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THE EFFECT OF ALTERNATIVE TYPE QUESTIONS AS
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ON THE PROBLEM-SOLVING SUCCESS OF SIXTH GRADERS
OF PORTAGE COUNTY, OHIO.

The Ohio State University, Ph.D., 1971
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THE EFFECT OF ALTERNATIVE TYPE QUESTIONS
AS COMPARED WITH NON-ALTERNATIVE TYPE
QUESTIONS ON THE PROBLEM-SOLVING
SUCCESS OF SIXTH GRADERS
OF PORTAGE COUNTY, OHIO

DISSERTATION

Presented in Partial Fulfillment of the Requirement for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

by

James W. Battoclette, B.A., M.E.

The Ohio State University
1971

Approved by

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Department of Curriculum
and Foundations
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FIELD OF STUDY

Major: Curriculum and Instruction: K-12
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CHAPTER I

INTRODUCTION

The literature leaves no doubt as to the schools' responsibility to help children and youth use problem-solving to facilitate learning. As a consequence, one of the major tasks of the teacher is to structure the learning act in such a way as to facilitate problem-solving.

Ferns regards problem-solving as both a method of learning and as a goal of the school. He states that "it is a means for achieving educational objectives including improvement of problem-solving abilities." He contends that problem-solving is also an end, or an objective of education because of its significance as a method of acquiring knowledge. He further states that "the problem-solving method is practically synonymous with learning, and there are indications that problem-solving is generally equal or superior to other methods of learning."

Background of the Problem

Various aids have been used to affect problem-solving success. More specifically, experiments in which aids have been used to affect


problem-solving success have been reported by Duncan (Maltzman, Eisman, Brooks, and Smith, 1956; Burack and Moos, 1956; Reid, 1951; Marks, 1951). Duncan contends that all of the studies on aids found that at least some kind of aid was effective, sometimes very effective in improving problem-solving success. He states that "studies of variation among problem elements consistently reported at least significant effects, occasionally powerful effects, on problem-solving performance. Performance on a problem may or may not be influenced by contextual variables, such as methods of presentation that do not change relationships among elements of a problem. But changes of a problem's internal structure usually influence performance even in cases where the problem remains, in some physical sense, the same."

Ausubel similarly states that "guidance in the form of hints will clearly tend to facilitate problem-solving (Burack and Moos, 1956; Maltzman, Eisman, Brooks, and Smith, 1956; M.R. Marks, 1951; Reid, 1951), and it is easily believed that hints would be pedagogically effective in developing problem-solving skills, at least in the early stages."

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Davis\textsuperscript{6} contends that in most problem-solving tasks, the response alternatives are not clearly defined for the subjects. Thus the subject must generate his own alternatives which he tests and rejects until the correct response is rewarded by the solution to the problem.

\textbf{Statement of the Problem}

This study proposes to show the effect of alternative type questions as compared with non-alternative type questions on the problem-solving success (performance) of a random sample of sixth grade children from the Portage County, Ohio schools.

In this study the writer classifies questioning as alternative and non-alternative and stipulates alternative type questions as those that directly generate or suggest for the learner a number of alternatives which serve as an aid or a hint to affect problem-solving success, while non-alternative type questions either do not or only indirectly generate or suggest a number of alternatives for the learner. Thus the alternative question is stated in such a way as to offer a choice of possible answers (alternatives). In contrast, the non-alternative question is stated as such that the learner himself must generate possible answers.

Success in problem-solving is defined as the recognition of the large, central idea, the intended sub-generalization related to the topic presented in the problem situation and the identification of the

generalizations that have universal application. Brownell and Hendrickson⁷ state that "generalizations are products of problem-solving. Not all problem-solving leads to generalizations, but generalizations are attainable in no other way. And since the fundamental learning process in acquiring generalizations is that of problem-solving, the teaching of generalizations consists in guidance in problem-solving with all that the statement implies."

The word "problem" is defined as a question, either of the alternative or the non-alternative type, for which the student does not have an immediate definite answer. The writer regards alternative questions as closed questions - closed because they do not offer the learner the opportunity to generate his own hypotheses (possible answers) but limits his choice to a select number. Non-alternative questions are regarded as open - open because they permit the learner to generate many possible answers (hypotheses) which offer many possible choices.

Problem-solving, accordingly, is the process whereby the learner selects or generates an answer (hypothesis) to the problem question presented. Then with specific inputs (related information) tests whether his first answer (hypothesis) is correct. If the learner decides that his first answer is correct the process is finished. However, if the learner judges that his first answer is not correct, he selects or generates another answer which he concludes is the correct

To help facilitate the problem-solving process the writer proposes the use of comparative problem questions of the alternative and non-alternative type.

A comparative problem question is defined as a question that compares, e.g., two or more factors, two or more things, two or more groups, two or more peoples.

A comparative problem question of the alternative type compares, for example, two peoples on a particular item; and the question itself, that is, the wording of which is such that it offers a choice of possible answers.

A comparative problem question of the non-alternative type suggest no such choice of possible answers.

Need and Value of the Study

Questioning strategies employed by teachers to enable children to develop toward higher levels of cognitive behavior are reviewed by Crump. The literature on questioning showed no use of alternative or non-alternative comparative type questioning to facilitate problem-solving.

Crump mentions that among other uses, questions are utilized to stimulate learning and to draw conclusions and generalizations. In analyzing the questions used by textbooks and teachers, the literature

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9 Ibid.
indicates that comparative problem solving questions are not frequently used to stimulate learning.

Perhaps the simple classification of questioning as alternative and non-alternative and the knowledge that one leads to greater or lesser problem solving success, or that both lead to equal success will add an additional questioning strategy.

Perhaps the use of the alternative question strategy by students who find intellectual problem-question generation difficult will help them move toward the utilization of the more open alternative type questioning technique.

Perhaps the alternative - non-alternative questioning strategy will aid teachers in the development of self-instructional materials and help move toward the realization of the one-to-one curriculum advocated by Frymier. 10

**Delimitations of the Study**

Thorndike 11 has suggested that problems be divided into two broad categories: "(1) practical problems - involving the need to get something done, and (2) intellectual problems - involving the need to understand." This study will limit its investigation to the second category - intellectual problems in the form of alternative and non-alternative comparative type questions.

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Hebb suggests that "we should distinguish between two modes of thought: (1) discovery or invention, the attaining of new ideas, and (2) verification, the process of testing, clarifying and systematizing them." The first mode, insightful problem-solving usually involves situations which are unstructured, that is, the behavior of individuals is observed but the subject is not asked to react to a written test. The second mode, verification problem-solving involves structured situations. Subjects are required to react in written form, and a product is involved. While insight is used by the learner during the problem-solving process, the emphasis is upon obtaining some verification of problem-solving success. This study will limit its investigation to verification problem-solving and through the use of alternative and non-alternative type questions via the problem-solving model attempt to show differences in problem solving success (performance).

The research population sample included in this study is limited to the geographical area of Portage County, Ohio and is to include a random sample of 220 sixth graders (110 each in the experimental and control groups) from the Portage County school system. The geographical area of Portage County was selected because the local school districts included comprise a discrete population entity. Sixth graders were selected for two major reasons: the writer's experience of twenty years with sixth grade age children, but more importantly Piaget's

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findings indicating that operations dealing with hypotheses expressed in verbal propositions become apparent around eleven and twelve years of age.

Basic Assumptions

A number of assumptions which are considered basic to this study are listed as follows:

1. That subjects will make use of the hints included in the alternative questions and not rely solely on the specific inputs (related information) to aid in the identification of the substantive and sub-generalizations, the posttest items.

2. That the subjects will utilize the problem-solving model as intended by the writer.

3. Sixth grade students of the Portage County, Ohio, schools are developmentally ready for the simulated exercises included in this study.

4. Sixth grade students of the Portage County, Ohio school are sufficiently mature to react positively to the simulated materials which comprise the mode of data gathering for this study.

5. That the subject matter included in the simulated exercises is neither too difficult nor too easy to stimulate positive reaction toward alternative questions as compared to non-alternative questions if such differences do statistically exist.
**General Plan of the Study**

Five integrated problem-solving exercises organized in booklet form are to be used by the subjects. Only the type of questions is to be varied - the experimental group, alternative question and the control group, non-alternative questions.

Early copies of the simulated exercises were used with four groups of sixth graders from the Ravenna City schools to determine the suitability of the material with children of this age level. Changes in vocabulary, content, and length were indicated after two field-tries. After the changes the exercises were administered to two additional sixth grade groups. A manual to be used by the investigator (the writer) to administer the exercises was similarly developed. (See: Appendixes A, B, and C).

The five integrated problem-solving exercises designed around the following problem-solving model is to be the treatment for both the experimental and control groups. The treatment is to be administered to all the subjects in the experimental and control groups simultaneously. Only the type of problem-solving question will be varied - the experimental group is to be given the alternative questions, and the control group the non-alternative questions.

**Problem-solving Model**

1. Introduction of the problem question
2. Statement of the problem question
3. First reaction to the problem question (hypothesis)
4. Presentation of specific inputs
5. Second reaction to the problem question (verification).
Immediately after each exercise situation, a posttest is to be administered to the subjects. Each posttest is to consist of two pairs of substantive generalizations and two pairs of sub-generalizations.

The five exercises - introduction, treatment, and posttest - take approximately 50 minutes to administer.

The statements that comprise the substantive generalization part of the posttest were administered to a random sample of 100 sixth graders from three Ravenna City schools to determine how well sixth grade students can already answer the items correctly from prior knowledge or experience. (See: Appendixes D, E, and F).

Organization of the Study

Chapters two, three, four, and five are organized as follows:

Chapter II is to be a review of related research and pertinent literature involving research of the influence of hints and aids on intellectual problem-solving success (performance), the use of problem-solving models to guide learning, and the utilization of questioning strategies to facilitate problem-solving.

Chapter III is to be a descriptive explanation of the design of the study. It will make reference to the treatment exercises and the posttest along with the statistical procedures required for the collection of data.

Chapter IV is to include the report of the data collected through the statistical procedure outlined in Chapter III.

Chapter V is to include a summary of the findings of the study, the conclusions reached, the inferences suggested, and the implications for further additional research.
CHAPTER II

REVIEW OF RELATED RESEARCH AND PERTINENT LITERATURE

In reviewing the literature the investigator considered three general areas to be related to the present study, namely, the use of problem-solving models to guide learning, research of the influence of hints and aids on intellectual problem-solving success (performance), and the utilization of questioning strategies to facilitate problem-solving.

The investigator will first present the problem-solving models as summarized by Russell; second, review the research on hints and aids as suggested by Duncan and Ausubel; and finally, list the questioning strategies as identified by Crump. A summary statement relating the three areas to this study will conclude the chapter.

The Use of Problem-solving Models to Guide Learning

Russell illustrates a number of problem-solving models. He emphasizes that these models are no more than hypotheses about problem solving. He states that "probably the most influential analysis

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16Ausubel, Educational Psychology: A Cognitive View, p. 547.
18Russel, Children's Thinking, p. 256.
of problem-solving is that of Dewey in *How We Think*, first published in 1910.¹⁹

The essence of Dewey's²⁰ theory is that problem-solving involves five stages, described as follows:²¹

1. A state of perplexity, doubt, frustration, or the like.
2. The identification of what is believed to be the problem.
3. A search for facts and a formulation of possible solutions.
4. The testing of successive solutions and, when necessary, the reformulation of the problem.
5. The application of the correct solution.

