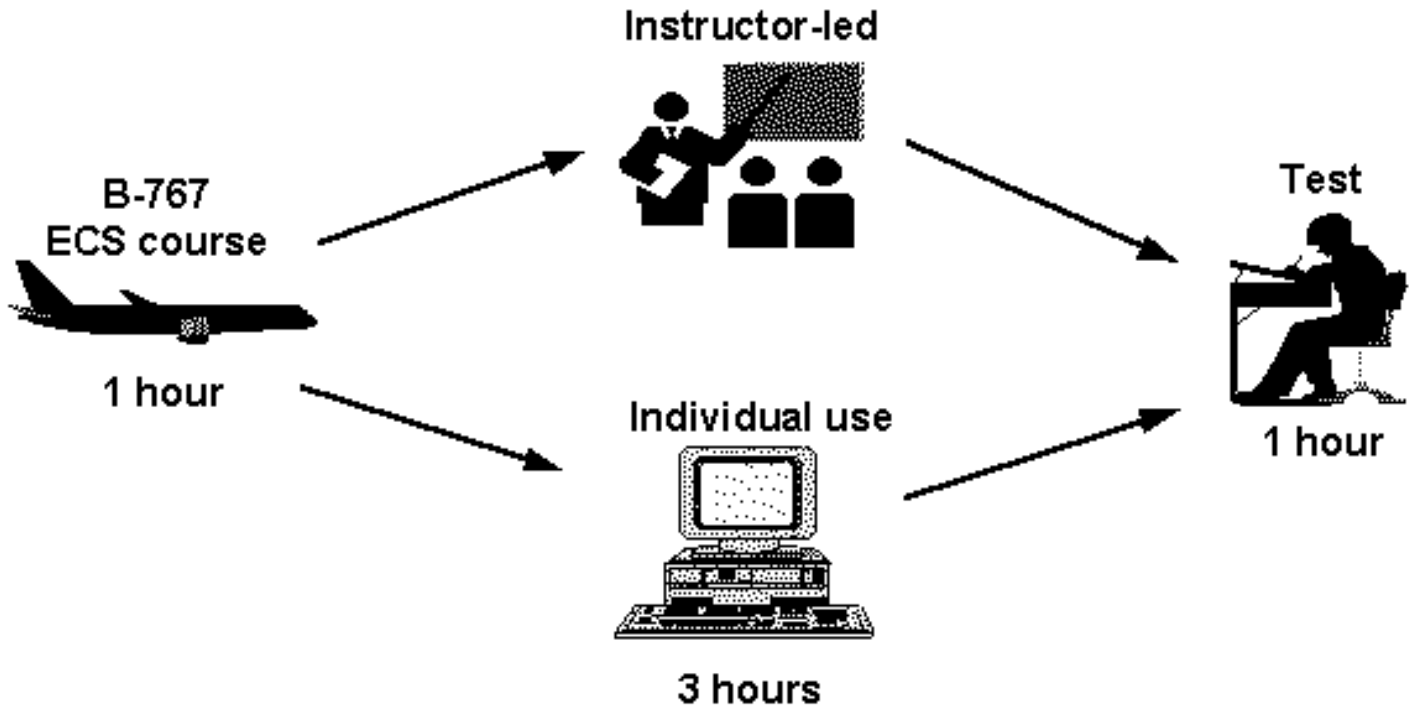

Figure 2.2 Design of the Experiment

After this one-hour course came the tutor usage phase, in which the students were split into the two groups ("instructor-led" and "individual-use") for the 2 1/2 hours troubleshooting training course. Each member of the individual-use group used the ECS Tutor individually to solve as many problems in the tutor as possible in the allotted time. The students used the tutor on the participating airline's training computers. The instructor-led group was given a stand-up lecture on ECS troubleshooting, with the instructor using the ECS Tutor as an instructional aid. This tutor usage phase was stopped for both groups when the instructor finished all ten problems in the tutor. Thus the time of instruction was the same for both groups, except for the three subjects in the individual-use group who finished early.

2.3.3 Data

After the instructor-led group had finished all 10 troubleshooting problems in the tutor, both groups were given a short examination that measured troubleshooting skills. This one-hour examination, developed by an instructor at the participating airline, was designed to measure a variety of skills. Most of the questions were multiple choice, with some fill-in-the-blank questions. Questions were divided into four sections, and data was collected on completion times for each of these sections (the questions are described in the "Results" section). During the examination the subjects could use a diagram of the ECS and the fault isolation manual to help them solve all the problems.

The exam also contained a poll with questions about the user's satisfaction level with the tutor. We also administered a background poll to determine the distribution of skill levels for computer use and ECS maintenance. After the subjects finished the examination and polls, they were asked to write about any impressions or observations concerning the tutor.

2.4 RESULTS

This section is divided into an *Examination results* section, covering the analysis of the data from the tutor examination, the *Examination comments* section, which describes the results of the poll, and the *Written comments* section, covering the written comments concerning the tutor.

2.4.1 Examination Results

The examination contained 23 questions, divided into four question types: components, procedures, systems, and troubleshooting. Component questions measured knowledge of the parts of the ECS. The procedure questions measured knowledge of the procedures necessary to diagnose the ECS. Systems questions addressed the various control systems and their relationships. The largest part of the examination was the malfunction section, which tested knowledge of troubleshooting performance on the B-767 ECS. Scores on the questions were weighted by difficulty; for example the troubleshooting questions counted about twice as much as the component questions, because they were more difficult and time-consuming.

The only significant difference between the group's scores was in the component section. These questions dealt with the ECS on a component level; for example these questions concerned the function of the parts, connections to other parts, or behavior of a specific part. There were two main reasons for the superior performance of the instructor-led group in the component-related questions. First, since the ECS Tutor does not explicitly teach the user about the ECS at the component level, the individual-use subjects were disadvantaged when it came to learning about the parts of the system. Second, students in the instructor- led group could ask the instructor to explain the finer points of the operation of the ECS, and the instructor would often answer questions by describing the behavior of one of the components. On the other hand, students in the individual-use group could ask the tutor about a component by clicking on one of the "Help" buttons, but dialog with a computer is not always as robust or meaningful as that with an instructor. This result, along with several of the written comments, points out the importance of giving adequate background information before attempting to teach troubleshooting. This background information could be taught with the computer, although in many cases it may be more effective and efficient for an instructor to teach this material.

The examination data showed no significant difference between the two groups in the time to complete the examination or in the weighted overall examination scores, as shown in Table 2.1. This is shown graphically in Figure 2.3, which is a "box and whiskers" plot of the median (line in the box), the first standard deviation (the box), and the second standard deviation (ends of the whiskers) for the overall scores of the two groups. Also, there was no significant difference in performance on the procedures, systems, and troubleshooting sections of the examination. There was also no significant difference in the average time that it took to complete the examination. Figures 2.5a, 2.5b, 2.5c, and 2.5d in the Appendix A shows the score distributions of the two groups for the four examination sections.

