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Job Aids, Feedback, and the Teaching of Verbal-Reasoning

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JOB AIDS, FEEDBACK, AND THE TEACHING OF VERBAL-REASONING

by

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The purpose of this study was twofold: (1) to test the effects of a job aid and feedback on learning to solve directional verbal-reasoning problems, and (2) to examine whether students' skills transferred to similar problems following the removal of both the job aid and feedback. Some previous researchers who studied problem solving utilized the think-aloud technique and used solutions generated by expert problem solvers. The think-aloud technique, although perhaps a good one, is not practical in the classroom. In the main study, a job aid was incorporated within the problem so students would be able to use guidance toward solutions generated by an expert problem solver (i.e., the experimenter). Thirty-nine students participated in the present study. The students were randomly assigned to two groups, those who would receive the job aid and those who would not. Three tests were given to the students, a pretest, middle test, and posttest. Both groups received feedback during the middle test. Within and between group comparisons show no statistically significant differences. Therefore, there was no evidence that the job aid or feedback improved mastery for this kind of verbal-reasoning problem.

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Job aids, feedback, and the teaching of verbal-reasoning

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Western Michigan University, 1992

U·M·I
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This study is dedicated
to the memory
of
my father

Mr. Curley O. Williams
January 1937 - August 1990

Thank you for guidance.
Thank you for
love.
Until we meet again

ACKNOWLEDGMENTS

I thank the Lord for all he has done. I also thank Mrs. Bettie Williams and Mr. Dexter Williams for their strength, love, and support. This would not have been possible without you. Mr. Rodson Campbell, I look forward to a new beginning with you. Thank you for being there when I needed you most. I thank my graduate support team and longtime friends Dr. Brian Yancey (for your expertise), Dr. Mark Jackson, and especially Dr. Monica Porter (for encouragement, and a shoulder to cry on when needed). I will always cherish our timely friendships. I especially thank my advisor/mentor, Dr. Richard Malott, for giving so much of himself to assist me in reaching one of my long-term goals. I thank Dr. Clarence Williams for moral support. To my committee members: Dr. Jack Michael, Dr. Dale Brethower, and Dr. Ben Wilson, thank you for your assistance. I must thank the State of Michigan for financial support. There are so many others to thank; to all those who assisted me throughout my studies, a sincere thanks.

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TABLE OF CONTENTS

Table of Contents--Continued

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The General Area of Research

Improving problem solving skills in students has been an approach taken by many researchers to improve students' academic performance (Bloom & Broder, 1950; Dufresne, 1988; Larkin, 1985; Mestre, Dufresne, Gerace, & Hardiman, 1988; Ross & Kennedy, 1990; Whimbey & Lochhead, 1986). Yet, some researchers say it is difficult, if not impossible, to teach problem-solving skills, and instructional technology has not advanced to the level to teach those skills (Gick, 1989; Polson & Jeffries, 1989). Bloom and Broder (1950) state that the major barrier to teaching and understanding problem solving is that thinking is generally covert, making it difficult for a teacher to teach and a learner to learn thinking. Skinner (1957) says responses to private stimuli do not appear to differ from responses to public events. However, he agrees with Bloom and Broder that the privacy of such stimuli raises problems. The two problems Skinner addresss are: (1) the difficulty encountered in the analysis of such stimulus control (the investigator cannot readily point to the stimuli to which he must appeal in predicting and controlling behavior); and (2) the inability to increase the frequency of a response because reinforcement can not take place (the verbal community can not

reinforce a given response in the presence of a given stimulus, if the stimulus does not act upon both the speaker and the reinforcing community).

In the following illustration, Whimbey and Lochhead (1986) demonstrate why they believe it is difficult to teach problem solving: "A beginner cannot observe how an expert thinks and solves problems in the way a beginner can observe a golf pro taking a stance, gripping the club, and then executing the swing" (p. 22). And the expert cannot observe the beginner practicing (thinking), point out flaws, and show the beginner how to improve.

Today, some researchers of problem solving have students think aloud to learn more about novice and expert problem solving skills. Thinking aloud is used to eliminate the difficulty of observing hidden behavior. However, thinking aloud is not practical in many classroom settings; therefore other approaches, such as the use of worked out examples, or modeled problems, have been implemented (Dufresne, 1988; Ross, 1987; Ross & Kennedy, 1990; Tarmizi & Sweller, 1988).

Problem Solving Defined

The area of problem solving is vast because the specific problems an individual solves may come from any domain. For example, an artist manipulating a light or taking another position to see the subject differently can be problem solving with art as the domain, or a student using textbook assistance because he is unable to calculate circle geometry angles can also be problem solving with

circle geometry as the domain.

Problem solving is defined by Skinner (1969) as what takes place when people come upon an unknown and do not have a response available in their repertoire to solve the problem and must either change themselves or the environment to do so. Woods (1981) defines problem solving as the mental process one uses to arrive at a best answer. In both definitions, the primary emphasis is a process of change that occurs to obtain an appropriate response. This change usually involves thinking.

Most problem solving techniques that researchers have worked with have been devised to teach initially poor problem solvers to be more systematic in their thinking. Two techniques discussed in the literature are: domain-specific and general problem solving. Domain-specific problem solving utilizes specific skills and strategies within a specific subject matter to obtain the solution to some unknown; general problem solving uses those strategies, and techniques that can be used across domains.

In both domain-specific and general problem solving, the first emphasis is to change unsuccessful students' thinking by first examining the ways successful problem solvers think through problems. Second, unsuccessful students are shown how to imitate the successful problem solvers. Heiman (1984) states that:

> The eventual aim is to train students to think dialectically, in the sense of the Socratic method. In the Socratic method, the teacher constantly questions the students' basic assumptions and premises, plays the devil's advocate, and probes weak areas, using such techniques as invidious generalizations and counterexamples. The desired end-product is that the student will

> come to perform the teacher's functions for himself via self-interrogation. (p. 3)

Whimbey and Lochhead (1986) listed a few behaviors/strategies good problem solvers have:

1. They avoid guessing; good problem solvers take the time to plan hypotheses, ask themselves questions, provide their own feedback, and test their answers before accepting them as final.

2. They divide whole problems into parts; good problem solvers divide problems to think through smaller portions.

3. They are concerned with accuracy; good problem solvers are more likely to retest their conclusions to ensure accuracy.

4. They have a positive attitude; good problem solvers believe academic-reasoning problems can be solved through careful, persistent analysis.

Literature Review

Various researchers have implemented different techniques to improve students' problem-solving skills. Some techniques in the domain-specific area consist of computer-based environmental tasks, such as the hierarchical analysis tool (HAT) (Dufresne, 1988; Mestre et al., 1988), a guided step-by-step solution (i.e., job aid) (Tarmizi & Sweller, 1988), active discussions between the tutor and student, frequent oral tests, and the use of previous worked out examples as a cue to the solution of the problem (Ross & Kennedy, 1990). There has been exten-

sive work in the area of domain-specific problem solving, particularly in the hard sciences (Bassock & Holyoak, 1989; Larkin, 1985; Smith, 1988).

Domain-Specific Problem Solving

Mestre et al. (1988) investigated promoting expert-like behavior among novices by constraining them to use a top-down analysis with the use of the hierarchical analysis tool. In this study, they used 42 students who had successfully completed the first semester's physics course with a grade of B or above. They randomly assigned the students to three treatment groups. The experimental group received the HAT, designed to simulate the thinking patterns of an expert, while the control groups received one of two other treatments: (1) EST, an equation sorting tool, a computer-based program designed to simulate novice problem solvers thinking patterns; and (2) textbook, a textbook designed so students were able to use the solved answers to problems to assist them in solving the current problems. Although pretest to posttest improvements were statistically significant (F (1, 39) = 21.25, $p < .0001$) for each group, no one group improved significantly more than any other group. The results suggest that the practice in completing the problems was responsible for the improvement in the number of correct answers, rather than the specific treatment.