The influence of Dewey on other problem solving models can be seen in the summaries of subsequent models, e.g., Gray, Johnson, Thorndike, Bloom and Broder, Hullfish, Syngg.

Gray²² contends that problem-solving may be analyzed into a series of steps as follows:

1. Sensitivity to problems
   A problem is a difficulty or a situation which demands adjustment.

2. Knowledge of problem conditions
   Problems can be stated, but they cannot be understood until data have been collected concerning them.

3. Suggested solutions or hypothesis
   As the data concerning a problem are collected possible solutions will be suggested.

¹⁹Russel, *Children's Thinking*, p. 256.


4. Subjective evaluation
   This step is essentially a process of comparing the suggested solution (step 3) with the problem conditions (step 2) to see if it will work.

5. Objective test
   This may be done by laboratory experiment, controlled observation, historical investigation, etc.

6. Conclusion or generalization
   The facts learned in one problem situation may have worth in subsequent situations.

Johnson\(^{23}\) states that "on the basis of incomplete evidence, problem-solving or deliberation may be separated into three processes, or groups of processes.

1. Orienting to the problem
   Orientation refers to the process by which the subject grasps the material of thought and keeps it available for deliberation.

2. Producing relevant material
   "Producing relevant material" refers to a aggregation of processes, since the materials of deliberation and the ways of manipulating them are variegated. The materials may be produced by perceptual processes, or by affective processes.

3. Judging the solution
   This terminal phase involves the selection of one or more of the alternatives elaborated by the foregoing processes.

Johnson\(^{24}\) further states that "problem-solving begins with the initial orientation and ends with the closing judgment, but between the steps of orienting and judging, almost anything can happen, in any sequence."


\(^{24}\)Ibid., p. 203.
Thorndike relates that his five phase model represents a logical sequence of steps, but it must be recognized only as a model to help our understanding of the problem-solving process. Actual behavior in a problem situation is often illogical. The phases may be defined as follows:

1. **Becoming aware of the problem**
   The route to some objective is blocked, routine behavior is not directly successful, and the individual realizes that a problem exists.

2. **Clarifying the problem**
   The problem, sensed at first only in general terms, is made more sharp and specific in terms of just what end is to be achieved and just what is known or what resources are available.

3. **Proposing hypotheses for solution of the problem**
   Specific proposals are suggested and elaborated for dealing with the problem situation.

4. **Reasoning out implications of hypotheses**
   Bringing together the hypothesis and the relevant facts which are known to him, the individual reasons out what follows from the hypothesis which he is considering.

5. **Testing the hypothesis against experience**
   The conclusions which follow from the hypothesis are tested against known facts or by experiment and the gathering of new facts, to see if the conclusions are valid and the hypothesis is supported.

For their study of the problem-solving processes of college students Bloom and Broder developed the following model to describe problem-solving characteristics.

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1. Understanding of the nature of the problem
   This means understanding the kind of problem to be attacked - more or less a clarification of what is involved or required in the problem.

2. Understanding of the ideas contained in the problem
   This means the possession of the basic information necessary for the solution to a problem as well as the ability to bring this knowledge to bear in attacking the problem.

3. General approach to the solution of problems
   This means the procedure of the student during his attack on a problem.

4. Attitude toward the solution of problems
   By attitude is meant the emotions, values, and prejudices of the student as they are involved in the attack on problems.

Burack\textsuperscript{27} includes nine steps in his problem-solving model. They are as follows:

2. Preliminary survey of material.
3. Analysis into major variable.
4. Location of crucial features.
5. Application of past experience.
6. Varied trials.
7. Control.
8. Elimination of sources of error.
9. Visualization.

Hullfish\textsuperscript{28} offers a step-by-step view of the process as follows:

---


1. The recognition and clarification of the problem
The presence and recognition of a problem situation is realized and clarified.

2. The getting of the hypothesis
After the individual locates and clarifies the problem, he must come up with a guess, hunch, an idea that may solve the problem.

3. The testing of the hypothesis
The checking of the hypothesis takes two forms: (a) "if-then" activity (if the hypothesis is true, certain consequences are certain to follow, and (b) no predictions of what may be expected are made, the individual will just wait to see if the hypothesis is correct.

4. The hypothesis is validated or not validated.
If sufficient evidence encircles the hypothesis, it is said to be valid. If it is not, further checking is in order.

Snygg proposes a cognitive field model for promoting learning. He suggests that it is applicable to both learning and problem-solving. It is as follows:

Step 1. Awareness of a need for greater organization (e.g., hunger, anxiety).

Step 2. Search of the phenomenal field for some means of achieving organization (e.g., food, self-assurance). This or some means of approaching it is differentiated in some degree as $\text{Goal}_1$.

Step 3. Simultaneous search of field for means of reaching or achieving the goal. The tentative path is differentiated into sub-paths. Perception of Problem$_1$.

Step 4. Act$_1$ begins, appropriate to this perception$_1$.

Step 5. Perception of Results. If the act or series of acts achieves the goal, no significant reorganization or change of the field is necessary and, as a consequence,

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Nothing is learned.

Step 6. If, however, the results are not as expected or hoped, the situation is reexamined. This results in Perception of Problem.

Step 7. This new and more highly differentiated perception of the situation results in new Act.

Step 8. Perception of Results. If the new results are those sought, the search-and-evaluation process in the problem area is terminated and the individual shifts his attention to problems elsewhere.

Step 9. If the desired result has not been attained, the search-act-evaluation process goes on until a new perception of the problem makes possible the attainment of the goal or until the learner differentiates another goal as a more practical way of satisfying his need. The new perception of the problem is what has been learned.

The Influence of Hints and Aids on Problem-solving Success

Duncan and Ausubel after reviewing the studies in which hints and aids of various kinds were of primary concern agree that guidance in the form of hints facilitates problem-solving, that is, leads to improved problem-solving success (performance).

A number of investigators have studied intellectual problem-solving by giving hints of various kinds - Reid, 1951; Marks, 1951; Burack and Moos, 1956; Maltzman, Eisman, Brooks, and Smith, 1956.

It should be noted that each of these studies took place in laboratory type settings and utilized college age students as subjects.


31 Ausubel, Educational Psychology: A Cognitive View, p. 547.
The aids and hints used to facilitate problem-solving included questions, statements, verbal urgings, and anagram patterns. The problems posed were in the form of constructions, the identification of errors, and the solution of puzzles and anagrams.

Reid's study was based on Duncker's notion of "explication of the goal" and sought to test the theory that "analysis or explication of the goal" is important for reaching solutions in meaningful problem-situations.

The experimental plan consisted of having all subjects first attempt the problem unaided and then assisting some (experimental subjects) in an analysis or explication of the problem goal, whereas others (the control subjects) received hints not intended to explicate the goal. For the experimental group the "experimental aids" were in the form of questions and statements structured and sequenced to aid in the analysis of the problem, i.e., to explicate the goal, e.g.; (1) How can you put each of the three matches into two triangles at the same time? (2) The only possible way of meeting the terms of the problem must be by joining triangles one to another so each match can serve as the edge of two triangles at the same time. The sole purpose of the "control aids" was to encourage the control subjects, as the experimental subjects had been encouraged by their aids, but not to analyze the problem, e.g.; (1) Do you want me to repeat the problem

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for you? (2) There really is a solution to this problem.

A total of 148 college students participated in a series of 236 individual experiments on two problem situations: (1) to construct four equilateral triangles all match length size, with only six matches, and (2) to fit together two wooden blocks so as to form a tetrahedron. The original tetrahedron from which the blocks had been formed had been divided in such a way that not a single one of its four triangular surfaces remained a complete triangle when the blocks were separated. In general, each successive hint to the experimental subjects increased the number of subjects solving the problem. Significantly more experimental subjects were successful in all experiments, and on both problems, allowing one to conclude that "analysis or explication of the goal" is important for reaching solutions in meaningful problem-situations.

In Marks' study two kinds of hints were used to facilitate problem-solving, (1) a list of problem elements in which possible errors might occur, and (2) verbal urgings at intervals by a Socratic questioning technique indicating where mistakes could occur.

Twenty-two subjects were split into an aid and a nonaid group of 11 each. The aid group were either required to analyze the problem situations through Socratic questions or through the list of elements. The subjects were first taught a method of extracting square roots with the use of a calculating machine and an auxiliary factor

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table. All the subjects served in either a simulated real-life or a simulated textbook situation. The problem in the real-life situation arose when the subject made errors in the test exercises because the examiner had falsified the table. The subject was made aware of his errors and was told to ascertain the source of error. In the textbook situation, the subject was given a typed narrative concerning one John Jones who had been trained in the method, but had failed to get correct roots for the test exercises. The problem arose when the subject was asked what he would do if he were in John Jones' place and had to correct the errors. The problem in either situation had but four elements: (1) the operator (the subject himself or John Jones) who might be repeating a manipulative error; (2) the calculating machine which might be making mechanical mistakes on some numbers; (3) the method, which might be faulty, (4) the divisor table, which might contain typographical or computational errors.

The hint hypotheses stated in the form of predictions are: (1) aid groups will evoke more vocalization than nonaid, and (2) aid groups will evoke more solutions than nonaid.

The study included two dependent variables - vocalizations and solutions. The subject was given credit for a vocalization if he spoke the name of an element aloud or pointed to it, together with some statement which indicated his contention that the particular element might be a source of error. The subject was granted credit for a solution if he indicated that the second digit of the divisor was in error, supplied the correct digit and repeated the computations with the correct divisor to secure the correct root.
The aid group was markedly superior to nonaid in vocalizations and solutions (one percent level). The Socratic questioning technique significantly increased both vocalizations and the number of solutions of the aid group as compared to the nonaid. However, the list of problem elements had no effect on the number of solutions in either the aid or the nonaid groups.

The purpose of the investigation by Burack and Moos[^35] was to determine whether existing relevant past experience would be drawn to solve a problem in the form of a mechanical puzzle utilizing the application of the principle of centrifugal force, and, if not, would hint as to such experience lead to the solution to the problem.

Three groups were used to answer three questions on the principle of centrifugal force:

1. Will verbal examples of the basic principle lead to the solution of the problem?
2. Will demonstrational examples of the basic principle lead to the solution of the problem?
3. Will a series of hints from abstract to concrete ideas lead to the solution of the problem?

Two separate studies were conducted - the first attempting to answer questions one and two, and the second, question three.

The question to be answered by the first study was: "If subjects are unable to apply existing relevant past experience, will examples, verbal or demonstrational, of the basic principle included in the directions for solving a particular problem necessarily lead

Two groups of eight students each randomly chosen from a college psychology class, one designated as verbal and one as demonstrational, were given one and one half minutes to solve the problem. The purpose of this trial was to determine whether relevant past experience would be drawn upon to solve the problem. Verbal subjects unable to solve the problem in the pre-experimental trial period (none were able) were given a standardized sheet of examples of centrifugal force and allowed an additional five minutes to reach the solution. Demonstrational subjects unable to solve the problem in the pre-experimental period (none were able) viewed a physical demonstration of the same two examples of centrifugal force and also allowed an additional five minutes to solve the problem.

Of the eight subjects in the verbal group, only three were able to reach the solution. Likewise, of the eight in the demonstrational group only three were able to solve the problem.