	Instructor-led	Individual-use
Time to complete test	31 min.	32 min.
Average component (A) score	80.0%	46.7%
Average procedure (B) score	73.3%	63.3%
Average system (C) score	63.4%	54.8%
Average troubleshooting (D) score	71.3%	76.6%
Average overall score	70.3%	65.1%

Table 2.1 Summary of Test Statistics

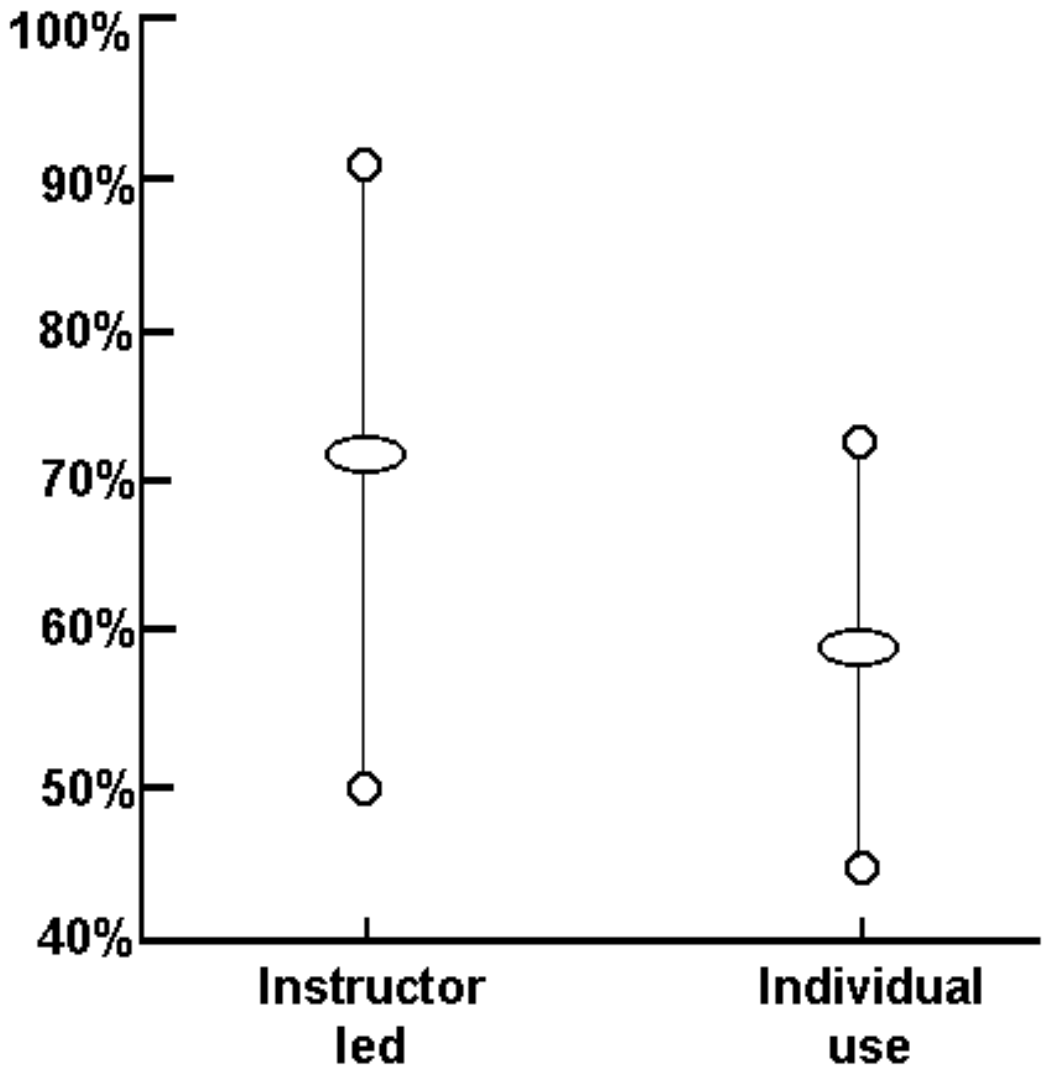

Figure 2.3 Overall Test Scores for Instructor-led (A) and Individual-use (B) Groups

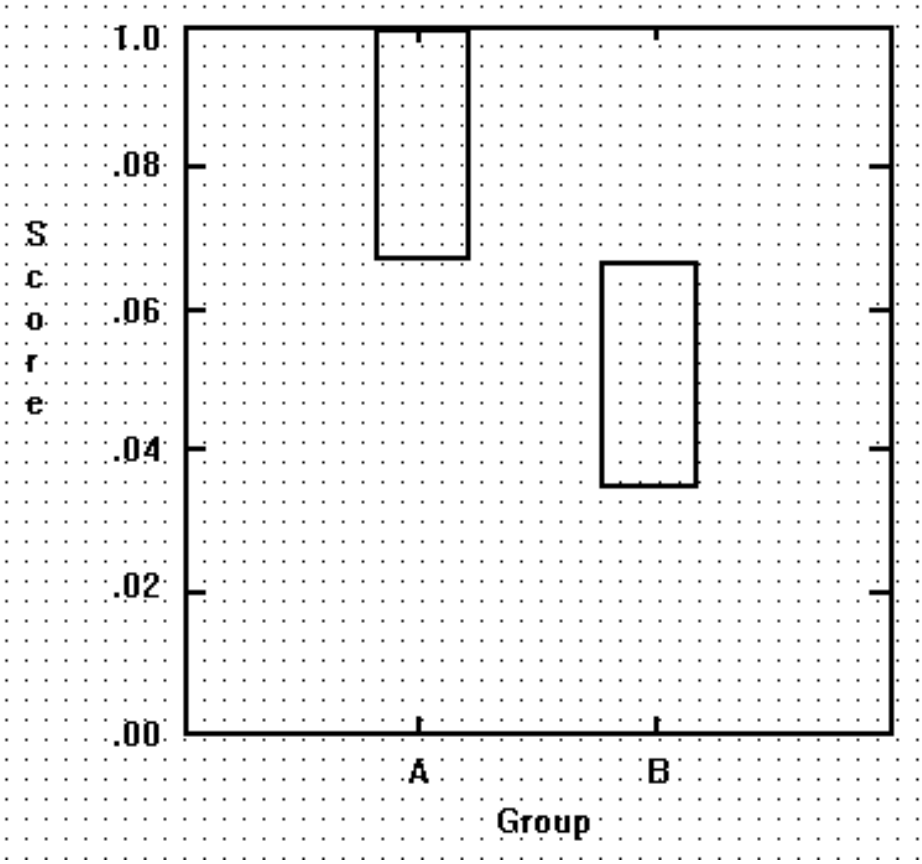

Figure 2.5a Distribution of Scores for Examination Sections A.