In physics, Dufresne (1988) studied whether novices could become better problem solvers by the author precipitating the formation of expert-like knowledge structures or by encouraging them to use an expert-like problem solv-

ing approach. Twenty-five students were randomly assigned to three groups: (1) students using the HAT, (2) students using the EST, and (3) students using the textbook (see previous experiment for definitions of each group). The effectiveness of the HAT was compared to the effectiveness of the two control treatments in three areas: (1) problem categorization, (2) explanations of physical situations, and (3) problem solving ability. The level of statistical significance was not reported; however, the author summarized that students in the HAT group were able to categorize the problems more reliably than the other two groups. The author also reported the HAT group showed "significant" improvement in problem solving, demonstrated by pretest to posttest comparisons, as well as significant improvement over the EST group but not beyond that achieved by using the textbook.

Ross and Kennedy (1990) examined how students used earlier examples to aid in problem solving. They stated that "there was a consensus among various experimenters that examples are crucial in learning a new domain, yet there are fundamental disagreements over how examples aid learning" (p. 42). Their hypothesis was that novices may often make use of earlier or reminded examples to help them solve current problems. And depending on the way in which the novice uses the previous example, it can either lead to successful learning or unsuccessful learning.

The experimenters used a within-subjects design to test the example-cuing manipulation with 30 students. Each of the students would receive a cue at his

or her first test on half of the problems (i.e., this problem is like that problem). Then they studied four principles of probability, and tried to solve eight problems using those principles. The students had a principle, a worked-out problem, and then four study examples presented to them, and afterward, a test. With only four minutes to go through each principle (study the example, a worked out problem), the first test was given. The results were statistically significant: first test cuing increased correct responding on the second test (t (29)= 2.78, $p < .01$). The appropriate formula to solve the problem was used more often by students on those problems where they received cuing. This is a demonstration of transfer of training within a single domain.

In another domain-specific study, Tarmizi and Sweller (1988) investigated guidance as a means of improving or hindering students' circle geometry problem-solving skills. They investigated the consequences of giving students relevant information during problem solving. One group of students practiced solving geometry problems by following precise directions concerning each required move for each problem (i.e., a job aid). A comparison group solved problems that were goal-free. Students in the goal-free group were given the steps for various problems but did not receive individual assistance on each problem presented. Last, the control group solved problems without any assistance. Problems for all groups were similar and could be solved using two theorems from circle geometry.

The performance of each group during both the acquisition and test phases was compared. The control group solved the least number of problems during

the acquisition phase and made the most errors. The goal-free group solved the most problems and made statistically significantly fewer errors compared to the other two groups. The authors found the problems solved by the goal free technique did not require the integration of two sources of information (i.e., problems and job aid), as did the guided-solution group. They suggested that any beneficial effect of guidance obtained by the guided solution group was cancelled by the heavy cognitive overload associated with using additional information.

Therefore, in the literature there have been both successes (Ross & Kennedy, 1990) and failures (Mestre et al., 1988) in domain specific problem solving. Much of the literature continues to focus on finding the behaviors expert or more successful problem solvers emit (Hardiman, Dufresne, & Mestre, 1988; Siegler 1985; Whimbey, 1980).

General Problem Solving

Polson and Jeffries (1989) reported that graduates from engineering programs are unable to apply the theoretical knowledge acquired during their years in school to actual engineering problems. Many observers have concluded that this inability to apply theoretical knowledge to actual problems is due in part to the failure to successfully teach general problem-solving skills.

Newell and Simon (1972) began to look at general problem solving and skill acquisition from an information-processing perspective. The information-processing paradigm characterizes problem solving as the interaction between the

problem solver and the task environment. There are two assumptions of this paradigm: First, the human problem solver can be characterized as an information-processing system, and, second, problem solving can be characterized as both a search process and a process of understanding. The authors assert that search mechanisms are central components of general problem-solving skills and that instruction in the use of these search mechanisms would improve general problem-solving skills.

In a review of general problem-solving strategies, Polson and Jeffries (1989) evaluated well-known programs. The first program evaluated, the productive thinking program, was developed by Covington, Crutchfield, Davies and Olton (1974). The productive thinking program purports to teach generalized problem-solving skills such as generating hypotheses and determining what is relevant to a solution. According to Polson and Jeffries (1989), there has been research to evaluate the effectiveness of this program. One study (Olton et al., 1967) assessed the effects of the productive thinking program on fifth and sixth graders when presented over an eight-week period. A split-class technique was used. Pre-tests, posttests, and follow-up tests six months later were given. Although the groups did not differ significantly on the pretest measures, the instructed group was significantly better than the control group both immediately after the program and six months later. This superiority existed both for measures of thinking skill and for improved attitudes toward thinking.

The CoRT (Cognitive Research Trust) thinking lessons are a two-year

course for improving general thinking skills (de Bono, 1973). They emphasize the teaching of thinking skills in a range of areas--problem solving, interpersonal discussions, and creative thinking. Much of the research is informal--testimonials from teachers and students who have used the materials or summaries of discussions by CoRT trained groups versus untrained groups on the same topic. Although positive results of several group studies are reported, in none of the studies are statistical analyses done.

Some programs purport to teach general skills. However, there is agreement that normally the educational system does not successfully teach general problem-solving skills to a majority of its graduates.

Preliminary Experiments

The present research consists of a series of preliminary studies followed by one main study. The overall question addressed was: Can students be taught to solve problems better? The preliminary studies dealt with two methods of improving problem solving skills: (1) peer groups using the think-aloud technique and (2) job aids. The final study was implemented to better assess the effectiveness of the developed job aid.

CHAPTER II

PRELIMINARY EXPERIMENTS AND PROGRAM DEVELOPMENT

Introduction

Several preliminary experiments were conducted prior to implementation of the main study. Throughout the preliminary experiments, the experimental question, method, and experimental design were altered and refined.

Preliminary Experiment 1: The Use of Peer Groups and Bloom's (1956) Taxonomy in Problem Solving

The initial preliminary experiment dealt with two issues. First, can students be taught to be better problem solvers? Second, will teaching them to ask better questions, according to the levels of Bloom's (1956) taxonomy, improve their test performance in class? It was noted that students probably could be trained to ask questions according to the six levels of Bloom's taxonomy, such as an analysis question (e.g., compare and judge the contributions of the Mesopotamian and Egyptian cultures with regard to their irrigation sytems and support your views.), in contrast to a knowledge level question (e.g., list the major rivers in Egypt.) However, to improve performance, students would not only have to ask higher level taxonomy questions, but they would have to be able to answer them. Therefore, not only does question formation seem to be an important variable to

improving performance but so is how one goes about answering the question.

Whimbey and Lochhead (1986) discussed in their text, Problem Solving and Comprehension, how successful problem solvers asked questions that led them to correct solutions. The authors had conducted several informal studies with students; they claimed that the use of their text, designed to teach general problem-solving skills, led to improved performance on standardized tests, such as the Graduate Record Examination (GRE) (GRE, 1983), and the Scholastic Aptitude Test (SAT) (Ten SATs, 1990). Much of the students' practice and training in solving problems involved asking relevant questions. After the experimenter reviewed the Whimbey and Lockhead text, it was used by 26 students enrolled in University 101 (i.e., a freshmen seminar at Western Michigan University, Kalamazoo, in the Summer session, 1989).