The question to be answered by the second study was as follows: "If subjects are unable to apply existing relevant past experience, will a series of hints progressing from abstracts to concrete ideas necessarily lead to solution?" 37

One group of eight students randomly selected from the same psychology class were also given one and one half minutes to solve the problem. The subjects unable to solve the problem in the

36Ibid.
37Ibid., p. 205.
pre-experimental period (none were able) were given a set of three hints, one at a time, after each of which the subjects were permitted two minutes to solve the problem. "The first hint was highly abstract (statement of the principle of centrifugal force), the second hint was somewhat concrete (two examples, rather remote from daily experience), and the third hint was quite concrete (two examples from daily experience)."38

The results: After the first (highly abstract) hint, six out of eight failed to solve the problem; after the second (less abstract) hint, the same six failed, and after the third (concrete) hint five of the eight subjects were successful in solving the problem.

An experiment by Maltzman, Eisman, Brooks, and Smith39 "was designed to determine whether task instructions to look for a particular kind of solution to anagrams would induce a disposition for these solutions when previous training and instructions were congruent with such a set."40

Ninety-six volunteers from introductory psychology classes, divided into eight experimental sub-groups of twelve each were the subjects for the experiment. The procedure involved (1) a training session and (2) a test session.

1. All of the 96 subjects initially received a training series

38Ibid., p. 206.


40Ibid., p. 420.
of 20 five-letter anagrams. There was only one solution for each of these 20 anagrams.

The first group of 48 received training anagrams that could be solved by a word referring to an aspect of eating or food. Twenty-four designated as the eating-instructions training group, prior to the start of the training session received instruction to look for words referring to eating. Twenty-four designated as the eating training group received no special task instructions.

The second group of 48 received training anagrams in always the same letter order, 32145. Twenty-four designated as the order-instructions training group, prior to the start of the training session received instruction to look for a given letter order in the anagrams. Twenty-four designated as the order training group received no special task instructions.

2. Immediately after the training session, a series of test anagrams were administered. All of the 96 subjects received the same test consisting of 10 five-letter anagrams. There were several different words as solutions, one of which was an eating word.

For the test session each of the four training groups of 24 was further sub-divided into sub-groups of 12 subjects each. The test was administered with the following results:
TABLE 1

TASK INSTRUCTIONS FOR ANAGRAMS

Mean Eating-Set Solutions to Test Anagrams

<table>
<thead>
<tr>
<th>Test Instructions</th>
<th>Training Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Order Instructions</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Eating instructions</td>
<td>6.75</td>
</tr>
<tr>
<td>Eating only</td>
<td>4.83</td>
</tr>
</tbody>
</table>

The table above shows that instructions influenced solution of test anagrams regardless of the class of training anagrams or the type of instructions that the subjects had been given for training anagrams.

Questioning Strategies to Facilitate Problem-solving

Chart one summarizes the questioning strategies proposed by Minor, Fraenkel, Clements, Gallagher, Carner, Crump, and Sanders.

Minor classifies questions as real and synthetic. Real questions or productive questions make discovery possible, invite students to reveal their thoughts, and their feelings... Answers to real ques-

41Ibid., p. 419.


<table>
<thead>
<tr>
<th>Minor</th>
<th>Fraenkel</th>
<th>Clements</th>
<th>Gallagher</th>
<th>Carner</th>
<th>Crump</th>
<th>Sanders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Evaluative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real questions</td>
<td>Heuristic questions</td>
<td>Divergent</td>
<td>Creative</td>
<td>Reflection</td>
<td>Analysis</td>
<td>Synthesis</td>
</tr>
<tr>
<td>Explanatory questions</td>
<td>Descriptive questions</td>
<td>Questions with many acceptable answers</td>
<td>Abstract</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synthetic questions</td>
<td>Factual</td>
<td>Questions with one acceptable answer</td>
<td>Cognitive memory</td>
<td>Concrete</td>
<td>Reproduction</td>
<td>Translation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Translation</td>
</tr>
</tbody>
</table>

**CHART 1**

**QUESTIONING STRATEGIES**
tions are neither right or wrong; they have no predetermined response. They are open-ended questions - "What does this poem mean to you?" What do you think ...?" Synthetic synthetic questions are used to test a student's knowledge of facts; they have one, and only one, possible, known answer.

Fraenkel suggests a classification system as such: factual, descriptive, explanatory, and heuristic type of questions.

Factual questions are those that ask - "who," "what," and "where." The purpose of factual questions is to test for factual information. There is one correct answer. Examples of factual questions are:

1. Who were the Grangers?
2. What is the present population of the Soviet Union?
3. When was Franklin D. Roosevelt first elected to the Presidency of the United States?
4. When did Pakistan and India become separate states?

Descriptive questions usually ask "how." They are used to synthesize knowledge, that is, to describe, to compare, to contrast, or to compare and contrast. A definite answer is still expected. Examples of such questions are:

1. Describe the characteristics of the five major vegetation zones of the Soviet Union.
2. How did the Whigs campaign in 1840?

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46 Ibid., p. 200.
3. Compare peasant life in the Soviet Union under Stalin with peasant life under Khruschev.

4. Contrast the executive branch during the administration of George Washington with the executive branch today.

5. Compare and contrast Jacksonian Democracy with Jeffersonian democracy.

Explanatory questions are those that ask - "why." Why questions are used by students to exercise reason, make inferences, seek causes and effects... Many answers are possible according to the data collected. Examples are:

1. Why do you think Jefferson was a greater President than Jackson?
2. Why do you feel the South was justly irritated with the Abolitionists?
3. Why has Russia lagged behind the West in economic development?

Heuristic questions are those that ask "what if." They encourage divergent thinking rather than convergent thought. Heuristic questions require the student to determine for himself whether the answer is acceptable.

Examples of heuristic questions are as follows:

1. What might have happened if Barry Goldwater had been elected President of the United States in 1964?
2. What kind of world would exist if there were no sound?
3. If you were inventing a language for Martians where would you begin?

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47 Ibid., p. 201.

Clements, Fielder, and Tabachnick contend that one way in which to think about questions is to identify the kinds of answers they may have: Some questions have one acceptable answer, some questions have many acceptable answers, and some questions have no acceptable answer.

The types of questions that have one acceptable answer are:

1. Questions that call for the evidence of one's own senses.
   a. Is the man's coat blue or black?
   b. Did the textbook say that Panama was a stable, prosperous country?

2. Questions that call for the evidence of the senses of others.
   a. Who is the mayor of Detroit?
   b. What did Columbus write to the King and Queen after his second voyage?

3. Questions that call for logical argument from stated premises.
   a. If all white men are agents of the devil, as Black Muslims believe, then should Negroes seek to integrate with the white American society?
   b. If imperialism is the last stage of capitalism, as some communists believe, then can a communist country be imperialistic?

The type of questions that have many acceptable answers call for statements of judgment, inference, or conjecture. Many answers are acceptable because of the different views people have about the world.

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50 Ibid., p. 93.
in which they live. Some Examples:51

1. What is the cause of the First World War?
2. Why do we have so many delinquents?
3. Why did Americans move west?

The type of questions that have no acceptable answer deal with the inaccessible, the unobservable, the unforeseeable, and the unverifiable. Consider these examples:52

1. Are women better than men?
2. What is the best country in the world?
3. What is the ultimate order of the universe?

Four types of thinking are identified by Gallagher53 each calling for a different type of questioning strategy. They are: cognitive memory, convergent, divergent, and evaluative thinking.

Gallagher54 points out the strategy for each type through a discussion of the relationship between the Spanish Armada and the colonization of America. A question requiring cognitive memory thinking might be: "Can someone tell us what he has read about the Spanish Armada?"

The ability to put facts in a logical and sequential order demands convergent thinking and a question such as: "Give an explanation

51 Ibid., p. 94.
52 Ibid., p. 94.
54 Ibid., p. 52.
for why the Spaniards lost?"

However, a question expecting divergent thought encourages multiple answers without concern for the one right answer. For example: "Suppose the Spaniards had won, what sort of things might be different about our country today?"

"Do you suppose we would have been better off if the Spaniards had won?" This type of question requires the application of values and demands a judgment.

Carner recognizes three levels of questioning - concrete, abstract, and creative.

Level one - concrete type questions limit the possible answers to place, fact, person, or time, that is to "where," "what," "who," and "when." Examples:

1. "Where was Mary?"
2. "What was Mary doing?"
3. "Who was Mary with?"
4. "When did Mary return home?"

Level two - abstract kinds of questions encourage one to generalize, to classify, to go beyond the detail level of comprehension. They explore the "hows" and the "whys" of a situation as well as the "whats." Examples of abstract type questions are:

1. "How are economies and cultures of the Laplanders and

56 Ibid., p. 548.
57 Ibid., p. 549.
Eskimos alike?"

2. Why are their cultures similar?"

Level three - creative questions not only require concrete and abstract thinking, but the reorganization of concepts into new patterns. "What if" questions are examples of this type of question.

Crump's classification system is structured around a hierarchy of four levels of questions, namely, reproduction, translation, reflection, and valuation.

The first two - reproduction and translation - are convergent in nature; they result in closed answers. Reproductive questions check factual recall while translative change original meaning into another form. An example of each is as follows:

1. "When did Columbus discover America?" (Reproduction)

2. "Farmers in northeastern Maine grow large quantities of:
   a. Potatoes
   b. Wheat
   c. Corn." (Reproduction)

3. "Prepare a timeline for the Valley Civilizations listing major events and eras between 3000 B.C. and 500 B.C." (Translation)

The second two - reflection and valuation - are divergent in nature; they result in open-ended answers. Reflective questions help students to generalize, to predict, to hypothesize, to theorize, to compare, to contrast.... Valuative questions aid one to deal with matters of rating, value, and judgment. Examples of each are as


59 Ibid., p. 658.
follows:

1. "What do the facts relating to the environment of the Navaho Indians indicate about their ways of making a living?" (Reflection)

2. "Why is life for Egyptians today better or worse than it was for ancient Egyptians?" (Valuation)

Sanders, utilizing the Taxonomy of Educational Objectives, edited by B. S. Bloom, developed a "taxonomy of questions."

Bloom's categories of objectives are summarized by Sanders as follows:

1. Memory: The student recalls or recognizes information.

2. Translation: The student changes information into a different symbolic form or language.

3. Interpretation: The student discovers relationships among facts, generalizations, definitions, values, and skills.

4. Application: The student solves a lifelike problem that requires the identification of the issues and the selection and use of appropriate generalizations and skills.

5. Analysis: The student solves a problem in the light of conscious knowledge of the parts and forms of thinking.

6. Synthesis: The student solves a problem that requires original, creative thinking.

7. Evaluation: The student makes a judgment of good or bad, right or wrong, according to standards he designates.

Through the use of the "taxonomy of questions," teachers can aid students to think in each category. Sanders offers an example

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60 Ibid., p. 659.


62 Ibid., p. 3.

63 Ibid., pp. 3-5.
of the use of the taxonomy:

1. **Memory**: What is meant by "gerrymandering?"

2. **Translation**: The dictionary defines "gerrymandering." Restate the definition in your own words.

3. **Interpretation**: Let us assume that each district in your city has the same population, and is dominated by political party "A" or "B" as designated below.

```
A  B  B  A  A
A  A  B  A  B
A  A  B  A  B
```

What is the greatest number of districts that party A could control if it is in charge of the redistricting and chooses to gerrymander? What is the greatest number of districts that Party B could control if it is in charge of the redistricting and chooses to gerrymander?

4. **Application**: Gather information about the present districts in your city and the population in each. Determine whether the present city election districts are adequate. (The student is expected to apply the principles of democracy previously studied in class).

5. **Analysis**: Analyze the reasoning in this quotation. "Human beings lack the ability to be fair when their own interests are involved. Party X controls the legislature and now it has taken upon itself the responsibility of redrawing the boundaries of the legislative election districts. We know in advance that our party will suffer."