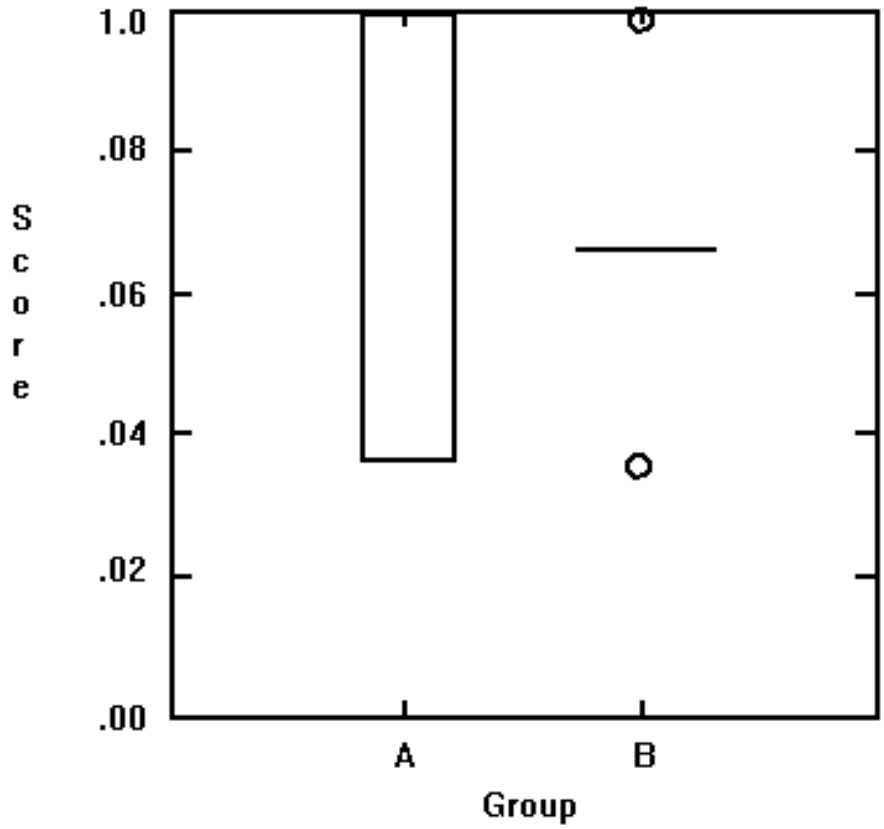

Figure 2.5b Distribution of Scores for Examination Sections B.

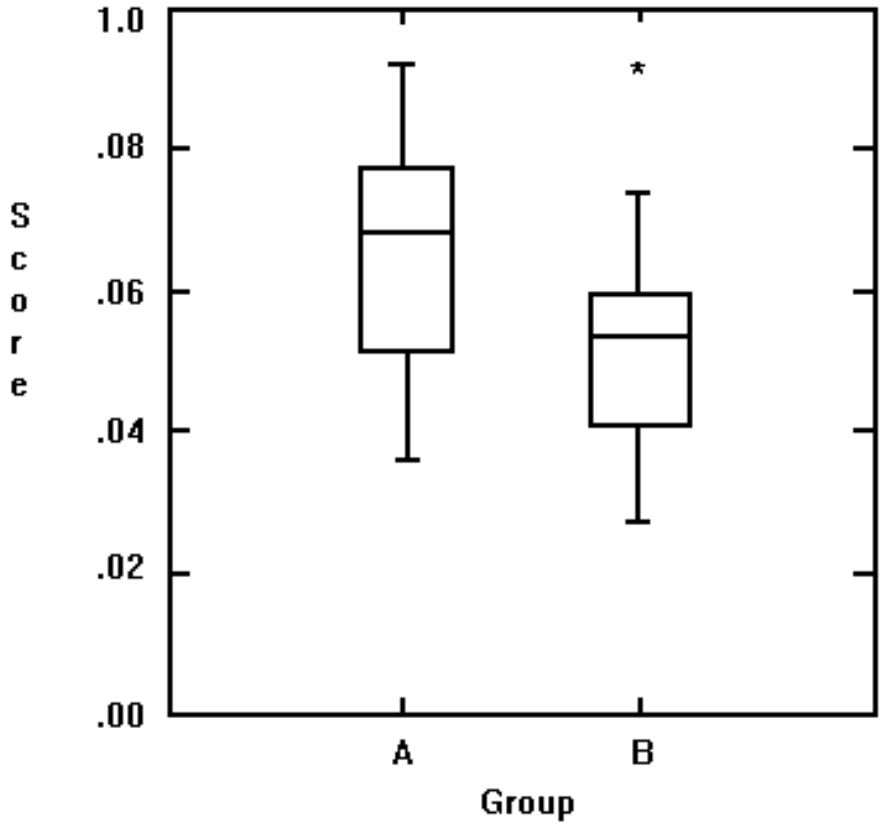

Figure 2.5c Distribution of Scores for Examination Sections C.

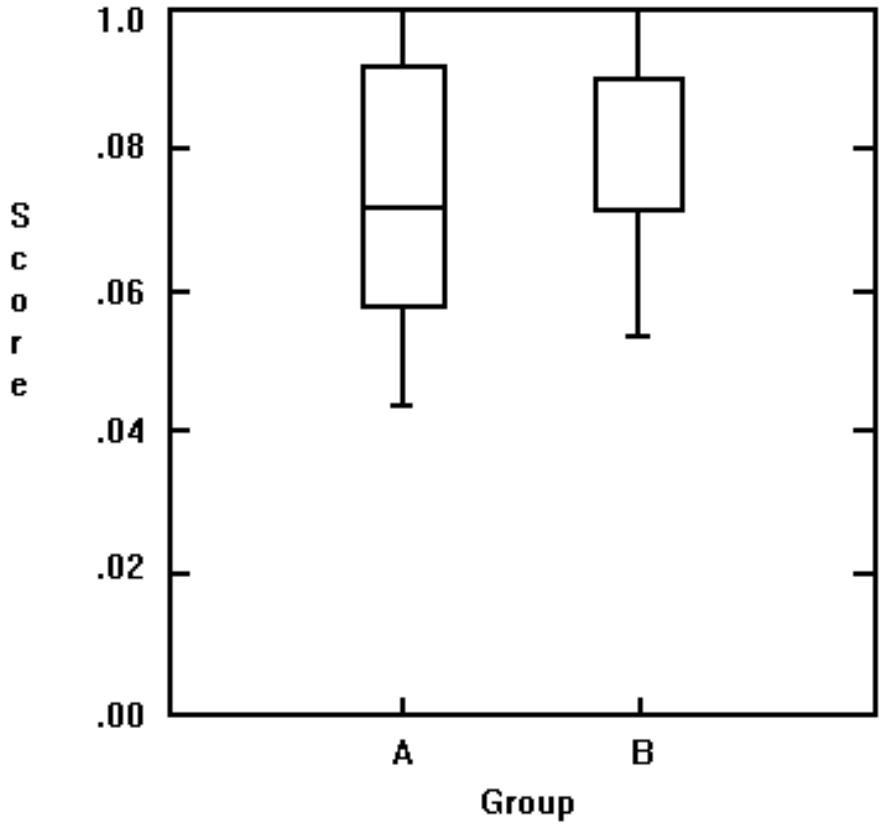

Figure 2.5d Distribution of Scores for Examination Sections D.