The preliminary experiment was designed to investigate the use of peer-group problem solving (using the think-aloud technique to solve problems overtly). It was also planned to teach question formation and the recognition of the levels of questions such as analysis, comprehension, synthesis, etc. using Bloom's (1956) educational taxonomy as a guide. The students' mean pretest (15.54) and posttest (21.58) scores on two different versions of Whimbey's Analytical Skills Inventory (WASI) (Whimbey & Lochhead, 1986) were compared; there was a statistically significant difference between the scores. However, pre-test and posttest scores on a test of the classification of Bloom's educational objectives did not lead to a statistically significant difference.

The results of the first preliminary experiment showed that the students' performances on the classification of Bloom's educational objectives did not improve and, therefore, the use of Bloom's taxonomy was probably not a variable that enhanced students' problem-solving skills. For this reason, in the second preliminary experiment, Bloom's taxonomy of educational objectives was not used as a supplement to problem solving.

Preliminary Experiment 2: The Use of Peer Groups in Problem Solving With Vocabulary Words

The second preliminary experiment was designed to investigate peer-group problem solving using the think-aloud technique and vocabulary enhancement using words chosen from Smith's (1986) Building Vocabulary for College as a supplement to peer-group problem solving. Nineteen students enrolled in an elective psychology course, Fall semester, 1989, at Western Michigan University and served as the subjects in this experiment. Again, the mean pretest, 16, and posttest, 22, WASI scores were statistically significantly different at $p < .003$, $F = 11.48$.

The second preliminary experiment showed that the think-aloud technique does improve problem solving. These findings were almost identical to the previous study. However, when a pretest and posttest of vocabulary words were compared, there was no statistically significant difference. Thus, there was no evidence that students' vocabulary was enhanced with current procedures and

therefore it could not be a variable that caused students' scores in problem solving to increase. For this reason, vocabulary enhancement as a supplement was eliminated. It was decided that a dictionary would be supplied for any student who was uncertain about the meaning of a word and another preliminary study would be implemented.

Preliminary Experiment 3: The Use of Job Aids in Problem Solving

The third preliminary experiment conducted Winter semester, 1990, at Western Michigan University was designed to investigate the use of job aids (Mager, 1988) as a means of assisting students in solving problems correctly. Generally, a job aid is something that helps but is not needed to complete a job or task. Checklists are examples of job aids; a person can use a checklist as an aid in completing a sequence of steps, rather than memorizing that sequence. A job aid might become a learning aid, if the student can more readily complete a task after practice with the job aid than after practice without it. The job aids in this preliminary experiment consisted of lists of steps the students should go through in solving various verbal-reasoning problems (e.g., directional, analogy, decoding, etc.). Three students enrolled in an elective psychology course at Western Michigan University and served as the subjects in this experiment. Two of the three students had taken the course before, yet continued to score only about 50% on the WASI pretest and posttest.

There were many procedural changes in this third preliminary experiment.

Peer groups were eliminated and job aids were developed to guide and prompt each student through the steps they should take to solve various types of problems. The development and use of the job aids as a guide prevented better problem solvers, in peer-groups, from providing the answer rather than guiding poor problem solvers as they were supposed to do. Also, the experimental design was changed from a group design to a single-subject design. These changes were made for several reasons: (a) to increase the amount of time the students came into contact with the material; rather than solving every other problem, they would solve each problem; (b) to give the students better feedback and guidance when they were unable to solve a problem or they solved a problem incorrectly; (c) to collect better data; and (d) to insure the students were using the job aids.

Another procedural change was the collection of data, which was done throughout the investigation rather than simply the pretest and posttest results. Therefore, the experimenter not only had the pretest and the posttest scores to compare but also the students' performance on all the intermediate problems. The last procedural change was the categorizing of the separate types of problems. This enabled the experimenter to develop several general job aids for the eight types of problems.

The three students scored 53%, 45%, and 40% on the WASI pretest. Their scores on the posttest were 76%, 74%, and 58%. Although no statistical analyses were done, differences in students pretest and posttest scores were observed, as well as the number of times each student worked on a particular type of problem

with the job aid until obtaining 90% accuracy. The range of variability in the number of sets each student received to work on a specific type of problem, while using the job aids, was from two to seven.

At the close of this preliminary experiment, the students met with the experimenter to discuss the job aids and the problems. All three students thought the job aids were not useful because they did not think the job aids led them to correct answers. In the next preliminary study, both the job aids and the procedure were changed.

Preliminary Experiment 4: Development and Evaluation of Job Aids

The purpose of the fourth preliminary experiment conducted Fall semester, 1990, at Western Michigan University was to further develop and evaluate the effectiveness of two job aids for two types of verbal-reasoning problems: (1) directional (e.g., You are facing southwest and turn left twice. Then make an about-face. Which direction is your back toward?), and (2) decoding (e.g., In a foreign language el prodo par means ranch with style, and par frenes sul means wooden toy ranch. If viem sul el means play with toy, how would you say wooden style in this language?).

Three college freshmen volunteered to enroll in a one-credit-hour psychology course that met two days, each week, for the first seven weeks. They were selected because they had performed no higher than 70% on a problem-solving exercise their class participated in during the previous summer session. A single-

subject experimental design was used for the evaluation of the job aids.

Although there are eight types of verbal-reasoning problems in Whimbey's text, only two types and their associated job aids were developed for the fourth study. This was done to increase the amount of time the students contacted a specific type of problem with the appropriate job aid. To insure that the students used the job aids, the experimenter set up a special contingency where part of the students' grades were based on their using the aids.

The investigation of the job aids consisted of a pretest, a training phase, and a posttest. During the pretest and postest, the students received ten directional and ten decoding verbal-reasoning problems without the job aids. The pretest was identical to the test they had taken the previous summer session. The posttest used a different but similar set of questions.

During most of the training phase, the students received a special job aid to solve each of the two problems. They also used the think-aloud technique. The job aid was faded after 100% accuracy was achieved twice by the students. The fading began by not including the visual component and then removing parts of the written component. For example, one of the fading steps consisted of removing two drawn compasses that were functioning as visual aids. One student's performance continued to increase until 100% accuracy on quiz items was reached without the assistance of the job aid.

During the training phase, the following variables were measured: (a) the time it took for each student to complete each problem, (b) the time it took to

complete a set of ten problems, and (c) the numbers of problems within each set solved correctly.

The job aids were modified three times throughout the fourth preliminary experiment to remove ambiguity. The information from this study was used to set up specific durations for each test during the main study.

Although no statistical analyses were done, the two students who did receive job-aid training improved their performance to 90% and 100% accuracy on directional quizzes immediately upon receiving the job aid and maintained at that level throughout the course. The student who did not need the job aid took three problem sets to achieve 100% accuracy on directional quizzes and then had a fluctuating performance (range: 80% to 100%). It would appear that for two of the students the job aid was effective in increasing the performance of solving directional verbal-reasoning problems (see Table 1).

The sessions with the decoding verbal-reasoning problems were incomplete because one of the students had dropped out prior to taking any of the quizzes of the decoding section. Another student's performance was at 100% accuracy on all quiz sets without the use of the job aid. The final student's performance was at or below 70% before receiving the job aid and immediately increased to 100% accuracy after receiving the job aid and then fluctuated between 80% and 100%.