6. **Synthesis**: (This question must follow the application question given above). If current election districts in our community are inadequate, suggest how they might be redrawn.

7. **Evaluation**: Would you favor having your political party engage in gerrymandering if it had the opportunity?

**Summary Statement: Focus of the Study**

The focus of this study incorporates and blends together elements of the problem-solving models reviewed, makes use of a question-
ing strategy classified as alternative and non-alternative and attempts to determine whether alternative type questions serve as an aid or hint to the solution of intellectual classroom problems.

The questioning strategies reviewed, shows questions to be classified into two major sub-sets, namely, divergent and convergent. The writer classifies his questioning strategy in the latter sub-set, and places alternative questions on a lower convergent cognitive level than non-alternative type questions.

The research reviewed on aids and hints clearly indicates that in psychological, laboratory type settings hints and aids do result in improved problem-solving performance. This study proposes to investigate the use of aids and hints in an educational, classroom-like setting to determine if the theory is applicable to alternative type questions in class-like situations.

Writer's Problem-solving Model

Gagne states that "most writers on problem-solving agree that the process takes a certain appreciable amount of time and proceeds through certain stages. These latter have been variously described, but perhaps they can be summarized as follows: (1) statement of the problem; (2) defining the problem, by distinguishing essential features; (3) searching for and formulating hypotheses; (4) verifying the solution." The writer's problem-solving model includes these essential elements. It is as follows:

1. Introduction of the problem question
A brief paragraph leading to and setting the stage for an understanding of the problem question.

2. Statement of the problem question
The listing of the comparative alternative question for the experimental subjects and the comparative non-alternative question for the control group.

3. First reaction to the problem question (hypothesis)
The subjects write what they think is the answer to the problem question.

4. Presentation of specific inputs
The presentation of information to be used by all the subjects to test their hypothesis, that is, the correctness and/or completeness of the first answer. (The specific inputs do not include direct information, but information by which the subjects are able to judge by inference the correctness and/or completeness of the first answer).

5. Second reaction to the problem question (verification)
With the information from the specific inputs in mind, the subjects write their second answer, that is, the subjects decide whether their first answer is correct or incorrect, complete or incomplete and make appropriate adjustments, if necessary.

The reason for the development of the model was threefold:
(1) to serve as the vehicle to introduce and present the alternative
questions to the experimental group and the non-alternative questions to the control group; (2) to provide a structured problem-solving situation for the first and second reaction to the problem question, and (3) to permit the logical transition into the posttest statement - the identification of the substantive and sub-generalizations used as the measure of problem-solving success.

The development of the above model grew out of the writer's following modification of Snygg's cognitive field model of learning. Steps one and two are incorporated in the goal setting stage, steps three and four in the goal realizing stage, and step five in the goal realized stage.

Goal Setting Stage

The learner is introduced to the problem situation, and subsequently is presented with a problem question. A psychological need exists to answer the question, so the learner searches his field for some means of achieving organization - the answer to the problem question. Thus a goal is set up in the mind of the learner.

Goal Realizing Stage

The learner sets out to resolve the problem. He writes his first answer - his hypothesis. Information in the form of specific inputs is subsequently presented to the learner which the learner uses to verify his first answer - his hypothesis.

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Goal Realized Stage

If the learner judges that his first answer is correct, the learner's search-act-evaluation process mentioned by Snygg is finished - the learner perceives his first answer correct and he has realized his goal.

However, if the learner judges that his first answer is not correct, the search-act-evaluation process continues and the learner selects or generates another answer which he concludes is a correct answer to the non-alternative question, or the correct answer from those offered in the alternative question.

66Ibid., p. 88.
CHAPTER III

THE DESIGN OF THE STUDY

The Problem

This study proposes to show the effect of alternative type questions as compared with non-alternative type questions on the problem-solving success (performance) of a random sample of sixth grade children from the Portage County, Ohio schools.

The hypothesis tested, stated in null form, is as follows:
That comparative problem-solving questions of the alternative type will not result in differences in the sixth grade students' problem-solving success (performance) as compared to comparative problem-solving questions of the non-alternative type.

Research Model

The posttest-only control group design is to be used in this study. Campbell and Stanley\(^6\) state that "the most adequate all-purpose assurance of lack of initial biases between groups is randomization. Within the limits of confidence stated by the tests of significance, randomization can suffice without the pretest." In addition, they contend that when the treatment and the posttest can be delivered to students or groups as a single package a pretest is unnecessary.

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The Subjects

A random sample of 220 sixth grade students - 110 each in the experimental and control groups - drawn from the population of sixth graders of the Portage County, Ohio schools comprised the subject for this study.

Permission to use the subjects was acquired with the cooperation of the county superintendent of schools, and the local superintendents and principals.

A list of the schools in the Portage County system with the number of sixth grade students in each school is as follows:

<table>
<thead>
<tr>
<th>School Name</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>AURORA LOCAL</td>
<td></td>
</tr>
<tr>
<td>Aurora Middle</td>
<td>174</td>
</tr>
<tr>
<td>CRESTWOOD LOCAL</td>
<td></td>
</tr>
<tr>
<td>Crestwood Middle</td>
<td>264</td>
</tr>
<tr>
<td>FIELD LOCAL</td>
<td></td>
</tr>
<tr>
<td>Central Elementary</td>
<td>40</td>
</tr>
<tr>
<td>Suffield Elementary</td>
<td>203</td>
</tr>
<tr>
<td>JAMES A. GARFIELD LOCAL</td>
<td></td>
</tr>
<tr>
<td>James A. Garfield Elem.</td>
<td>146</td>
</tr>
<tr>
<td>ROOTSTOWN LOCAL</td>
<td></td>
</tr>
<tr>
<td>Rootstown Middle</td>
<td>166</td>
</tr>
<tr>
<td>SOUTHEAST LOCAL</td>
<td></td>
</tr>
<tr>
<td>Southeast Elementary</td>
<td>207</td>
</tr>
<tr>
<td>STREETSBOROY LOCAL</td>
<td></td>
</tr>
<tr>
<td>Campus Elementary</td>
<td>92</td>
</tr>
<tr>
<td>Wait Elementary</td>
<td>91</td>
</tr>
<tr>
<td>Wise Elementary</td>
<td>94</td>
</tr>
<tr>
<td>WATERLOO LOCAL</td>
<td></td>
</tr>
<tr>
<td>Waterloo Middle</td>
<td>158</td>
</tr>
</tbody>
</table>


**Instruments to Collect Data**

Previous to the development of the treatment exercises and the posttest items, the literature was searched for a suitable test of problem-solving success (performance) and content materials around which to organize the treatment. Since no suitable posttest instrument was found and no suitable content materials available, the investigator developed his own.

The treatment for the experimental and the control subjects, and the posttest items are both included in booklet form as a set of five integrated problem-solving exercises designed around the model described in chapter two and outlined below.

1. Introduction of the problem question
2. Statement of the problem question
3. First reaction to the problem question (hypothesis)
4. Presentation of specific inputs
5. Second reaction to the problem question (verification).

**Content of the Treatment Exercises**

The content of the simulated problem-solving treatment exercises is organized around five substantive, interdisciplinary generalizations. The content itself includes a comparative analysis of two simulated civilizations - the Azo and the Eku civilizations. The general introduction included in appendix A or B indicates that the two make-believe civilizations lived many, many hundreds of years ago in a natural environment similar to that of Portage County, Ohio. One day a great crack in the earth divided these people into two separate groups, but for some unexplained reason the two areas remained identical in all
ways, e.g., the same climate, the same available natural resources. In subsequent exercises the two civilizations are depicted as developing different cultural ways despite their initial similar beginning.

**Types of Generalizations**

Womack recognizes four types of generalizations - substantive, sub-generalization, normative, and methodological. Substantive generalizations are principles which have universal application. The sub-generalization differs from the substantive generalization in that it has limited rather than universal application. Substantive generalizations are derived from subject-matter, but are indirectly related to its content. Sub-generalizations, however, are directly related to subject-matter content.

Normative generalizations do not have the credibility of universal application, nor the objectivity of substantive or sub-generalizations and carry a certain degree of indoctrination since they are value judgments. Methodological generalizations are rules which describe skills and techniques.

For the purpose of this study, the emphasis is on substantive generalizations and sub-generalizations.

**Statement of Generalizations**

The substantive generalizations around which the content is organized appear in two forms: regular statement form and "if, then, always" statement form.

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Lewenstein 69 says: "Among the most useful generalizations are those which can be stated as "if...then, always" propositions. If so and so is present, then such and such is likely to happen. Such generalizations help individuals to decide which among the choices open to them they should follow."

The writer has found that comparative problem-solving questions flow easier from "if, then, always" statements.

Rationale for the Selection of Generalizations

The rationale for the selection of the substantive generalizations included in this study is based on the concept of the cultural pyramid 70 that, according to Lewenstein, 71 has frequently been used by social scientists to serve both as a basic frame of reference for viewing society as a whole and for explaining the relationships of various social science disciplines to each other. This approach is diagramed as figure one.

The natural environment is the base of all human and cultural activities. Natural resources, including soil, climate, land features, water availability, and so on, define opportunities and set limits to what people can do in a particular area.


71 Lewenstein, Teaching Social Studies in Junior and Senior High School, pp. 88-89.
Other limits and opportunities are set by the kinds and quantities of technology man has with which to work on the natural environment. However, the say in which technology has been developed and used to manipulate the resources and forces of nature determine the degree of the influence the natural environment has on the people of an area.

Man produces food, clothing and shelter, and other things to satisfy his material needs. Man also invents ways to determine which things are to be produced, and shared by the people. In order to control its economic system, the society develops a political system.

Generalizations Used in this Study

The substantive generalizations to be used in this study are as follows:

1a. The influence of the environment, negative or positive, de-
creases with improvements in the technology for coping with it.

1b. Man's utilization of resources is related to his level of technology.

2. The more complex the economic system, the more diverse the division of labor.

3. An economy that uses money is to be considered more advanced while an economy that uses a system of barter is to be considered less advanced.

4. The more complex the group the greater the need for satisfactory controls over the people.

5. The degree of modification of one's environment determines how well a people have adapted to the environment.

The sub-generalizations related to the content are listed in each of the exercises in appendix A or B. The sub-generalizations differ from the substantive generalizations in that they refer directly to the two make-believe civilizations while the substantive generalizations are universal in nature, that is, they do not refer directly or specifically to the Eku and Azo civilizations.

The Posttest

The posttest consisting of substantive and sub-generalizations is to be considered in two ways. The set of item statements will be considered first and the set of paired item statements will be considered second.

The Posttest Item Statements

The 42 item statements consist of the 20 substantive and the 22
sub-generalizations included in the student booklets - appendixes A or B. The items are distributed among the five exercises as follows:
(See: Appendix G for the correct statement responses).

Statements - Exercise One

1. The Eku were more influenced by their environment than were the Azo.
2. The level of technology (ways of making things) of the Eku was higher than that of the Azo.
3. The Eku made greater use of the resources in their environment than did the Azo.
4. The Azo were more influenced by their environment than were the Eku.
5. The level of technology (ways of making things) of the Azo was higher than that of the Eku.
6. The Azo made greater use of the resources in their environment than did the Eku.
7. As the level of technology increases, the influence of the environment decreases.
8. As the level of technology increases, the influence of the environment increases.
9. If the level of technology is high, then a people will make less use of the resources in their environment.
10. If the level of technology is high, then a people will make greater use of the resources in their environment.
Statements - Exercise Two

1. The Azo had a more diverse division of labor than did the Eku.
2. The Eku had a less diverse division of labor than did the Azo.
3. The Eku had a simpler type of economic system than did the Azo.
4. The Azo had a more complex type of economic system than did the Eku.
5. If the people of an area have a more complex type of economic system, then they will have a more diverse division of labor.
6. If the people of an area have a more complex type of economic system, then they will have a less diverse division of labor.
7. If the people of an area have a simple type of economic system, then they will have a more diverse division of labor.
8. If the people of an area have a simple type of economic system, then they will have a less diverse division of labor.