2.4.2 Examination Results

The examination contained 17 questions about various aspects of the tutor. Questions were of two types: general questions dealing with the usability and general behavior of the tutor, and questions about several features of the tutor. Subjects were asked to rate their agreement with each statement, using the scale "agree strongly," "agree," "no opinion," "disagree," and "disagree strongly." The questions were equally mixed between positively and negatively phrased sentences. Figure 2.6 in the Appendix A shows the distribution of responses for the subjects in the individual-use group.

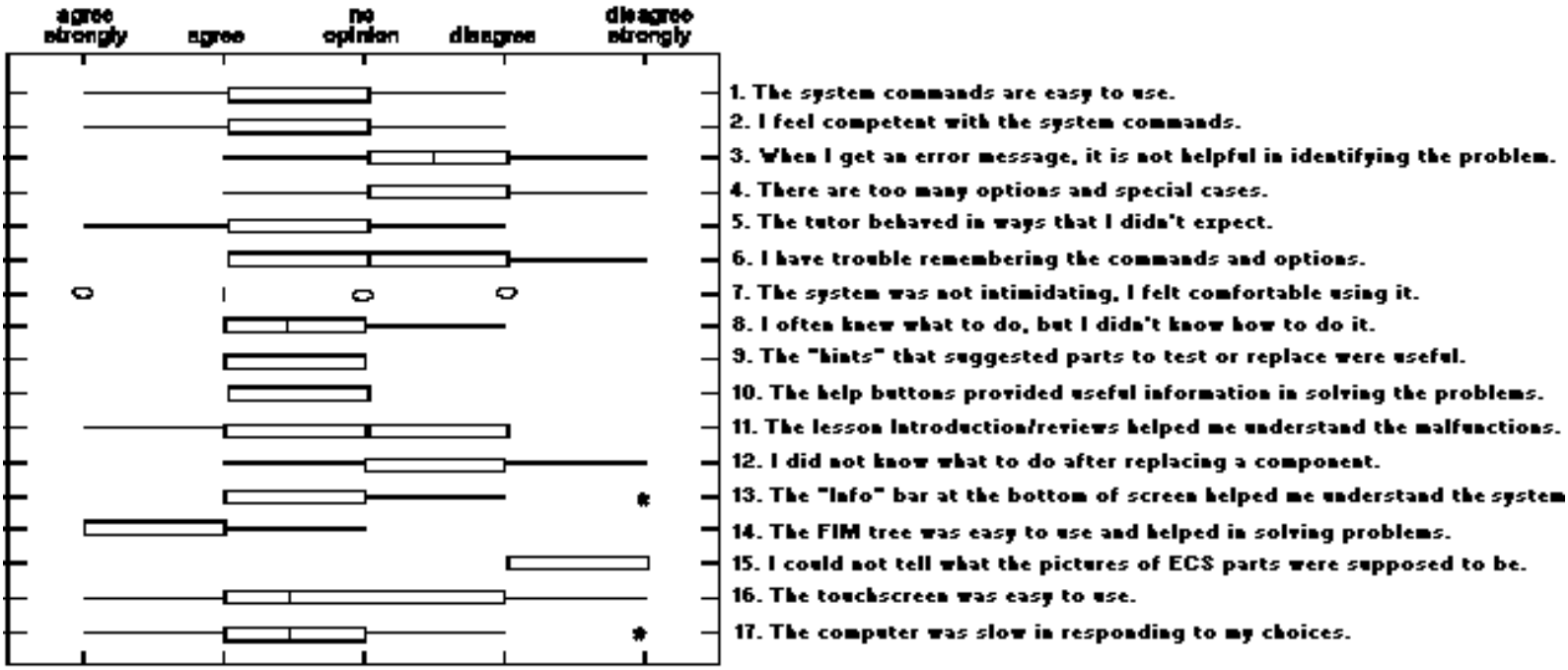

Figure 2.6 Examination Response Distribution for the Individual-use Group

Overall, satisfaction with the tutor was high. Some subjects in the individual-use group thought that the tutor behaved in unexpected ways. Ongoing usability studies are being used to locate the source of this problem. Also, fine-tuning of the context-sensitive help will improve the system's ability to offer guidance to the user at the appropriate time. There were no strong negative responses to the overall design of the tutor or to specific features, although the responses to several questions indicated that the wording of error messages could be improved.

A comparison between the two groups showed no significant difference in satisfaction with the tutor. This comparison was done by removing all examination questions that were not relevant to satisfaction or were not relevant to both user groups. The negatively-phrased questions were then inverted, and then the responses for each question were sorted by value, with "one" being the highest level of agreement and satisfaction, and "five" being the lowest. The distributions for the two groups are shown in Figure 2.4. The two distributions are almost identical, indicating that preference for the tutor was independent of the method of presentation. This seems to indicate that the positive features of instructor-led instruction (for example, natural instructor-student dialog) were balanced by the positive features of individual-use instruction (for example, full control over instructional rate).