This fourth preliminary experiment suggested that, at least for the directional problems, the job aids could increase students' performance. The decoding

Table 1

Direction Verbal-Reasoning Performance

	Student #1 (Training with Job Aids)	Student #2 (Training with Job Aids)	Student #3 (No Training)
Summer Pretest	70%	60%	60%
Fall Pretest	70%	80%	80%
Problem Sets	Job Aid		
1	90%	50%	90%
2	100%	30%	100%
		Job Aid	
3	100%	100%	80%
	Fade		
4	100%	90%	90%
5	100%	100%	90%
6	100%	100%	100%
Fall Posttest	100%	** N/A	100%

category was dropped from the fifth preliminary experiment, to better concentrate on one type of problem.

Preliminary Experiment 5: The Validation of the Job Aid

The fifth preliminary experiment conducted Winter semester, 1991, at Western Michigan University was designed to validate the effects of the job aid and to determine whether improved performance was due to the job aid or some other variable. A combination of thirty-eight students enrolled in several introductory psychology courses volunteered to take the three tests.

A methodological change in the fifth preliminary experiment was a change from a single-subject to a between-group experimental design. In the previous experiment, the job aid appeared to make a difference; however, whether the difference was due to simple practice and not the job aid could not be determined. Therefore, a control group was added to assess if the training were the cause of the increase in students' performances.

A methodological error in this preliminary experiment resulted in a nonrandom assignment of students to the job-aid and no-job-aid group. This occurred because over half the students received 80% or more correct on the pretest. Therefore, only those students who scored 60% or below on the pretest were placed in the job-aid group so they could come in contact with the treatment.

For the job aid group, there were statistically significant differences between their pretest and middle test (with the job aid) mean scores ($t = -2.10$, $p < .05$), as well as between their pretest and posttest mean scores ($t = -2.43$, $p < .05$). Their scores were 62.35 on the pretest, 82.35 on the middle test, and 82.73 on the posttest. For the group that did not receive the job aid, there were no statistically significant differences between any of the tests.

The materials were identical for the fifth preliminary experiment and the main study. The main study was done to more accurately assess the effectiveness of the job aid.

CHAPTER III

INTRODUCTION

The purpose of the present study was twofold: (1) to test the effects of a job aid and feedback on increasing the performance of students completing directional verbal-reasoning problems and (2) to examine whether students' skills transferred to similar problems following the removal of the job aid. Many of the previous researchers utilized the think-aloud technique and or solutions generated by expert problem solvers (Bloom & Broder, 1950; Dufresne, 1988; Ross & Kennedy, 1990). However, although effective, the think-aloud technique is not practical in the classroom setting for several reasons: (a) students may overhear solutions given by others, (b) the level of noise may disturb some students, (c) the instructor may not be able to oversee whether students are solving problems or talking about unrelated material, and (d) the students may solve the problems for each other.

In the present study, a job aid was incorporated within the problems so students could use the techniques of an expert problem solver (the experimenter), without the possible inconveniences of the think-aloud technique. This is a follow-up on earlier successful and unsuccessful research dealing with transfer of training within a domain and using what might be called job aids (Ross & Kennedy, 1990; Tarmizi & Sweller, 1988). It differs in the domain of the skills

being taught and in the nature of the job aid. The domain, directional verbal-reasoning problems, is of special interest because it is one of the several domains Whimbey and Lochhead (1986) suggested must be mastered before performing well on common academic placement tests. The implication is that mastery of such skills will also have more general benefits. The job aid is of special interest because, if it proves effective, similar job aids could readily be developed for the teaching of the skills used in the other domains Whimbey and Lochhead suggest are relevant to performance on academic placement tests.

CHAPTER IV

METHOD

Subjects

During the second half of the winter semester of 1991, 55 undergraduate students at Western Michigan University were enrolled in one of two sections of a Black Americana Studies course, Black Experience. Thirty-one students were enrolled in one section and 24 students in the other. The course fulfilled one area of the general education requirement for undergraduates, and therefore had student enrollees classified as freshmen to seniors.

The 55 students were to take three tests involving directional verbal-reasoning problems; however, some students missed class during the tests, and therefore all three tests were not taken by all students. The students were informed that the exercises they would do were to assist a doctoral student with research and even though their class was participating in taking these tests as an exercise, their individual data would not be used unless they authorized its usage through a signed informed-consent sheet. Of the 55 students who took the tests, 39 gave their consent. Of the 39 students who gave their consent, 27 took all three tests; only their data were used.

Setting

The study was conducted at Western Michigan University, Kalamazoo, Michigan in a course that met three days per week on Monday, Wednesday and Friday.

Dependent Variables

The experimenter measured the following within-group comparisons: (a) the percentage of items correct on the pretest and the posttest to compare performance before and after the training with the job aid, (b) the percentage of items correct on the middle test to compare the performance of the students who received the job aid to those students who did not, and (c) the number of students who missed each individual question on each test.

Materials

Each of the students had three booklets, one for each of three tests: the pretest, middle test, and posttest. The pretest booklet contained: (a) a cover sheet asking for information about the student such as name, social security number, and classification; (b) directions such as "do not turn the pages of the test until instructed to do so"; and (c) a final sheet with ten directional verbal-reasoning problems. Each student received the same test. The posttest booklet was identical in format with two exceptions: (a) there was a different set of

directional problems, (b) a blank sheet of paper followed the questions to separate the problems from (c) the answer key that followed. All of the students also received the same posttest.

There were two middle-test booklets: one had a job aid incorporated within each problem that began to fade to no job aid after five problems. The other middle test had the same problems without a job aid. These two tests were arranged the same. However, the job-aid booklet contained a cover sheet that included a practice problem and an explanation of the use of the directional job aid and a small marker, a notebook tab, that accompanied the directional job aid (see Figure 1). The marker was used with the visual aid, two drawn compasses that were included in the written job aid (see Figure 2). During the middle test, the students' use of the job aid was encouraged and monitored by embedded instructions asking them to leave specific evidence of use of the job aid. An example of such evidence would be answering a question asking which of the two compasses was appropriate. This was also done to evaluate whether the students were actually using the job aid to assist them in solving the problems or whether

Figure 1. The Upright Visual Aid Marker Held by Students While They Completed Directional Verbal-Reasoning Problems on the Middle Test.

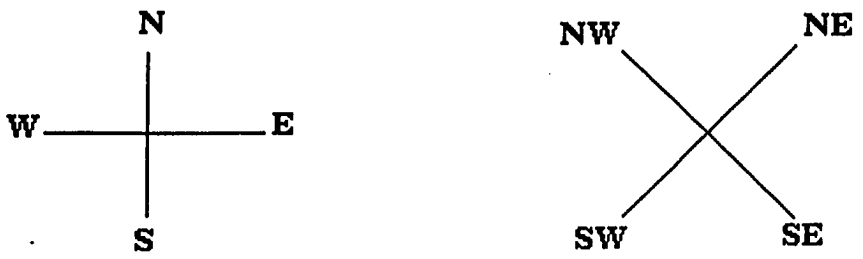

Figure 2. The Visual Aid, Two Drawn Compasses, Used by Students While They Completed Directional Verbal-Reasoning Problems on the Middle Test.

they were using some other technique.

Instructions were presented on the first page. There was only one problem on each page. Above the problem was the answer to the preceding problem. A blank sheet of paper was inserted between problems to prevent students from seeing the answers on the next typed page.