Statements - Exercise Three

1. The economy of the Eku was considered to be more advanced than the Azo economy.
2. The economy of the Eku was considered to be less advanced than the Azo economy.
3. The Eku used money while the Azo used a system of barter.
4. The Eku used a system of barter while the Azo used money.
5. If the economy of a people requires the use of money, then that economy is considered to be less advanced.
6. If the economy of a people use a system of barter, then that economy is considered to be more advanced.
7. If the economy of a people requires the use of money, then that economy is considered to be more advanced.
8. If the economy of a people use a system of barter, then that economy is considered to be less advanced.

Statements - Exercise Four
1. The Eku society may be classified as more complex than the Azo society.
2. The Eku society needed more controls over the people than did the Azo society.
3. The Azo society may be classified as simpler than the Eku society.
4. The Azo society needed less controls over the people than did the Eku society.
5. If a society is classified as simple, then it will need less controls over the people.
6. If a society is classified as simple, then it will need more controls over the people.
7. If a society is classified as complex, then it will need more controls over the people.
8. If a society is classified as complex, then it will need less controls over the people.

Statements - Exercise Five

1. The Azo were able to modify the environment to a high degree.
2. The Azo had learned to adapt to the environment to a high degree.
3. The Eku were able to modify the environment to a high degree.
4. The Eku had learned to adapt to the environment to a high degree.
5. If the people of an area have been able to modify the environment to a high degree, then it has learned to adapt to the environment to a high degree.
6. If the people of an area have been able to modify the environment to a low degree, then it has learned to adapt to the environment to a low degree.
7. If the people of an area have been able to modify the environment to a low degree, then it has learned to adapt to the environment to a high degree.
8. If the people of an area have been able to modify the environment to a high degree, then it has learned to adapt to the environment to a low degree.

The Posttest Paired Item Statements

The 20 paired item statements are the same items included in the 42, but matched because of their direct or opposite relationship to each other.
For example, the two sub-generalizations listed below have a direct relationship in that; if the Azo had a more diverse division of labor than did the Eku, then the Azo had a more complex type of economic system than did the Eku.

1. The Azo had a more diverse division of labor than did the Eku. (Exercise Two, Item one)
2. The Azo had a more complex type of economic system than did the Eku. (Exercise Two, Item four)

The two substantive generalization items listed have an opposite relationship - for an economy that uses money is either less advanced or more advanced. One of the statements is correct and its opposite is incorrect.

1. If the economy of a people requires the use of money, then that economy is considered to be less advanced. (Exercise Three, Item five)
2. If the economy of a people requires the use of money, then that economy is considered to be more advanced. (Exercise Three, Item seven)

The justification for the pairing of generalization items is based upon this assumption: If a student really understands the regular substantive generalization intended, he will be able to identify both items of the pair.

**Testing of the Instruments**

The five simulated problem-solving exercises, and the five post-tests (statements) following each exercise were field-tried with groups of sixth grade students in the Ravenna City schools. The manual to be
used by the investigator to administer the treatment exercises was similarly tried. (See: Appendix C).

The content of the simulated exercises while based on two fictitious civilizations is nevertheless based upon anthropologically correct information as verified by reference to the two texts listed below.

An Introduction to Anthropology by Ralph L. Beals and Harry Hoijer


Anthropology: An Introduction by Lowell D. Holmes


The posttest items, that is, the substantive generalizations stated in "if, then, always" form and included as statements at the end of each treatment exercise, were administered to a random sample of 100 sixth grade students from the Ravenna City schools to determine how well sixth graders could already answer the items correctly from prior knowledge or experience.

Table two reports the results:

| TABLE 2 |
| MEANS AND STANDARD DEVIATIONS: RAVENNA SAMPLE |

<table>
<thead>
<tr>
<th>Item Statements</th>
<th>Number</th>
<th>Means</th>
<th>S. D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 items</td>
<td>9.55</td>
<td>2.03</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Paired Item Statements</th>
<th>Number</th>
<th>Means</th>
<th>S. D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 paired items</td>
<td>3.12</td>
<td>1.47</td>
<td></td>
</tr>
</tbody>
</table>
Examination of table two indicates that the Ravenna sixth graders were able to identify less than half of the 20 substantive generalization statements and less than one-third of the 10 paired statement items.

Considering the substantive generalizations as 20 item statements, the sample of sixth graders obtained a mean score of 9.55 and a standard deviation of 2.03. Considering the substantive generalizations as 10 paired items, a mean score of 3.12 and a standard deviation of 1.47 was revealed.

The Effect of the Problem Questions and the Specific Inputs on Problem-solving Success

In addition to measuring and presenting the results of the cumulative effect of the alternative questions as compared to the non-alternative questions, the investigator also measured and will present the posttest data which reveals the direct effect of the problem questions and the specific inputs on problem-solving success.

The measurement of the direct effect of the problem questions and the specific inputs can be found by examining two of the five answer patterns produced by the problem-solving model utilized in this study. (See: pages 54-56).

Only the use of pattern three will reflect evidence that the problem question will have a direct effect on the subject's first answer and subsequently on problem-solving success as measured by the posttest. In the case of pattern three, the subject will write his first answer utilizing the problem question. The specific inputs will indicate no direct effect in improving performance because the subject's
second answer was incorrect while his first answer was correct. Conversely, the problem question will indicate a direct effect because the first answer was correct.

Only the use of pattern two will reflect evidence that the specific inputs will have a direct effect on the subject's second answer and subsequently on problem-solving performance. In the case of pattern two, the subject will write his first answer utilizing the problem question. The specific inputs will indicate a direct effect because the subject's second answer was correct, while his first answer was incorrect. Conversely, the problem question will indicate no direct effect because the first answer was incorrect.

Patterns one, four, and five indicate no evidence that the problem questions and/or the specific inputs will have an influence on problem-solving performance.

In the case of pattern one, the subject will write his first answer utilizing the problem question. He will subsequently verify from the specific inputs that his first answer is correct. However, one cannot be sure which had the direct effect of improving performance, because there is no direct evidence of change and thus no indication of which had the actual effect - the problem question or the specific input.

In the case of pattern four, the subject will write his first answer using the problem question, and then judge from the specific inputs that his first answer is incorrect and write a different second answer which is also incorrect. Since both answers are incorrect, one cannot determine any direct effect caused by either the problem ques-
tion or the specific inputs on problem-solving performance.

In the case of pattern five, the subject will write his first answer utilizing the problem question. He will subsequently decide from the specific inputs that his first answer is correct and will write the same response for his second answer. However, since both answers are incorrect and both are the same, one cannot determine any direct effect of either the problem question or the specific inputs on problem-solving success.

**Answer Patterns**

The problem-solving model utilized in this study produces the following answer patterns. It is assumed that the subjects in the experimental and control groups will utilize the model as intended by the investigator. (See: The Writer's Problem-solving Model, chapter two).

**Pattern One:** First Answer - Correct  Second Answer - Correct

- a. Student uses the question to help channel thinking.
- b. Student writes what he thinks is the answer to the problem question.
- c. Student uses the specific inputs to test first answer.
- d. Student decides that first answer is correct. _Is Correct._
- e. Student writes second answer which is the same as the first answer. _Is Correct._

**Pattern Two:** First Answer - Incorrect  Second Answer - Correct

- a. Student uses the question to help channel thinking.
b. Student writes what he thinks is the answer to the problem question.

c. Student uses specific inputs to test first answer.

d. Student decides that first answer is incorrect and/or incomplete. Is Incorrect.

e. Student writes second answer which is different from the first answer. Is Correct.

Pattern Three: First Answer - Correct
Second Answer - Incorrect

a. Student uses the question to help channel thinking.

b. Student writes what he thinks is the answer to the problem question.

b. Student uses the question to help channel thinking.

c. Student uses the specific inputs to test first answer.

d. Student decides that the first answer is incorrect and/or incomplete and changes the answer. But the answer Is Correct.

e. Student writes second answer which is different from the first answer. Is Incorrect.

Pattern Four: First Answer - Incorrect
Second Answer - Incorrect/different

a. Student uses the question to help channel thinking.

b. Student writes what he thinks is the answer to the problem question.

c. Student uses the specific inputs to test first answer.

d. Student decides that the first answer is incorrect and/or incomplete. Is Incorrect.
e. Student writes second answer which is different from the first answer. Is Incorrect.

Pattern Five: First answer - Incorrect
Second Answer - Incorrect/same

a. Student uses the question to help channel thinking.
b. Student writes what he thinks is the answer to the problem question.
c. Student uses specific inputs to test first answer.
d. Student decides that the first answer is correct. But the answer is Incorrect.
e. Student writes second answer which is the same as the first answer. Is Incorrect.

Included in appendixes I and J are samples of each answer pattern - one through five - for both the control and the experimental groups.
CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

This study proposed to show the effect of alternative type ques-
tions as compared with non-alternative type questions on the problem-
solving success (performance) of sixth graders of the Portage County, 
Ohio schools.

The hypothesis tested, stated in null form, is as follows: That 
comparative problem-solving questions of the alternative type will not 
result in differences in the sixth grade students' problem-solving 
success (performance) as compared to comparative problem-solving ques-
tions of the non-alternative type.

Model to be Used to Determine the Effect of 
Alternative Questions as Compared with Non-
alternative Questions on Problem Performance

To determine the effect of alternative questions compared with 
non-alternative questions on problem-solving performance, to indicate 
which group experienced greater problem-solving success, and to test 
the null hypothesis, that is, to determine significant difference be-
tween scores of the experimental group using alternative questions and 
the control subjects utilizing non-alternative questions, the following 
model is to be used.

The Posttest Item Statements

To show differences of the mean between the two groups, and to 
determine significant difference between the scores of the experimental
and the control groups on the 42 item posttest, these comparisons are to be made:

1. Comparison between the scores on the 22 sub-generalizations.
2. Comparison between the scores on the 20 substantive generalizations.
3. Comparison between the scores on the 42 sub-generalizations and substantive generalizations.
4. Comparison between the scores on each exercise.

The Posttest Paired Item Statements

To show differences of the mean between the groups, and to determine significant differences between the scores on the paired items the following comparisons are to be made:

1. Comparison between the scores on the 10 sub-generalization pairs.
2. Comparison between the scores on the 10 substantive generalization pairs.
3. Comparison between the scores on the 20 sub-generalization and substantive generalization pairs.
4. Comparison between the scores on each exercise.

Model to be Used to Determine the Effect of the Problem Questions and the Specific Inputs on Problem-solving Success

While the posttest scores are used to measure the direct cumulative effect of the alternative questions as compared to the non-alternative questions, the posttest scores for the subjects utilizing answer pattern two (specific inputs) and answer pattern three (problem questions) are used to measure the effect of the problem questions and the specific inputs on problem-solving success.
The following comparisons are to be made with both the 42 post-test item statements and the 20 posttest paired items.