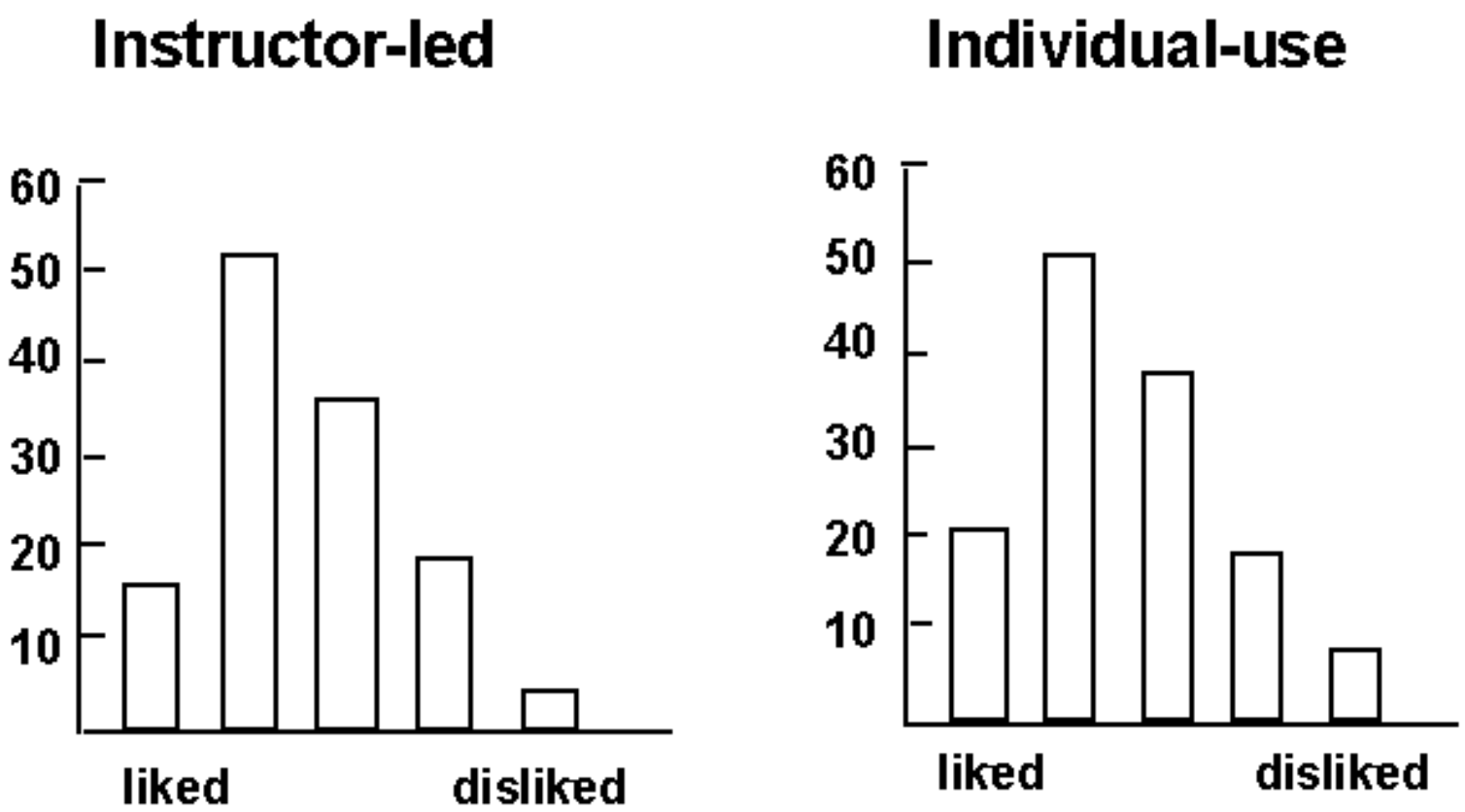

Figure 2.4 Tutor Preferences of the Two Groups, Measured by Poll Responses

2.4.3 Written Comments

The examination asked the subjects to write down any specific problems that they had with the tutor, and about their general opinion of the tutor. Only four subjects (of twenty total) responded to this section, all of whom were in the individual-use group. Table 2.2 shows all of the written comments from the examination.

Subject B-49: This training without an instructor is close to useless; it should only be used to enhance the class.
Subject B-50: ECS Tutor is very effective, but takes time to get relaxed with. For someone with a lot of computer background the ECS Tutor would help a great deal.
Subject B-55: 1) Arrow was not always accurate; touch screen was not aligned correctly 2) No chance to correct yourseld if computer made wrong selection, because of poor alignment! 3) Twice system locked up - may be Delta's computer not program - and made student go to beginning of lesson and the time and mistakes shown at end of lesson were unrealistic Was very interesting thanks.
Subject B-56: I found it frustrating when I tried to get back to a problem to see how it was written. The backup selection would only take me one screen back but not any further. I did not like the CBT simply because it did not answer my questions, only gave me information that the program thought I needed.

Table 2.2 Written Responses to Poll

2.4.3.1 Hardware and Software Bugs

The written responses indicated several different problems that subjects had with the tutor and the training program. On the first level were problems with the computer hardware. Since there was not enough time to allow the students to calibrate their own touchscreens, the touchscreens were calibrated by one of the evaluators. But individual differences in height, handedness, and hand-eye coordination were significant enough to cause problems for some subjects. Since not all user's actions are confirmed, some errors in screen touching were attributed to logic errors by the tutor. There was no way to correct these problems during the experiment, and several users became irritated at being "falsely accused" of making mistakes. Similarly, the tutor would unpredictably crash on two of the training computers, and the subjects would have to start again from the beginning. Thus some individual-use subjects paid more attention to the mechanics of using the tutor, rather than focusing on the content of the tutor. This software problem was found after the experiment and has been fixed.

2.4.3.2 Response Time

Another problem some subjects had with the tutor was the long lag between the time that the students performed an action and the time that the tutor responded to that action. The computers used for development were two to three times as fast as those used for the experiment, and the lag was not significant on the development computers. The lag was much more noticeable on the computers used in the experiment. The subjects would sometimes repeat an action several times if there was not feedback showing that the computer was processing their input. As a result, user actions were applied to subsequent displays, which led to unwanted behaviors in the tutor.

2.4.3.3 Navigation

Some subjects were also uncomfortable with the behavior of navigation between screens. For example, the version of the tutor that was used in the experiment had a "back" button that allowed the user to toggle back and forth between the previous two screens. In designing the tutor we thought that this would be as much as the user would need, and went with this simple design. But the users expected that the button would cause the tutor to keep going back to previous screens until they arrived at the starting screen. There were several times when it would be faster to have the button work in the expected way, and some users became frustrated when it did not work the way they wanted. Earlier testing did not indicate that this was a problem; only in a classroom setting did it tend to confuse the users.

2.4.3.4 Time Constraints

Probably the largest source of frustration was the limited information that the subjects had about the ECS. In the standard two-week training course that technicians must take before being certified on a plane type, about five hours are spent on the ECS. But because of time limits, only one hour was spent on this background material. Thus there were many uncertainties about the ECS, which led to frustration when trying to use the tutor. In retrospect, more time should have been spent on the introductory part of the experiment.

These results show that it is important that the subjects have all the necessary background information. Students that lack the prerequisite knowledge will have trouble in learning complex reasoning tasks such as troubleshooting. Also, having robust, usable tutoring software that has been thoroughly tested on the target platform is important. Software that is frustrating to use will not have the full impact of usable software.

2.4.4 Caveats

Although we did our best to ensure that the ECS Tutor experiment was a valid experiment, there were several problems with the design of the study. These problems are quite common in the design and execution of training evaluations (Goldstein 1987). The problems that we experienced were not a result of poor planning, but had more to do with constrained resources. These problems need to be considered when drawing conclusions from this study. The problems have to do with sample size, experience level of the subjects, and the testing of troubleshooting skills, and are described below.

2.4.4.1 Subject Group Sample Size

It is difficult to draw hard conclusions from subject groups that are smaller than 40 persons. Individual differences play an important role when population sizes are small, as they were in this experiment. Most of the results were not statistically significant, but this could be from individual differences between the two groups, and not because of inherent differences in the efficiency of the teaching methods. Future studies should use larger subject groups.

2.4.4.2 Experience Level of Subjects

Another problem had to do with the experience levels of the subjects. Of the twenty subjects, ten were experienced instructors with between two and 19 years experience, and the other ten participants were flightline technicians with less than two years experience. This should be compared with the two goals of the ECS Tutor: to teach general troubleshooting skills, and to teach specific knowledge to troubleshoot the B-767 ECS. The first goal, teaching general skills, is the most important of the two, as general skills can transfer across instances of airliner troubleshooting, and across airliner types. Clearly, the participants in the experiment already had strong troubleshooting skills, although they did not have specific knowledge of the B-767 ECS. Because of the mismatch between the intended users and the actual users of the tutor in this study, it would be very unlikely for any teaching method to cause a measurable difference in performance, since most of the subjects were already fairly knowledgeable about troubleshooting.