The directional job aid had a visual component, drawn compasses; and to insure the students were pointing in the correct direction, the experimenter provided a notebook tab (a divider) with the words "Front" written on one side and "Back" written on the other. In the corners of the front and back were written the letters "L" and "R" to depict the left side and the right side. The students were instructed to use this as a model of themselves in solving the problems.

The experimenter used between four and six questions that were identical in structure in the pretest and the middle test. There were four questions that used the NE, SE, NW, SW directions, and six questions that used N, S, E, W

directions. On the posttest, there was five questions N, S, E, and W and five questions for the other.

Procedure

The investigation consisted of two meetings with each of the two classes. During the first meeting, the experimenter distributed copies of an informed-consent sheet as well as another sheet with the experimenter's telephone number and office number. The sheet with the experimenter's telephone number was distributed to the students to insure they were able to contact the experimenter if they had further questions regarding the tests they were taking. The informed consent instructions were read by the students as well as by the experimenter to the students, before testing took place. It was stressed before the pretest that the students write down any information they used that assisted in solving the problems. The experimenter used this information in the analysis of the results to note whether students were using something like the visual aid component of the job aid prior to being introduced to it.

Then the students received the pretest with two minutes to read through the first page and write their name, classification, social security number, and date. The experimenter collected pretest data from the students by informing them, "For complete credit you must have something written down beside at least one of the problems that explains what you did to solve the problem (e.g., a chart, I visualized ___?)." The students then turned to the next section where they were

given ten minutes to complete 10 directional problems. After solving the problems they closed their pretest booklets and waited for further instruction. When all students were finished, or when ten minutes had elapsed, the test booklets were collected by the experimenter (all of the subjects completed the tests). The meeting lasted twenty minutes. The experimenter randomly divided the students into two groups after the pretest was graded. The students were placed in either the job-aid group or the no-job-aid group according to their pretest scores and then by randomly assigning one student to a group and the next student to the other group.

The overall procedure for the administration of the middle test was identical to that of the pretest. Those in the job-aid group had more information to read and therefore took longer to complete the ten questions. However, the job aid was faded starting from the sixth question to no-job-aid assistance, except for the marker, on the tenth question. The fading began by omitting the visual component and then removing parts of the written component. The students still had up to ten minutes to complete the test, which the students in both groups could accomplish. The experimenter asked those who had the test without the job aid to sit quietly until the others were done. The middle test took approximately 10 minutes.

Generally, the format of the posttest, also given on the second meeting, was identical to the pretest. There were ten directional questions, and no job aid was available. The posttest differed from the pretest in that at the end of the test, all

students did have the answers provided. The duration of this phase was also 10 minutes.

Experimental Design

This study used a reversal design (ABA) to evaluate whether students' performance on the middle test would improve upon implementation of the job aid. The ABA within-group comparison design was combined with between-group comparisons to better evaluate whether the job aid caused a change in performance.

CHAPTER V

RESULTS AND DISCUSSION

The present data do not support the use of incorporated job aids as a way of improving problem-solving performances of students working with directional verbal-reasoning problems, either while working with the job aid or after it is removed (see Table 2). Using t tests to compare means for the job-aid group versus the no-job-aid group across all three tests indicates no statistically significant differences. Within-group comparisons also failed to show statistically significant differences.

Table 2

Average Test Scores

Group	Pretest	Middle Test	Posttest
Job Aid	5.53	5.33	5.8
No Job Aid	6.0	5.58	4.91

An examination of the pretest answer sheets showed that half the students in the no-job-aid group and a little under half in the job-aid group already used a drawn compass similar to the visual aid job-aid provided in the middle test. A

few other students reported using other techniques to assist them in solving the problems, techniques such as visualization of themselves on a map (see Figure 3). The data support the study's conclusions regarding the performance of students who used the job aid, that is, the job aid did not improve students' problem solving ability. The records of job-aid usage during the first five questions of the middle test were examined. This provided evidence that again only about half the students in the job-aid group used the job aid on any given question (see Figure 4). It is possible, however, that some students used the job aid, without providing evidence of doing so. Furthermore, even on those questions with evidence of use of the job aid, only 48% of the answers were correct (see Figure 4). And there was no obvious superiority when the job aid was used.

The present study evaluated the following questions: (a) whether students

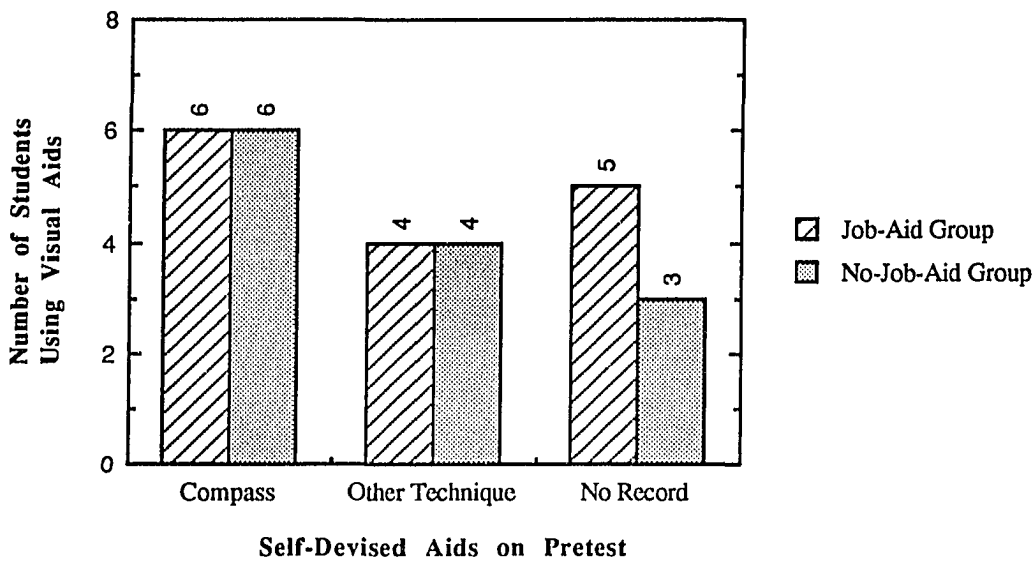

Figure 3. Self-Devised Aid Used on the Pretest.

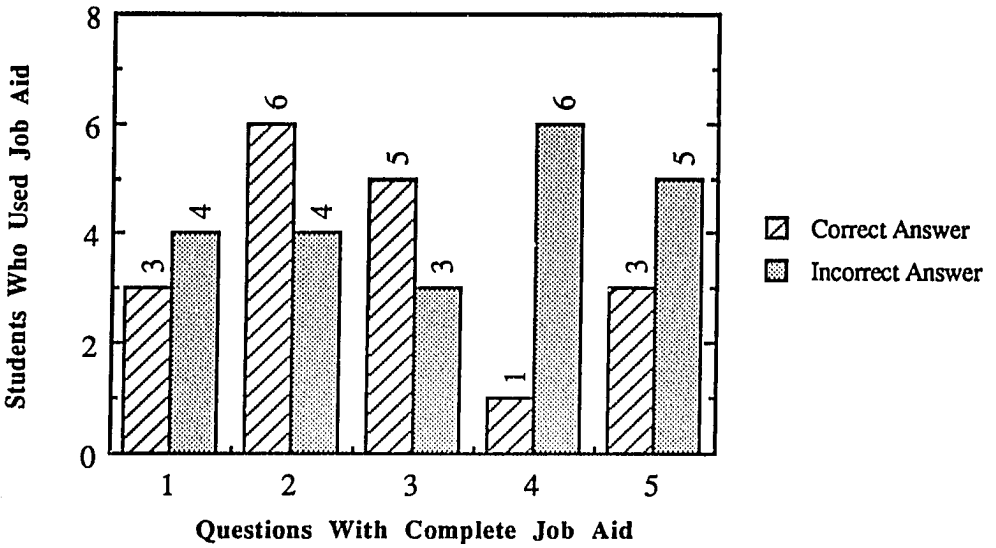

Figure 4. Students Who Used the Job Aid per Question and Their Performance.

would perform better on a test that incorporated a job aid and feedback when compared to another group that received feedback only; and (b) whether the use of a job aid would lead to a transfer of skills to similar problems. Concerning the first question, there are two reasons why the job aid seemed likely to work, though it did not. First, the students were given a step-by-step guide to lead them to the correct answer; and second, the preliminary studies seemed to indicate a difference would occur because of job aid usage. But, again, the data in this study suggest otherwise. The students' performances were similar across all tests. And, although a complete job aid was included for the first five questions of the middle test for one group, that group did not perform any better than the other on those five questions (see Figure 5).