1. Comparison of the scores of the control subjects' specific input effect with the scores of the experimental subjects' alternative question effect;

2. Comparison of the scores of the experimental subjects' specific input effect with the scores of the control subjects' non-alternative question effect;

3. Comparison of the scores of the control subjects' non-alternative question effect with the scores of the experimental subjects' alternative question effect;

4. Comparison of the scores of the control subjects' specific input effect with the scores of the experimental subjects' specific input effect.

The Effect of Alternative Questions as Compared with Non-alternative Questions on Problem-solving Success

Problem-solving success as measured in this study is the recognition of the sub-generalizations and the substantive generalizations both singly (item statements) and in related and/or opposite pairs (paired item statements).

Problem-solving Success: Differences of the Means

The Posttest Item Statements

The differences of the means between the control and the experimental groups in the identification of sub-generalizations and substantive generalizations singly are presented in tables 3 and 4.

Table 3 indicates that the use of non-alternative questions as compared to alternative questions result in equal problem-solving success on substantive generalizations, sub-generalizations, and on a combination of substantive and sub-generalizations.
TABLE 3
MEANS AND STANDARD DEVIATIONS: PROBLEM-SOLVING SUCCESS

ITEM STATEMENTS

<table>
<thead>
<tr>
<th>Groups</th>
<th>No. of Items</th>
<th>X</th>
<th>S. D.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Substantive Generalizations</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control:</td>
<td></td>
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<td></td>
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<tr>
<td>Non-alternative Questions</td>
<td>20</td>
<td>14.327</td>
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<tr>
<td>Experimental:</td>
<td></td>
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<td></td>
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<tr>
<td>Alternative Questions</td>
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<td>2.6394</td>
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<td><strong>Sub-Generalizations</strong></td>
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<tr>
<td>Non-alternative Questions</td>
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<tr>
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<td>15.168</td>
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<td><strong>Substantive and Sub-generalizations</strong></td>
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<td></td>
<td></td>
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<tr>
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<td></td>
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<tr>
<td>Non-alternative Questions</td>
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<tr>
<td>Alternative</td>
<td>42</td>
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It should be noted that both control and experimental groups performed better in the identification of substantive generalizations than did the Ravenna sample. Examination of tables two and three indicate the sample recorded a mean score of 9.55 without treatment compared
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<tr>
<th>Groups</th>
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<th>Mean (X)</th>
<th>Standard Deviation (S.D.)</th>
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<td>1.106</td>
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<tr>
<td>Non-alternative</td>
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<td>2.953</td>
<td>1.062</td>
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<td>Questions</td>
<td>Four</td>
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<td>1.449</td>
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<td>Questions</td>
<td>Five</td>
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<td>1.032</td>
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<td>Questions</td>
<td>Five</td>
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<td>0.873</td>
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<td>Questions</td>
<td>Four</td>
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<td>Questions</td>
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<td><strong>Substantive and Sub-generalizations</strong></td>
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<td>Control: One</td>
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<td>Control: Two</td>
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<td>Non-alternative</td>
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<td>1.661</td>
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<td>Questions</td>
<td>Four</td>
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<td>Questions</td>
<td>Five</td>
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<td>Experimental: One</td>
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<td>Alternative Questions</td>
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<td>Questions</td>
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<td>Five</td>
<td>6.467</td>
<td>1.815</td>
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</tbody>
</table>
with the respective mean scores of 14.327 and 14.449 for the control and the experimental groups that received the treatment.

Table 4 considers the substantive generalizations, the sub-generalizations, and the substantive and sub-generalizations distributed among the five statement exercises. Again the data show that the type of question had no different effect on problem-solving performance irrespective of the type of generalization used to measure problem-solving success.

Problem-solving Success: Differences of the Means

The Posttest Paired Item Statements

The differences of the means between the control and the experimental groups in the recognition of sub-generalizations and substantive generalization pairs are presented in tables 5 and 6.

Table 5 considers the 42 substantive and sub-generalizations as 20 matched pairs, because of their direct or opposite relationship to each other, and indicate equality of performance between the control and the experimental groups.

It should be noted again that the control and the experimental groups performed better in the recognition of substantive generalization pairs than did the Ravenna sample. Examination of tables two and five indicate the Ravenna sample made a mean score of 3.12 without the treatment while the control and the experimental samples made mean scores of 6.262 and 6.346 with treatment.

Table 6 also indicates no different effect of alternative as compared to non-alternative questions and problem-solving success. As in table 4, the mean scores of the matched pairs in each of the
TABLE 5
MEANS AND STANDARD DEVIATIONS: PROBLEM-SOLVING SUCCESS

PAIRED ITEM STATEMENTS

<table>
<thead>
<tr>
<th>Groups</th>
<th>No. of Items</th>
<th>X</th>
<th>S. D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive Generalizations</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Control:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-alternative Questions</td>
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<td>6.262</td>
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<td>Experimental:</td>
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<td></td>
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<td>Alternative Questions</td>
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<td>Sub-generalizations</td>
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<tr>
<td>Control:</td>
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</tr>
<tr>
<td>Non-alternative Questions</td>
<td>10</td>
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<td>1.9672</td>
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<tr>
<td>Experimental:</td>
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<tr>
<td>Alternative Questions</td>
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<td>4.579</td>
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<td>Substantive and Sub-generalizations</td>
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<tr>
<td>Non-alternative Questions</td>
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<tr>
<td>Alternative Questions</td>
<td>20</td>
<td>10.916</td>
<td>2.9751</td>
</tr>
</tbody>
</table>

five exercises and for each of the generalization types, show almost equal results.
TABLE 6
MEANS AND STANDARD DEVIATIONS: PROBLEM-SOLVING SUCCESS

PAIRED ITEM STATEMENTS BY EXERCISES

<table>
<thead>
<tr>
<th>Groups</th>
<th>Exercises</th>
<th>Number of Paired Items</th>
<th>$\bar{X}$</th>
<th>S. D.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>2</td>
<td>1.150</td>
<td>0.6265</td>
</tr>
<tr>
<td>Control:</td>
<td>Two</td>
<td>2</td>
<td>1.178</td>
<td>0.7500</td>
</tr>
<tr>
<td>Non-alternative</td>
<td>Three</td>
<td>2</td>
<td>1.187</td>
<td>0.7664</td>
</tr>
<tr>
<td>Questions: One</td>
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<td>2</td>
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<td>Five</td>
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<tr>
<td></td>
<td>Two</td>
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<td>1.224</td>
<td>0.6910</td>
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<td>Three</td>
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<td>1.393</td>
<td>0.8214</td>
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<td>1.402</td>
<td>0.7379</td>
</tr>
<tr>
<td></td>
<td>One</td>
<td>2</td>
<td>0.224</td>
<td>0.5196</td>
</tr>
<tr>
<td></td>
<td>Two</td>
<td>2</td>
<td>1.084</td>
<td>0.7663</td>
</tr>
<tr>
<td></td>
<td>Three</td>
<td>2</td>
<td>1.467</td>
<td>0.8047</td>
</tr>
<tr>
<td></td>
<td>Four</td>
<td>2</td>
<td>0.477</td>
<td>0.7690</td>
</tr>
<tr>
<td></td>
<td>Five</td>
<td>2</td>
<td>1.505</td>
<td>0.7935</td>
</tr>
<tr>
<td></td>
<td>One</td>
<td>2</td>
<td>0.234</td>
<td>0.5245</td>
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<td></td>
<td>Two</td>
<td>2</td>
<td>1.112</td>
<td>0.7439</td>
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<td>Three</td>
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<td>1.411</td>
<td>0.8004</td>
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<td>Four</td>
<td>2</td>
<td>0.477</td>
<td>0.7567</td>
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<td></td>
<td>Five</td>
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<td>1.374</td>
<td>0.8744</td>
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<td>1.374</td>
<td>0.8187</td>
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<td>2.262</td>
<td>1.1683</td>
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<td>2.546</td>
<td>1.3476</td>
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<td>1.869</td>
<td>1.2596</td>
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<td>4</td>
<td>2.336</td>
<td>1.0365</td>
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<td></td>
<td>Three</td>
<td>4</td>
<td>2.626</td>
<td>1.3565</td>
</tr>
<tr>
<td></td>
<td>Four</td>
<td>4</td>
<td>1.869</td>
<td>1.1981</td>
</tr>
<tr>
<td></td>
<td>Five</td>
<td>4</td>
<td>2.776</td>
<td>1.3688</td>
</tr>
</tbody>
</table>
Problem-solving Success:

Significance of the Difference of the Means

To test the null hypothesis, that is, to establish significance of the difference between the means of the control group as compared to the experimental group related to problem-solving success (performance), a t test of the means is employed.

The Posttest Statement Items

The significance of the differences between the means of the two groups are presented for the 20 substantive generalizations, the 22 sub-generalizations, the combined 42 item statements, and for each of the five exercises in tables 7 and 8.

TABLE 7

<table>
<thead>
<tr>
<th>Types of Generalizations</th>
<th>( \frac{\bar{X}_e - \bar{X}_c}{\text{t}} )</th>
<th>( t )</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive</td>
<td>0.122</td>
<td>0.326</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Sub</td>
<td>-0.486</td>
<td>-1.156</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Combined</td>
<td>-0.579</td>
<td>-0.946</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
</tbody>
</table>

Tables 7 and 8 indicate that the difference between the means is not significant at the .05 level. The data included in the two tables show no different effect of alternative questions as compared with non-alternative questions whether the results of the posttest item
### TABLE 8

**t TEST OF DIFFERENCE OF MEANS: PROBLEM-SOLVING SUCCESS**

**ITEM STATEMENTS BY EXERCISES**

<table>
<thead>
<tr>
<th>Types of Generalizations</th>
<th>$\bar{X}_e - \bar{X}_c$</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ex. One</td>
<td>0.009</td>
<td>0.060</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Ex. Two</td>
<td>-0.075</td>
<td>-0.507</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Ex. Three</td>
<td>0.000</td>
<td>0.000</td>
<td>212</td>
<td></td>
</tr>
<tr>
<td>Ex. Four</td>
<td>0.084</td>
<td>0.430</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Ex. Five</td>
<td>-0.009</td>
<td>-0.067</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Sub</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ex. One</td>
<td>-0.206</td>
<td>-1.358</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Ex. Two</td>
<td>-0.009</td>
<td>-0.075</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Ex. Three</td>
<td>-0.047</td>
<td>-0.311</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Ex. Four</td>
<td>-0.056</td>
<td>-0.324</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Ex. Five</td>
<td>-0.169</td>
<td>-1.181</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Combined</td>
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<td></td>
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</tr>
<tr>
<td>Ex. One</td>
<td>-0.097</td>
<td>-0.912</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Ex. Two</td>
<td>-0.065</td>
<td>-0.316</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Ex. Three</td>
<td>-0.037</td>
<td>-0.161</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Ex. Four</td>
<td>0.009</td>
<td>0.035</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Ex. Five</td>
<td>-0.169</td>
<td>-0.696</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
</tbody>
</table>

Statements are considered cumulatively for each type of generalization or separately for each exercise.