2.4.4.3 Testing Troubleshooting Skills

The last problem has to do with the difficulty of testing troubleshooting skills. Because troubleshooting requires a combination of several types of skills and knowledge, tests that attempt to measure troubleshooting skills should also measure a variety of skills. It is also difficult to design an examination to measure this knowledge "out of context," because performance on the job may be very different from performance in the classroom. In an ideal experiment, the subjects would have been tested on real equipment and evaluated by a panel of experts, but this was not possible. Future examinations should attempt a more realistic task for measuring troubleshooting skills, even if the testing must be done on paper.

2.5 CONCLUSION

The experiment found no significant difference between the troubleshooting performance of subjects that used the tutor in instructor-led and individual-use modes. An analysis of the performance on the four question types (components, procedures, systems, and malfunctions) also found no statistically significant difference. An analysis of user satisfaction with the tutor found no difference between the two groups. Possible problems with the significance of these results are small population size, experience levels of the subjects, and difficulty of testing troubleshooting skills.

This experiment also led to several important points to be considered in designing CBT courses and CBT evaluations. First, the subjects should have all the necessary background information, since students who lack the prerequisite knowledge will have trouble in learning complex reasoning tasks. Also, having robust, usable tutoring software that has been thoroughly tested on the target platform is important. Difficult software that is frustrating to use will not have the full impact of usable software. Third, because individual differences play an important role when population sizes are small, studies should use larger subject groups with at least 40 subjects.

2.6 REFERENCES

Charney, D. H., and Reder, L. M. (1986). Designing interactive tutorials for computer users. *Human-Computer Interaction, 2*, (4), 297-317.

Czaja, S. J., Hammond, K., Blascovich, J. J., and Swede, H. (1986). Learning to use a word-processing system as a function of training strategy. *Behavior and Information Technology, 5*, (3), 203-216.

Goldstein, I. L. (1987). The relationship of training goals and training systems. In G. Salvendy (Ed.), *Handbook of human factors* (pp. 963-975). New York: John Wiley & Sons.

Pearce, M. C. (1992). Report on the environmental control system tutor usability study at clayton state college. Unpublished manuscript. Galaxy Scientific Corporation.

Chapter Two
Appendix A

Figures 2.5a, 2.5b, 2.5c, 2.5d: Distribution of scores for examination sections A, B, C, and D. These "box and whiskers" show the median (line in the box), the first standard deviation (the box), and the second standard deviation (ends of the whiskers) for the section scores of the two groups. Group A was instructor-led and Group B was individual-use.

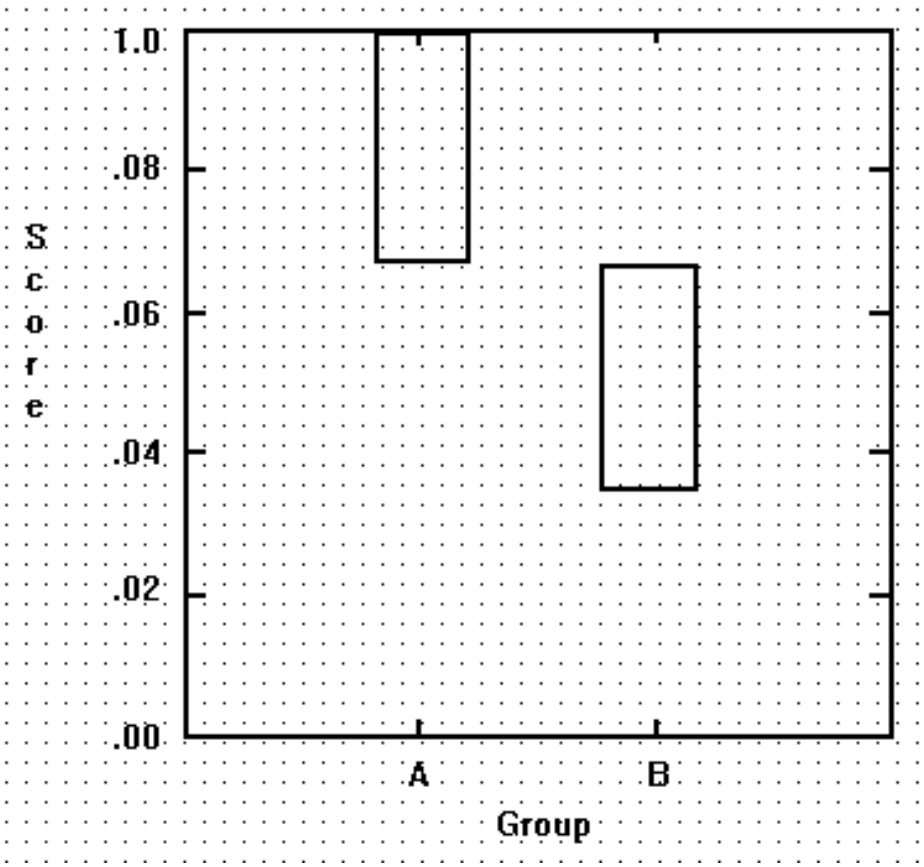

Figure 2.5a Distribution of Scores for Examination Sections A.

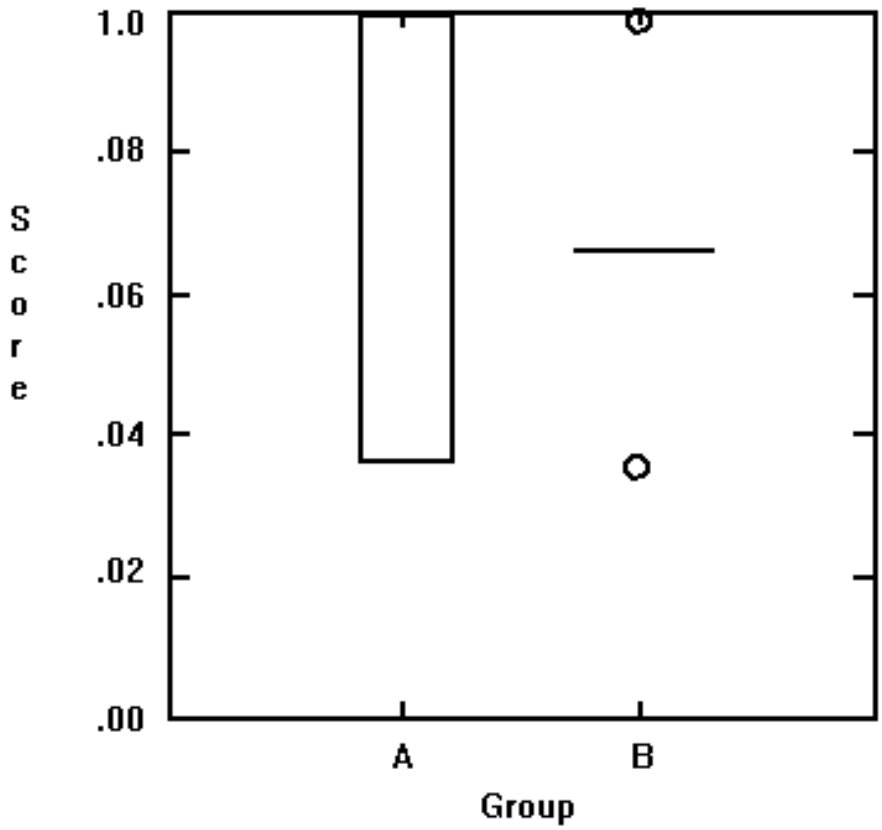

Figure 2.5b Distribution of Scores for Examination Sections B.