A positive answer to the second question concerning the possibility of

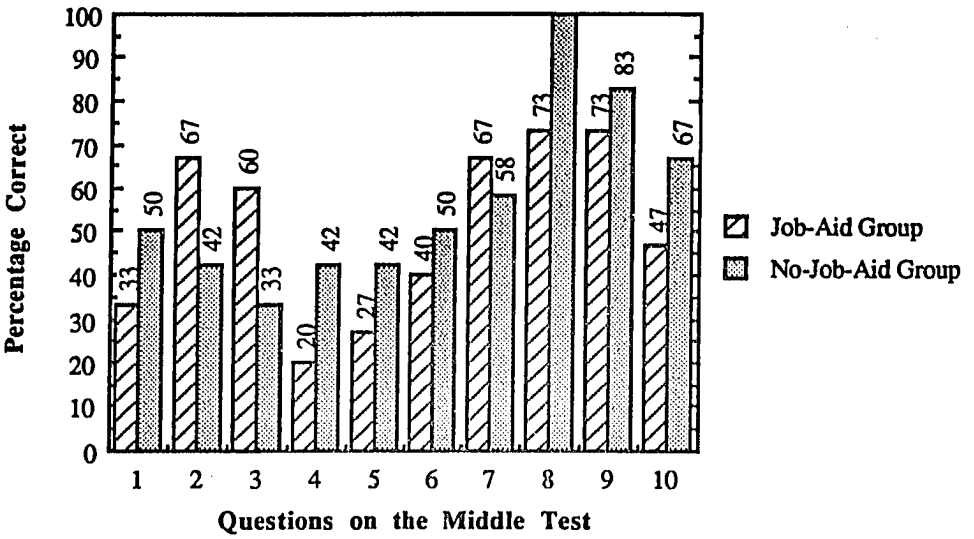

Figure 5. Middle Tests Performances for the Job-Aid and No-Job-Aid Group.

transfer of improved skills to similar problems no longer seemed plausible, because the skills showed no improvement even when the job aid was being used in the middle test.

The preliminary experiments supported some of the findings reported by Whimbey (1980) and Whimbey and Lochhead (1986). These researchers claimed to improve performance by using global and general training techniques. Like Whimbey's results, the performance of students in the preliminary experiments also showed an improvement. However, after doing a more detailed analysis and using a more rigorous research methodology, no effects were found. Perhaps the rigor of the main experiment eliminated an important component of the technique. A possible important component was the types and number of problems used in the experiment. In the final study, only one type of problem was used.

This reduction consequently decreased the amount of thinking behavior the students would be required to emit to solve multiple types of problems. Because the purpose of Whimbey and Lochhead's (1986) text is to improve students' thinking skills by training them to become more active problem solvers, maybe reducing the types of problems and the amount of thinking a student must emit to gain mastery hinders rather than assists in gaining skills on a single problem.

In the preliminary experiments there were methodological differences that perhaps could account for the statistically significant differences and some of those changes might account for the failure to replicate the earlier findings in the main study.

For example, in the fifth preliminary experiment, a different population of students was used; this could account for the differences in the students' performances across tests. However, there were confounding variables because of the lack of random assignment to groups.

In the fourth preliminary experiment, two types of problems were used, there was a single-case design rather than a group design and the students received 70 questions during training compared to a total of 30 questions received by the students throughout the main study. Also, there were more effective contingencies in the fourth preliminary experiment that might account for the differences in the scores.

In the first and second preliminary experiments, the Whimbey Analytical Skills Inventory (Whimbey & Lochhead, 1986) was used. Even though in

Whimbey and Lochhead's studies, several components were used (Piagetian-based science laboratories, vocabulary enhancement, problem solving and reading exercises using the thinking aloud technique), even without using all of Whimbey's (1980) components in the first and second preliminary experiments, statistically significant differences were found. Compared to the main study, the students in the first and second preliminary studies were able to practice completing the various types of problems throughout the semester, which was not the case in the main study, where the students received three booklets to complete, each taking a total of 10 minutes.

Even though statistically significant differences were found in the first two preliminary experiments, the students' performances were still low on the posttest (approximately 60%). The development and the continuation of the experiments was to improve the students' performance to a level that would be considered above average or good, according to the letter grades in college (approximately 80% correct).

However, because of the findings of these experiments, and the main experiment specifically, it is concluded that it is difficult to improve intellectual skills and any program that is used for that purpose should be rigorously tested to insure that the effect it is reported to have is valid.

Even though the results of this particular study do not support the use of job aids, at least for this particular type of problem, a future experimenter should not rule out job aids as being beneficial to the student. For another experiment

in this area, it is suggested that the experimenter arrange to have some sort of contingencies in place to make it more likely that the students work to obtain a desired end, such as points toward a final grade. This would enable the experimenter to better rule out lack of effort and failure to use the job aid as a cause for low performance.

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Appendix A

Informed Consent Form and and Human Subjects Institutional Review Board Letter of Approval

INFORMED CONSENT FOR PARTICIPATION IN A RESEARCH STUDY

Dear Student:

You are invited to participate in a research study to be conducted by Angela M. Williams, a graduate student in the Applied Behavior Analysis Program at Western Michigan University. Angela will be investigating the effects of a job aid and feedback as a method of teaching the accurate solving of one type of verbal-reasoning general problem.

As a student participating in BAS # 200, I would like your permission to review some information that will be collected during the time of your class. This information consists of your performance on three problem solving exercise booklets. I will meet with your group on two different occasions to present to you directional verbal-reasoning problems. This information may be included in my dissertation research on improving problem solving through the use of a job aid and feedback.

Your name will not be seen by anyone other than myself and perhaps one other graduate research assistant (for scoring accuracy checks). The information that will be used within the dissertation itself is the data on your performance, I would also like your permission to review your high school grade point average and your entering ACT or SAT scores.

If you do not want me to use these data, do not sign your name to this sheet. Only those students who have signed the consent form will have their academic records investigated. You will not be penalized in any way for not allowing me to use this data, also, your course grade will not be affected in any way by the outcome of these tests. However, if it is acceptable that I review and use this information please sign below.

As a participant, you may withdraw your consent and discontinue participation at any time without penalty. If you have any questions or concerns please feel free to contact me, Angela M. Williams at 375-1257. I will be passing out a separate sheet of paper with my name and telephone number on it for your use if you have any concerns.

IF YOU AGREE PLEASE SIGN BELOW. YOUR SIGNATURE INDICATES THAT YOU UNDERSTAND THE ABOVE INFORMATION AND HAVE DECIDED TO VOLUNTARILY PARTICIPATE.