The Posttest Paired Item Statements

The significance of the difference between the means of the control and the experimental groups are presented for the 10 substantive statement pairs, the 10 sub-generalization pairs, the combined 20 paired item statements, and for each of the five exercises in tables 9 and 10.
### TABLE 9

**t TEST OF DIFFERENCE OF MEANS: PROBLEM-SOLVING SUCCESS**

**PAIRED ITEM STATEMENTS**

<table>
<thead>
<tr>
<th>Types of Generalization</th>
<th>$X_e - X_c$</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive</td>
<td>0.084</td>
<td>0.328</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Sub</td>
<td>-0.169</td>
<td>-0.674</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Combined</td>
<td>-0.093</td>
<td>-0.216</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
</tbody>
</table>

### TABLE 10

**t TEST OF DIFFERENCE OF MEANS: PROBLEM-SOLVING SUCCESS**

**PAIRED ITEM STATEMENTS BY EXERCISES**

<table>
<thead>
<tr>
<th>Types of Generalizations</th>
<th>$X_e - X_c$</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ex. One</td>
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<td>-0.565</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Ex. Two</td>
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<td>0.474</td>
<td>212</td>
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</tr>
<tr>
<td>Ex. Three</td>
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<td>0.254</td>
<td>212</td>
<td>&gt; .05</td>
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<tr>
<td>Ex. Four</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ex. Five</td>
<td>0.019</td>
<td>0.178</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Sub</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ex. One</td>
<td>0.010</td>
<td>0.131</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Ex. Two</td>
<td>0.028</td>
<td>0.272</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
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<td>Ex. Three</td>
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</tr>
<tr>
<td>Ex. Four</td>
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<td>0.000</td>
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<tr>
<td>Ex. Five</td>
<td>-0.131</td>
<td>-1.146</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Combined</td>
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<td></td>
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<tr>
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<td>-0.414</td>
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<tr>
<td>Ex. Two</td>
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<td>Ex. Three</td>
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<td>-0.101</td>
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<tr>
<td>Ex. Four</td>
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<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ex. Five</td>
<td>-0.112</td>
<td>-0.590</td>
<td>212</td>
<td>&gt; .05</td>
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</tbody>
</table>
Tables 9 and 10 showing the posttest data as paired items also indicate that the difference between the means is not significant at the .05 level. Again the data included in the tables show no different effect of the two types of questions.

**Summary Statement**

The conclusion: there is no difference of effect between alternative type questions and non-alternative type questions according to the results of this study. Non-alternative questions resulted in equal problem-solving success as compared to alternative questions.

The null hypothesis, stating that the alternative type questions would not result in greater problem-solving success (performance), is accepted. This failure to reach significance was evidenced by the analysis of the posttest in three forms, namely, substantive generalizations, sub-generalizations, and a combination of both types of generalizations; and in two major sets - statement items and statement item pairs.

In each form and in both sets, the data indicate that the variation of treatment (alternative compared with non-alternative questions) produced equal problem-solving performance. The subjects using nonaid questions of the non-alternative type were just as successful in correctly identifying substantive and sub-generalizations (the defined measure of problem performance) as the subjects that utilized aid questions of the alternative type.

While aids and hints have been shown to improve problem-solving performance in laboratory settings, this study leaves in doubt whether aids, at least in the form of alternative questions, produce any sig-
significant advantage in an educational setting.

**The Effect of the Problem Questions and the Specific Inputs on Problem-solving Success**

Although the posttest data indicate no significant difference between the effect of alternative questions as compared to non-alternative questions on problem-solving success, the examination of the direct effect of the problem questions and of the specific inputs remains.

As mentioned in chapter three, only pattern two reflects a direct effect of the specific inputs relative to problem-solving performance, and only pattern three reflects a direct effect of the problem-questions on problem-solving success. These two patterns are to be related and compared in four different ways to determine which (if either) had the greater effect on problem-solving success.

**Two sets of data are to be presented for each comparison: the difference of the means for the posttest item statements and posttest paired item statements, and the significance of the difference of the means for items statements and paired item statements.**

1. **Comparison of the Specific Input Effect (Control Subjects) with the Alternative Question Effect (Experimental Subjects) on Problem-solving Success**

**Differences of the Means:**

**The Posttest Item Statements and the Paired Item Statements**

Table 11 and 12 present data comparing the specific input effect (control subjects) with the alternative question effect (experimental subjects) relative to problem-solving performance. Table 11 shows the
<table>
<thead>
<tr>
<th>Groups</th>
<th>Subjects</th>
<th>N*</th>
<th>No. of Items</th>
<th>$\bar{X}$</th>
<th>S. D.</th>
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<tbody>
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<td>Substantive Generalizations</td>
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<tr>
<td>Control:</td>
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<td></td>
</tr>
<tr>
<td>Specific Input Effect</td>
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<td>3.112</td>
<td>1.1250</td>
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<td></td>
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<tr>
<td>Alternative Question Effect</td>
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<td>63</td>
<td>4.0</td>
<td>2.730</td>
<td>1.1806</td>
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</tr>
<tr>
<td>Control:</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Specific Input Effect</td>
<td>86</td>
<td>152</td>
<td>4.4</td>
<td>3.612</td>
<td>0.9903</td>
</tr>
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</tr>
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<td>3.127</td>
<td>1.2246</td>
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</tr>
<tr>
<td>Specific Input Effect</td>
<td>86</td>
<td>152</td>
<td>8.4</td>
<td>6.730</td>
<td>1.5652</td>
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<tr>
<td>Experimental:</td>
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<td></td>
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<tr>
<td>Alternative Question Effect</td>
<td>45</td>
<td>63</td>
<td>8.4</td>
<td>5.857</td>
<td>1.9581</td>
</tr>
</tbody>
</table>

*The N refers to the number of times the subjects utilized either pattern two (specific inputs) or pattern three (alternative question) for one or more of the five problem-solving exercises.
### TABLE 12
MEANS AND STANDARD DEVIATIONS: PAIRED STATEMENTS-
SPECIFIC INPUT EFFECT COMPARED WITH ALTERNATIVE
QUESTION EFFECT ON PROBLEM-SOLVING SUCCESS

<table>
<thead>
<tr>
<th>Groups</th>
<th>Subjects</th>
<th>N*</th>
<th>No. of Pairs</th>
<th>$\bar{X}$</th>
<th>S. D.</th>
</tr>
</thead>
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<tr>
<td><strong>Substantive Generalizations</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Control: Specific Input Effect</td>
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<td>152</td>
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<td>1.437</td>
<td>0.6691</td>
</tr>
<tr>
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<td>63</td>
<td>2.0</td>
<td>1.143</td>
<td>1.1806</td>
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<td><strong>Sub-generalizations</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Control: Specific Input Effect</td>
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<td>152</td>
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</tr>
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<td><strong>Substantive and Sub-generalizations</strong></td>
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</tr>
<tr>
<td>Control: Specific Effect Effect</td>
<td>86</td>
<td>152</td>
<td>4.0</td>
<td>2.530</td>
<td>1.3604</td>
</tr>
<tr>
<td>Experimental: Alternative Question Effect</td>
<td>45</td>
<td>63</td>
<td>4.0</td>
<td>2.063</td>
<td>1.3305</td>
</tr>
</tbody>
</table>

*The N refers to the number of times the subjects utilized either pattern two (specific inputs) or pattern three (alternative question) for one or more of the five problem-solving exercises."
data for the item statements and table 12 for the paired item generalizations.

Tables 11 and 12 indicate that the mean scores on the specific input effect resulted in greater problem-solving success for each type of generalization and for either statement item set.

This evidence suggests that for the control subjects the specific inputs played the greater role toward problem-solving success than did the alternative questions for the experimental subjects.

Significance of the Difference of the Means:
The Posttest Item Statements and the Paired Item Statements

To determine if the greater problem-solving success of the control subjects' specific input effect is significant, the differences between the means of the specific input effect and the alternative question effect are compared. A t test of the mean is employed.

Table 13 presents the data for the posttest item statements and table 14 for the posttest paired item statements.

Tables 13 and 14 indicate that the difference between the mean scores on the specific input effect over the alternative question effect is significant.

Table 13 shows the means of the control subjects to differ significantly at the .025 level for substantive generalizations, at the .005 level for sub-generalizations, and at the .0005 level considering the two types of generalizations combined.

The means in table 14 suggest a significant difference between the means for substantive generalizations at the .005 level and for the combination of substantive and sub-generalizations at the .025
TABLE 13

_t_ TEST OF DIFFERENCE OF MEANS: ITEM STATEMENTS-
SPECIFIC INPUT EFFECT COMPARED WITH ALTERNATIVE
QUESTION EFFECT ON PROBLEM-SOLVING SUCCESS

<table>
<thead>
<tr>
<th>Types of Generalizations</th>
<th>X_e - X_c</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive</td>
<td>-0.382</td>
<td>-2.232</td>
<td>2.2</td>
<td>&lt; .025</td>
</tr>
<tr>
<td>Sub</td>
<td>-0.485</td>
<td>-3.042</td>
<td>2.2</td>
<td>&lt; .005</td>
</tr>
<tr>
<td>Combined</td>
<td>-0.873</td>
<td>-3.450</td>
<td>2.2</td>
<td>&lt; .0005</td>
</tr>
</tbody>
</table>

TABLE 14

_t_ TEST OF DIFFERENCE OF MEANS: PAIRED STATEMENTS-
SPECIFIC INPUT EFFECT COMPARED WITH ALTERNATIVE
QUESTION EFFECT ON PROBLEM-SOLVING SUCCESS

<table>
<thead>
<tr>
<th>Types of Generalizations</th>
<th>X_e - X_c</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive</td>
<td>-0.294</td>
<td>-2.816</td>
<td>212</td>
<td>&lt; .005</td>
</tr>
<tr>
<td>Sub</td>
<td>-0.172</td>
<td>-1.248</td>
<td>212</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Combined</td>
<td>-0.467</td>
<td>-2.300</td>
<td>212</td>
<td>&lt; .025</td>
</tr>
</tbody>
</table>

level. However, the means of the sub-generalization item pairs do not differ significantly at the .05 level.

2. Comparison of the Specific Input Effect (Experimental Subjects) with the Non-Alternative Question Effect (Control Subjects) on Problem-solving Success
Differences of the Means:

The Posttest Item Statements and the Paired Item Statements

Tables 15 and 16 present means and standard deviations comparing the effect of the specific inputs of the experimental subjects with the non-alternative question effect.

Significance of the Difference of the Means:

The Posttest Item Statements and the Paired Item Statements

While tables 15 and 16 indicate that the mean scores on the specific input effect (experimental subjects) resulted in greater problem-solving success than did the mean scores on the non-alternative effect (control subjects), tables 17 and 18 will show whether they are significant.

Tables 17 and 18 show that in both item statement sets there occurred no significant difference at the .05 level between the direct effect of the specific inputs (experimental subjects) and the direct effect of the non-alternative questions (control subjects). The greater problem-solving success of the experimental subjects' specific input effect was not significant at the .05 level.