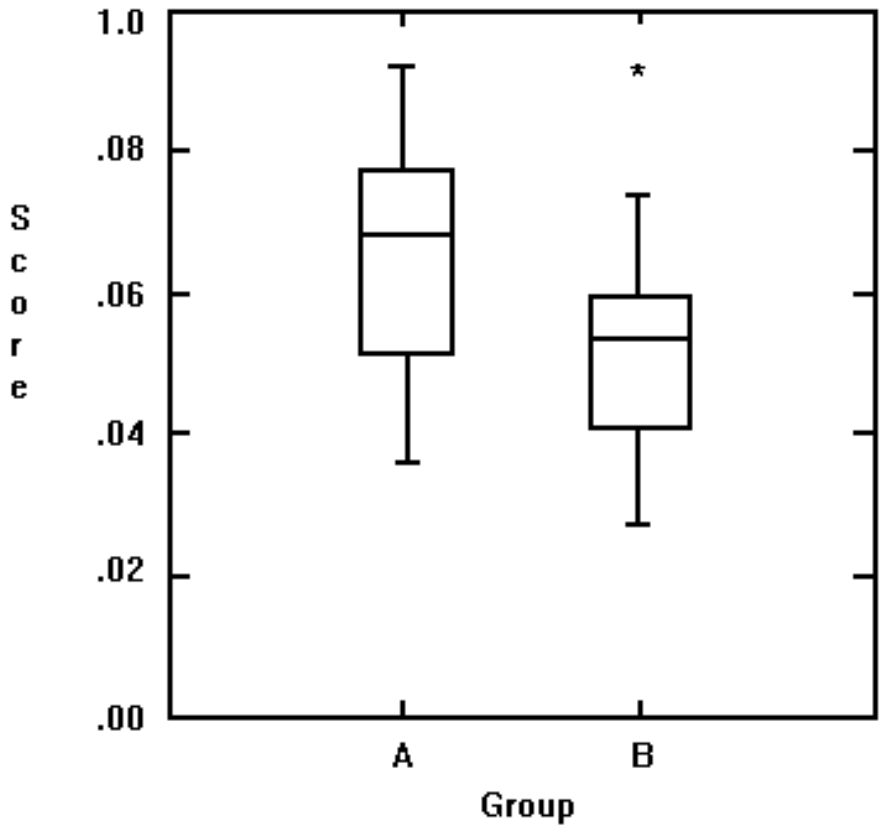

Figure 2.5c Distribution of Scores for Examination Sections C.

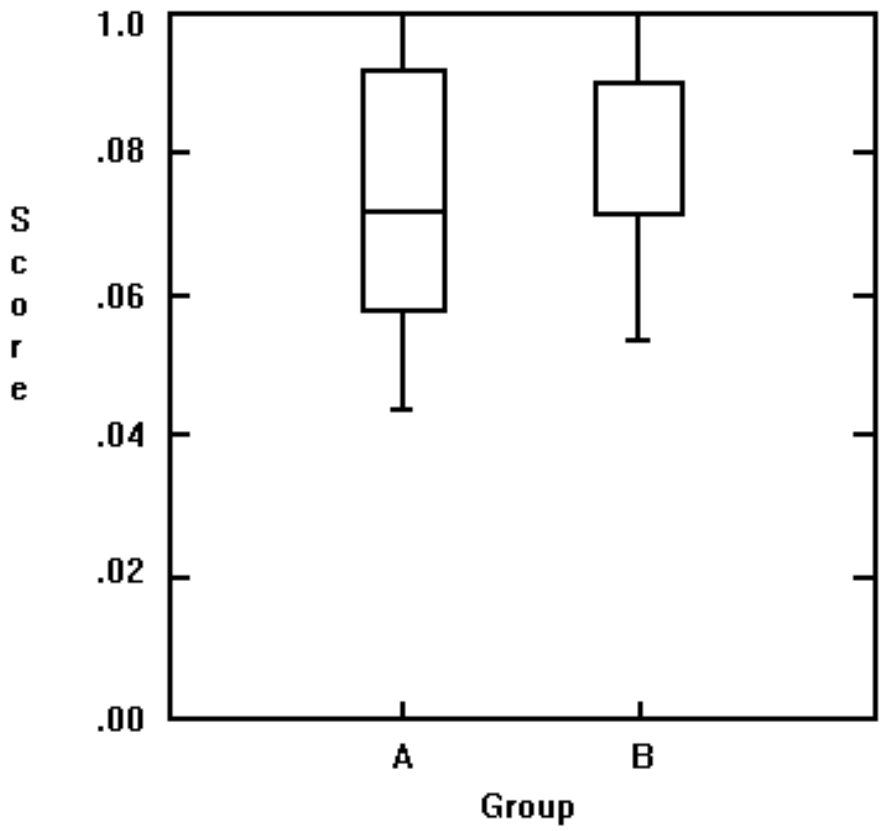

Figure 2.5d Distribution of Scores for Examination Sections D.

Figure 2.6: Examination Response Distribution for the Individual-use Group

Chapter Two
Appendix B

Evaluation # _____

ECS Tutor Evaluation

This evaluation will measure your knowledge of the B-767 ECS and of troubleshooting procedures. The evaluation is to be given after you have seen the ECS Tutor, and is divided into background and troubleshooting questions. The background questions will measure your knowledge of the various component, systems, and procedures related to the ECS. The troubleshooting questions measure your ability to diagnose malfunctions of the ECS.

Most of the questions are multiple choice; simply circle the letter in front of that answer you think is correct. If you need more room for the "short answer" questions, continue on the back of that page, but the answers should not be very long.

You may use the materials from the introductory section of the evaluation (the pack diagram, equipment drawings, and FIM), including any notes you took.

For each of the sections, you should write the times that you begin and end that section; an area is provided. You should not rush to finish the evaluation; correctness is more important than time.

The last two pages of this package are forms that ask your opinion of the tutor and about your experience with ECSs. Please take the time to fill these out, as they will influence the changes that are made to the tutor.