Participant's Name:_____ Date:_____

Human Subjects Institutional Review Board

Kalamazoo, Michigan 49008-3899

WESTERN MICHIGAN UNIVERSITY

Date: January 30, 1992

To: Angela Williams

From: Mary Anne Bunda, Chair Mary Anne Bunda

Re: HSIRB Project Number: 91-04-32

This letter will serve as confirmation that your research protocol, "Job Aids, Feedback, and the teaching of verbal-Reasoning" has been approved under the exempt category of review by the HSIRB. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the approval application.

You must seek reapproval for any changes in this design. You must also seek reapproval if the project extends beyond the termination date.

The Board wishes you success in the pursuit of your research goals.

xc: Richard Malott, Psychology

Approval Termination: January 15, 1993

Appendix B

Pretest Form

NAME: _____

DATE: _____

SEMESTER: _____

Last four digits of your SS#: _____

Classification: _____

The following booklet consist of ten questions that you are to answer to the best of your ability. There are a few important matters that are extremely important before you start to answer the questions. First, do not turn any of the pages of the booklet until told to do so. Second, after you are finish with one page you can not turn back to the previous page. Third, as soon as you are completed with the 10 problems, close the booklet and wait for further instructions.

After reading the directions please wait until told to turn to the next page.

Section # 1: 10 minutes for 10 problems

For each problem on the following page, write down your answer and any information that you used to help you solve the problem. **For complete credit you must have something written down beside at least one of the problems that explains what you did to solve the problem.** (i.e. a chart, I visualized ___?)

Last four digits of SS# _____

1. Your left side is toward the south. You then make a left turn. Which direction is your left side on now?

2. You are facing north. You turn left then make an about-face. Which direction are you now facing?

3. You are facing west. You turn right, then make another right. Make an about-face. Which direction is behind you?

4. You are facing east and turn left. Make another left turn. Then four right turns. Which direction is behind you?

5. You are facing northwest then turn to face southeast. Make an about-face. Which direction are you facing?

6. You are facing southeast and turn left. Which direction is your left side facing?

7. Your back is toward the southeast and then you turn right. Turn to face northeast. Then make another right turn. Which direction are you facing toward now?

8. Your back is toward the southwest and then you turn right. Turn to face northeast. Then make another right turn. Which direction is your back toward now?

9. You are facing east and turn right. Which direction is your right side facing?

10. You are facing north and make three left turns. Make an about-face then turn right. Which direction is your back towards?

Appendix C

Middle Tests With and Without the Job Aid

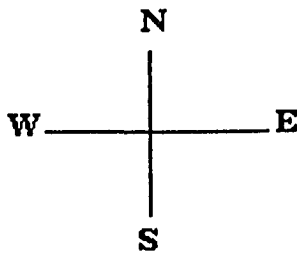
NAME: _____ DATE: _____
The last four digits of your SS#: _____ Year: _____

The following booklet consist of another set of ten problems that you are to answer to the best of your ability. As with the previous test, you are not to turn through the pages of this booklet, also after you have completed the 10 problems, close the booklet and wait until given further instructions and finally, after you have completed one page, you are not to turn back to the previous page.

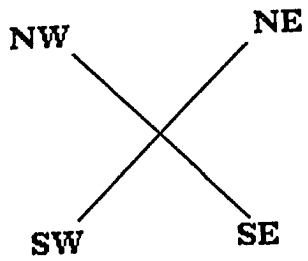
After reading the directions below, please wait for further instructions before you begin the answer the problems.

Directions

Use the following drawings (called visual aids) to assist you in solving the first 10 problems. Also use the attached marker to work with while solving the problems. Remove the marker from the paper now and you will be told what to do with it.



visual aid #1



visual aid # 2

attached marker

Example Problem: If you are facing north and turn left which direction are you facing? **Place the front of the marker toward N on visual aid # 1, then turn to the left side "of the marker," that direction is your answer.** (West)

Example Problem 2: If your back is toward the Southwest and you make two right turns, then a left turn, which direction is your back toward now? **Place the back of your marker toward SW on visual aid # 2 (that means the front of your marker should be facing NE), then make two right turns to the right of the marker. Now make a left turn. Which direction is your "back" toward now?** (Northwest)
Practice completing the given problems until you obtain the correct answers.

Turn to the next page only and complete the readings

A. 1st draw or choose the visual aid that will help you correctly solve the problem. If the problem has one of the directions (north, south, east or west) in it, the 1st visual aid should be used.

B. If the problem (as in # 2) began with (northwest, southwest, SE or NE, then visual aid # 2 should be used.

C. If the problem asks you to do an about-face it is asking you to do a half turn (the opposite side of where you were facing before). Example: if you are facing west and do an about face, you will turn to face the east; W--------> E. Or if you are facing SW and do an about face, you will turn to face NE; SW->NE.

D. Finally, your marker is to be used for each question. Make sure the front of the marker is facing the direction on your visual aid that the problem tells you to face or the back is towards the direction it tells you to begin with.

E. **You can write anything on the paper that will help you to solve the problems.**

Section # 1: 20 minutes for 10 problems

Read Everything Carefully

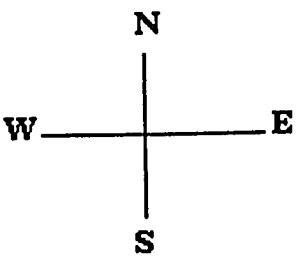
A. Read through the problem and steps B - D (below) and circle the appropriate visual aid.

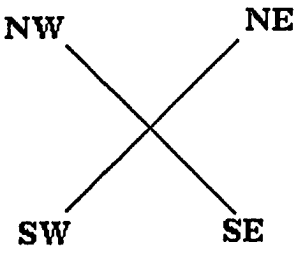
1. You are facing southeast and make an about face. Then turn right twice. Which direction is on your left side?

B. Put your marker on the direction the problem first starts with (either with the back or the front of the marker toward the direction as the problem directs you).

C. Continue to move your marker in the direction the problem tells you to move.

D. **Circle your answer to show that you are reading this.**





Visual aid # 1 Visual aid # 2 Your answer:

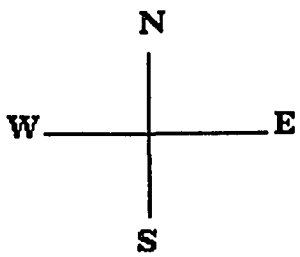
The answer to question # 1 is Northeast

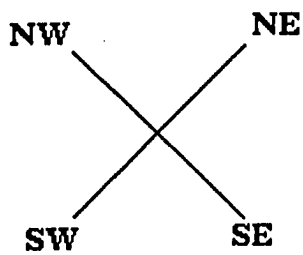
A. Read through the problem and steps B - D (below) and circle the appropriate visual aid.

2. You are facing northwest and make a left turn. Turn right then make another right. Now which direction is behind you?

B. Put your marker on the direction the problem first starts with (either with the back or the front of the marker toward the direction as the problem directs you).

C. Continue to move your marker in the direction the problem tells you to move. **Make a square around this sentence.**





Visual aid # 1 Visual aid # 2 Your answer:

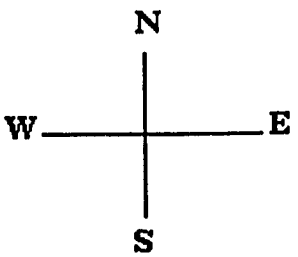
The answer to question # 2 is Southwest

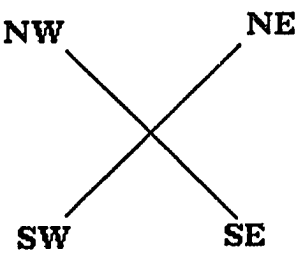
A. Read through the problem and steps B - D (below) and circle the appropriate visual aid.