NOTE: This is not a test! This results of this evaluation are confidential and will not be used to evaluate you. You should not sign your name to this evaluation. The study is designed to evaluate the ECS Tutor, and not the people taking this evaluation.

A. Components

These questions will evaluate your knowledge of the parts of the B-767 ECS. These questions are all multiple choice; just circle the correct answer.

Start Time: _____

1. The function of the Primary Heat Exchanger is to:
   - A. limit flow of bleed air into the pack.
   - B. cool the air before it enters the compressor.
   - C. cool bleed air coming out of the compressor before it enters the condenser.
   - D. none of the above.
2. The low limit valve:
   - A. receives differential pressure to command the valve.
   - B. can receive an electrical command from the standby pack controller to command the valve.
   - C. can receive an electrical command from the pack temperature controller to command the valve.
   - D. all of the above.
3. When performing a pack temperature controller BITE, the pack sensor is faulted. Where is the sensor located?
   - A. In the ceiling of the cabin.
   - B. Between the primary water extractor and the turbine.
   - C. Near the flow control valve.
   - D. Downstream of the turbine.

Finish Time: _____

B. Procedures

The questions in this section will measure your knowledge of the procedures necessary to diagnose the B-767 ECS. You will be given a task, and must describe the steps to perform the task. For the "short answer" questions, please include an explanation.

Start Time: _____

4. On the pack temperature controller, if you press the PRESS TEST switch and the GO light does not illuminate, you should:
   - A. replace the components with the lights illuminated
   - B. press the VERIFY switch to reset the controller.
   - C. replace the controller.
   - D. replace the faulty lamp.

5. A B-767 has a problem with the ECS system. Using the FIM and fault code 21-51-19, go to the appropriate chart to find the fault. Starting at block #1 answer YES. The next block would be answered NO. What is the problem?

6. A B-767 has a problem with the ECS system. Using the FIM, find the correct fault code. On the overhead panel with the pack selector switch in "AUTO," the "INOP" light on the reset switch is illuminated. When STBY was selected the light extinguished. What is the fault code for this problem?

Finish Time: _____

C. Systems

This section will measure your knowledge of the various systems and the relationships between components of the ECS. The goal is to measure what you know of the behavior and functioning of the pack.

Start Time: _____

7. What controls the pack when the selector switch is in auto?

_____

8. What controls the pack when the selector switch is in STBY N?

_____ and _____

9. Circle the correct answers: In STBY C the Low Limit Valve is normally (closed, open), and the Temperature Control Valve is normally (closed, open).

10. If the INOP light and the PACK OFF lights are illuminated on the reset switch in the AUTO position, the problem is with the

   A. Trim Valve failed.
   B. Pack Outlet overtemp.
   C. Gasper Fan failed.
   D. Compressor Outlet overtemp.

11. What is the purpose of the altitude switch?

   A. to increase airflow through the pack at 31,000 feet, since the air is thinner at higher altitude.
   B. to allow colder air to the turbine at 31,000 feet
   C. so the EICAS can record the altitude on the autoevent if the pack fails.
   D. all of the above.

12. What indication would you get in the cockpit if the altitude switch failed?

   A. Failure flag on the captains altimeter.
   B. Both packs trip and will not reset.
   C. No indication in the cockpit.
   D. EICAS maintenance message "PACK CONTROLLER BITE."

D. Malfunctions

This is the most important section of the evaluation, since it measures what the ECS Tutor was designed to teach to its users. Include a short explanation for your answers.

Start Time: _____

13. The left pack fails. In the cockpit the left PACK OFF light on the RESET switch is illuminated and will not reset when the pack selector switch is in any position. There is also an EICAS message L PACK OFF. What would you suspect the problem to be?

14. The pilot tells you the INOP light on the pack reset switch for the right pack illuminated and will not extinguish. You go up to the cockpit and move the selector switch to the STBY positions and try to reset the switch. The INOP light stays illuminated. There is also an EICAS message L PACK TEMP. You go down to the pack bay and physically check the heat exchangers. Heat exchangers check OK. You also do a BITE check on the Pack Temperature Controller; the BITE test is OK. You check the Flow Control Valve. It checks out OK. You do a BITE check on the Standby pack controller; checks OK. Using the FIM manual, what is the problem?

15. When performing a BITE test on the standby pack controller, you get a NO GO light in position 3. What component is faulted?

16. When performing a pack temperature controller BITE, what position should the pack selector switch on the overhead be set to?

17. A B-767 is incoming with a pack malfunction. The indications were not radioed in. Once the plane lands, in what order would you check these items?

__ inspect heat exchangers.

__ operate pack temperature controller BITE.

__ check condition of the PACK OFF/INOP lights.

__ try to operate the pack in different modes.

18. A B-767 has a problem with the ECS system. On the ground with the packs operating, the left pack trips off. You have an "INOP" light and "PACK OFF" light illuminated. You allow the pack to cool and reset the switch, the lights extinguish. After a while the pack trips again in AUTO and STBY. You go down to the left pack bay and notice water dripping from a drain tube on the water extractor. This would indicate:

A. normal condition.
B. coalescent bags need to be replaced.
C. water nozzles in the ram air duct are clogged.
D. leak in the potable water system.

Finish Time: _____

You have completed the evaluation; please fill out the following evaluation.

Evaluation for ECS Tutor

This is an evaluation to determine how effective you think the ECS Tutor is. Please choose a number **between 1 and 5** that describes your agreement with each statement, using the definition in the scale below. Be sure to read the statements carefully. Write your choice to the left of the question.

NOTE: This is not a test! This study is confidential and will not be used to evaluate you. You should not sign your name to this evaluation. The evaluation is designed to determine which parts of the ECS Tutor need improvement.

1 ---------- 2 ---------- 3 ---------- 4 ---------- 5

strongly agree neutral disagree strongly

agree disagree

General System Questions

__ 1. The system commands are easy to use.

__ 2. I feel competent with and knowledgeable about the system commands.

__ 3. When I get an error message, I find that is not helpful in identifying the source of the problem.

__ 4. There are too many options and special cases.

__ 5. The tutor behaved in ways that I didn't expect.

__ 6. I have trouble remembering the commands and options and must ask questions frequently.

__ 7. The system was not intimidating, I felt comfortable using it.

__ 8. I often knew what to do, but I didn't know how to do it.

Questions about Specific Components of the ECS Tutor

__ 9. The "hints" that suggested possible parts to test or replace were useful.

__ 10. The help buttons provided useful information in solving the problems.

__ 11. The lesson introductions and reviews helped me to understand how the malfunctions were related.

__ 12. I did not know what to do after replacing a component.

__ 13. The "Info" bar at the bottom of screen helped me understand the system.

__ 14. The FIM tree was easy to use and helped in solving problem.

__ 15. I could not tell what the pictures of ECS parts were supposed to be.

__ 16. The touchscreen was easy to use.

__ 17. The computer was slow in responding to my choices.

If you have any other comments about the ECS Tutor or about your answers to these questions, please write them on the back of this paper. Thank You.