3. Your back is toward northeast. You make an about-face. Then turn right twice. Which direction is on you left side?

B. Put your marker on the direction the problem first starts with (either with the back or the front of the marker toward the direction as the problem directs you).

C. Continue to move your marker in the direction the problem tells you to move.





Visual aid # 1 Visual aid # 2 Your answer:

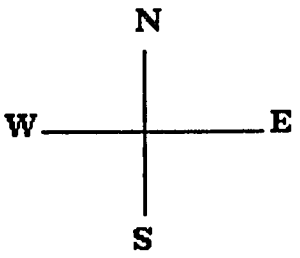
The answer to question # 3 is Southeast

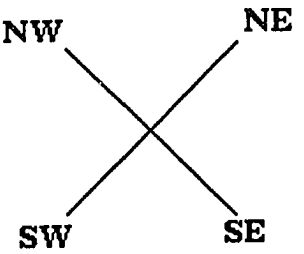
A. Read through the problem and steps B -C below and **underline** the appropriate visual aid.

4. Your back is toward southeast. After making a left turn, make an about-face. Which direction are you now facing?

B. Put your marker on the visual aid, on the direction the problem first starts with (either with the back or the front of the marker toward the direction as the problem directs you).

C. Continue to move your marker in the direction the problem tells you to move.





Visual aid # 1 Visual aid # 2 Your answer:

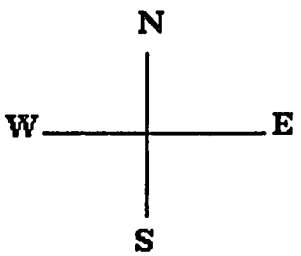
The answer to question # 4 is Southeast

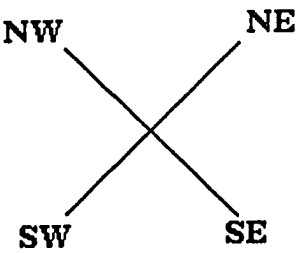
A. Read through the problem and steps B - C (below) and circle the appropriate visual aid.

5. Your back is toward southeast. After making a left turn, make an about-face. Which direction are you now facing?

B. **Underline the direction the problem first begins with.** Put your marker on the direction the problem first starts with (on the visual aid).

C. Continue to move your maker in the direction the problem directs you to move.





Visual aid # 1 Visual aid # 2 Your answer:

The answer to question # 5 is Northeast

A. Read through the problem and steps B - C (below).

6. You are facing northwest and then make a right turn. After making another right turn which direction is on your right side?

B. Put your marker on the direction the problem first starts with (either with the back or the front of the marker toward the direction the problem first starts with).

C. Continue to move your marker in the direction the problem tells you to move.

Write your answer here: _____

The answer to question # 6 is Southwest

A. Read through the problem and steps B - C (below).

7. You are facing south and make a right turn. Make another right turn then an about-face. Turn left. Which direction are you now facing?

B. Put your marker on the direction the problem first starts with (either with the back or the front of the marker toward the direction the problem first starts with).

C. Continue to move your marker in the direction the problem tells you to move. **Circle your answer.**

Write your answer here: _____

The answer to question # 7 is East

A. Read through the problem

8. If you are facing east and turn right twice. Which direction would be directly behind you?

Write your answer here: _____

The answer to question # 8 is East

9. Your right side is toward the north. Which direction are you facing?

Write your answer here: _____

The answer to question # 9 is West

10. You are facing southwest and turn left twice. Then make an about-face. Which direction is your back toward?

Write your answer here: _____

The answer to question # 10 is Northeast

NAME: _____

DATE: _____

Last four digits of SS#: _____ Classification: _____

The following booklet consist of another set of ten problems that you are to answer to the best of your ability. Please do not turn through the pages of this booklet and do not begin to answer the problems until told to start. Again, you can not turn to a previous page after you have turned from it.

Section # 1: Time 10 minutes, for 10 questions.

For each problem in this section, write down your answer and write down any information that you used to help you solve the problem. **For complete credit you must have something written down beside at least one problem that explains what you did to solve the problem.** (i.e., chart, I visualized ____).

Please wait to turn the page until told to do so.

Last four digits of SS# _____.

1. You are facing southeast and make an about-face. Then turn right twice. Which direction is on your left side?

Write your answer here _____

The answer to question # 1 is **Northeast**

2. You are facing northwest and make a left turn. Turn right then make another right. Now which direction is behind you?

Write your answer here _____

The answer to question # 2 is **Southwest**

3. Your back is toward northeast. You make an about-face. Then turn right twice. Which direction is on your left side?

Write your answer here _____

The answer to question # 3 is **Southeast**

4. You are facing southwest and turn right. Make an about-face, Which direction are you facing?

Write your answer here _____

The answer to question # 4 is **Southeast**

5. Your back is toward southeast. After making a left turn, make an about-face. Which direction are you now facing?

Write your answer here _____

The answer to question # 5 is **Northeast**

6. You are facing northwest and then make a right turn. Make another right turn then an about-face. Turn left. Which direction are you now facing.

Write your answer here _____

The answer to question # 6 is **Southwest**

7. You are facing south and make a right turn. Make another right turn then an about-face. Turn left. Which direction are you now facing?

Write your answer here _____

The answer to question # 7 is **East**

8. If you are facing east and turn right twice. Which direction would be directly behind you?

Write your answer here _____

The answer to question # 8 is **East**

9. Your right side is toward the north. Which direction are you facing?

Write your answer here _____

The answer to question # 9 is **West**

10. You are facing southwest and turn left twice. Then make an about-face. Which direction is your back toward?

Write your answer here _____

The answer to question # 10 is **Northeast**

Appendix D

Posttest Form

NAME: _____

DATE: _____

SEMESTER: _____

Last four digits of your SS#: _____

Classification: _____

The following booklet consist of the final set of ten problems that you are to answer to the best of your ability. As with all of the previous exercises, please do not turn through the pages of this booklet. Once you are finished with one page do not turn back to a previous page. And after you have finished the ten problems, close your book and wait until you are given further instructions.

Section # 1: 10 Minutes for 10 problems

Last four digits of your SS#: _____

For complete credit please write down any information (beside at least one problem) that you used to assist you in solving each of the problems.

1. If you are facing north and turn right twice. Then turn to your left side. Which direction is on your left?

2. If your back is toward southeast and you then turn left, then make a right turn, which direction are you now facing?

3. If you are facing west and make an about-face then make two right turns, which direction are you now facing?

4. If you are facing northwest and turn right, then make a left turn which direction is your back toward?

5. If you are facing east and make an about-face then turn left which direction are you now facing?

6. If you are facing south and turn right twice then make an about face, which direction would be on your right side?

7. If your left side is toward northeast and you turn right which direction would you now be facing?

8. If your right side is toward southwest and you make an about-face, which direction would you now be facing?

9. If you were facing southeast and turn left three times then make an about-face, which direction would your right side be on now?

10. You are facing north and make a left turn. Turn right then make another right. Now which direction is behind you?

The Key

1. N
2. Se
3. W
4. Se
5. S
6. W
7. Sw
8. Ne
9. Sw
10. W

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