3. Comparison of the Non-alternative Question Effect (Control Subjects) with the Alternative Question Effect (Experimental Subjects) on Problem-solving Success

Differences of the Means:

The Posttest Item Statements and the Paired Item Statements

The mean averages of the five posttests are presented in tables 19 and 20 to determine whether a difference in problem-solving performance occurs between the means of the direct effect of the
### TABLE 15
MEANS AND STANDARD DEVIATIONS: ITEM STATEMENTS-
SPECIFIC INPUT EFFECT COMPARED WITH NON-ALTERNA-
TIVE QUESTION EFFECT ON PROBLEM-SOLVING SUCCESS

<table>
<thead>
<tr>
<th>Groups</th>
<th>Subjects</th>
<th>N</th>
<th>No. of Items</th>
<th>$\bar{X}$</th>
<th>S. D.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Substantive Generalizations

**Control:**
Non-alternative Question

- 16 subjects, 19 items, $\bar{X} = 2.737$, S.D. = 1.5579

**Experimental:**
Specific Input Effect

- 82 subjects, 160 items, $\bar{X} = 2.887$, S.D. = 1.1655

#### Sub-generalizations

**Control:**
Non-alternative Question

- 16 subjects, 19 items, $\bar{X} = 2.842$, S.D. = 1.2140

**Experimental:**
Specific Input Effect

- 82 subjects, 160 items, $\bar{X} = 3.019$, S.D. = 1.2104

#### Substantive and Sub-generalizations

**Control:**
Non-alternative Question

- 16 subjects, 19 items, $\bar{X} = 5.579$, S.D. = 2.1938

**Experimental:**
Specific Input Effect

- 82 subjects, 160 items, $\bar{X} = 5.906$, S.D. = 1.7186

*The N refers to the number of times the subjects utilized either pattern three (non-alternative question) or pattern two (specific inputs) for one or more of the five problem-solving exercises.*
TABLE 16
MEANS AND STANDARD DEVIATIONS: PAIRED STATEMENTS-SPECIFIC INPUT EFFECT COMPARED WITH NON-ALTERNATIVE QUESTION EFFECT ON PROBLEM-SOLVING SUCCESS

<table>
<thead>
<tr>
<th>Groups</th>
<th>Subjects</th>
<th>N*</th>
<th>No. of Pairs</th>
<th>( \bar{X} )</th>
<th>S. D.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Substantive Generalizations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control: Non-alternative Question</td>
<td>16</td>
<td>19</td>
<td>2.0</td>
<td>1.211</td>
<td>0.9177</td>
</tr>
<tr>
<td>Experimental: Specific Input Effect</td>
<td>82</td>
<td>160</td>
<td>2.0</td>
<td>1.278</td>
<td>0.7304</td>
</tr>
<tr>
<td><strong>Sub-generalizations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control: Non-alternative Question</td>
<td>16</td>
<td>19</td>
<td>2.0</td>
<td>0.895</td>
<td>0.9366</td>
</tr>
<tr>
<td>Experimental: Specific Input Effect</td>
<td>82</td>
<td>160</td>
<td>2.0</td>
<td>0.956</td>
<td>0.9124</td>
</tr>
<tr>
<td><strong>Substantive and Sub-generalizations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control: Non-alternative Question</td>
<td>16</td>
<td>19</td>
<td>2.0</td>
<td>2.105</td>
<td>1.3701</td>
</tr>
<tr>
<td>Experimental: Specific Input Effect</td>
<td>82</td>
<td>160</td>
<td>2.0</td>
<td>2.222</td>
<td>1.2447</td>
</tr>
</tbody>
</table>

*The N refers to the number of times the subjects utilized either pattern three (non-alternative question) or pattern two (specific inputs) for one or more of the five problem-solving exercises.
### TABLE 17

**t TEST OF DIFFERENCE OF MEANS: ITEM STATEMENTS—SPECIFIC INPUT EFFECT COMPARED WITH NON-ALTERNATIVE QUESTION EFFECT ON PROBLEM-SOLVING SUCCESS**

<table>
<thead>
<tr>
<th>Types of Generalization</th>
<th>$\bar{X}_e - \bar{X}_c$</th>
<th>$t$</th>
<th>df</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive</td>
<td>0.150</td>
<td>0.513</td>
<td>177</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Sub</td>
<td>0.177</td>
<td>0.601</td>
<td>177</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Combined</td>
<td>0.327</td>
<td>0.761</td>
<td>177</td>
<td>&gt; .05</td>
</tr>
</tbody>
</table>

### TABLE 18

**t TEST OF DIFFERENCE OF MEANS: PAIRED STATEMENTS—SPECIFIC INPUTS EFFECT COMPARED WITH NON-ALTERNATIVE QUESTION EFFECT ON PROBLEM-SOLVING SUCCESS**

<table>
<thead>
<tr>
<th>Types of Generalizations</th>
<th>$\bar{X}_e - \bar{X}_c$</th>
<th>$t$</th>
<th>df</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive</td>
<td>0.067</td>
<td>0.372</td>
<td>177</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Sub</td>
<td>0.061</td>
<td>0.274</td>
<td>177</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Combined</td>
<td>0.117</td>
<td>0.381</td>
<td>177</td>
<td>&gt; .05</td>
</tr>
</tbody>
</table>

non-alternative question as compared to the direct effect of the alternative question.
**TABLE 19**

MEANS AND STANDARD DEVIATIONS: ITEM STATEMENTS-
NON-ALTERNATIVE QUESTION EFFECT COMPARED WITH ALTERNATIVE QUESTION EFFECT ON PROBLEM-SOLVING SUCCESS

<table>
<thead>
<tr>
<th>Groups</th>
<th>Subjects</th>
<th>N*</th>
<th>No.of Items</th>
<th>$\bar{X}$</th>
<th>S. D.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Substantive Generalizations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Control:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-alternative Question</td>
<td>16</td>
<td>19</td>
<td>4.0</td>
<td>2.824</td>
<td>1.6292</td>
</tr>
<tr>
<td>Experimental:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative Question</td>
<td>45</td>
<td>63</td>
<td>4.0</td>
<td>2.730</td>
<td>1.1806</td>
</tr>
<tr>
<td><strong>Sub-generalizations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-alternative Question</td>
<td>16</td>
<td>19</td>
<td>4.4</td>
<td>2.824</td>
<td>1.2367</td>
</tr>
<tr>
<td>Experimental:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Alternative Question</td>
<td>45</td>
<td>63</td>
<td>4.4</td>
<td>3.127</td>
<td>1.2246</td>
</tr>
<tr>
<td><strong>Substantive and Sub-generalization</strong></td>
<td></td>
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<tr>
<td>Control:</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-alternative Question</td>
<td>16</td>
<td>19</td>
<td>8.4</td>
<td>5.647</td>
<td>2.2897</td>
</tr>
<tr>
<td>Experimental:</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Alternative Question</td>
<td>45</td>
<td>63</td>
<td>8.4</td>
<td>5.857</td>
<td>1.9581</td>
</tr>
</tbody>
</table>

*The N refers to the number of times the subjects utilized either pattern three (non-alternative question) or pattern two (specific inputs) for one or more of the five problem-solving exercises.*
**TABLE 20**

**MEANS AND STANDARD DEVIATIONS: PAIRED STATEMENTS—
NON-ALTERNATIVE QUESTION EFFECT COMPARED WITH ALTERNATIVE QUESTION EFFECT ON PROBLEM-SOLVING SUCCESS**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Subjects</th>
<th>N*</th>
<th>No. of Pairs</th>
<th>$\bar{X}$</th>
<th>S. D</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Substantive Generalizations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-alternative Question</td>
<td>16</td>
<td>19</td>
<td>2.0</td>
<td>1.121</td>
<td>0.9177</td>
</tr>
<tr>
<td>Experimental:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative Question</td>
<td>45</td>
<td>63</td>
<td>2.0</td>
<td>1.143</td>
<td>0.7590</td>
</tr>
<tr>
<td><strong>Sub-generalizations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Control:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-alternative Question</td>
<td>16</td>
<td>19</td>
<td>2.0</td>
<td>0.895</td>
<td>0.9366</td>
</tr>
<tr>
<td>Experimental:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative Question</td>
<td>45</td>
<td>63</td>
<td>2.0</td>
<td>0.921</td>
<td>0.8670</td>
</tr>
<tr>
<td><strong>Substantive and Sub-generalizations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-alternative Question</td>
<td>16</td>
<td>19</td>
<td>4.0</td>
<td>2.105</td>
<td>1.3701</td>
</tr>
<tr>
<td>Experimental:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative Question</td>
<td>45</td>
<td>63</td>
<td>4.0</td>
<td>2.163</td>
<td>1.3305</td>
</tr>
</tbody>
</table>

*The N refers to the number of times the subjects utilized either pattern three (non-alternative question) or pattern two (specific inputs) for one or more of the five problem-solving exercises.*
The comparison of the direct alternative question effect and the non-alternative question effect indicates that alternative questions do result in slightly greater problem-solving performance than do non-alternative questions. In both sets - single items and pair items - and in both types of generalizations, the experimental subjects had higher mean average scores.

Significance of the Difference of the Means:

The Posttest Item Statements and the Paired Item Statements

In order to establish the significance of the differences between the means of the experimental and control subjects, a t test of the means between the effect of the two types of questions on problem-solving performance is employed. The t test results are presented in tables 21 and 22 to determine if the greater problem-solving success of the alternative question effect is significant.

**TABLE 21**

**t TEST OF DIFFERENCE OF MEANS: ITEM STATEMENTS - NON-ALTERNATIVE QUESTION EFFECT COMPARED WITH ALTERNATIVE QUESTION EFFECT ON PROBLEM-SOLVING SUCCESS**

<table>
<thead>
<tr>
<th>Types of Generalizations</th>
<th>$\bar{X}_e - \bar{X}_c$</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive</td>
<td>0.094</td>
<td>0.266</td>
<td>78</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Sub</td>
<td>0.303</td>
<td>0.905</td>
<td>78</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Combined</td>
<td>0.210</td>
<td>0.379</td>
<td>78</td>
<td>&gt; .05</td>
</tr>
</tbody>
</table>
TABLE 22

t TEST OF DIFFERENCE OF MEANS: PAIRED STATEMENTS-NON-ALTERNATIVE QUESTION EFFECT COMPARED WITH ALTERNATIVE QUESTION EFFECT ON PROBLEM-SOLVING SUCCESS

<table>
<thead>
<tr>
<th>Types of Generalizations</th>
<th>$\bar{X}_e - \bar{X}_c$</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive</td>
<td>0.068</td>
<td>0.324</td>
<td>78</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Sub</td>
<td>0.026</td>
<td>0.112</td>
<td>78</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Combined</td>
<td>0.042</td>
<td>0.119</td>
<td>78</td>
<td>&gt; .05</td>
</tr>
</tbody>
</table>

Tables 21 and 22 indicate no significant problem-solving performance difference resulting from the direct application of the alternative questions as compared to the non-alternative question types. This was evident for all the generalization types in tables 20 and 21.

4. Comparison of the Specific Input Effect (Control Subjects) with the Specific Input Effect (Experimental Subjects) on Problem-solving Success

Differences of the Means:
The Posttest Item Statements and the Paired Item Statements

Tables 23 and 24 are presented with two purposes in mind:
(1) to determine on which group the specific input effect had the greater influence - the control subjects guided by the non-alternative questions or the experimental subjects aided by the alternative type questions, and (2) to substantiate whether the control subjects' greater problem-solving success attributed to the specific input effect reported in tables 11 and 12 is also greater compared to the specific
CHAPTER 23

MEANS AND STANDARD DEVIATIONS: ITEM STATEMENTS-
SPECIFIC INPUT EFFECT (CONTROL SUBJECTS) COMPARED
WITH SPECIFIC INPUT EFFECT (EXPERIMENTAL SUBJECTS)
ON PROBLEM-SOLVING SUCCESS

<table>
<thead>
<tr>
<th>Groups</th>
<th>Subjects</th>
<th>N*</th>
<th>No.of Items</th>
<th>X</th>
<th>S. D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive Generalizations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control: Specific Input</td>
<td>86</td>
<td>152</td>
<td>4.0</td>
<td>3.112</td>
<td>1.1250</td>
</tr>
<tr>
<td>Effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental: Specific</td>
<td>82</td>
<td>160</td>
<td>4.0</td>
<td>2.894</td>
<td>1.1651</td>
</tr>
<tr>
<td>Input Effect</td>
<td></td>
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<td>Sub-generalizations</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Control: Specific Input</td>
<td>86</td>
<td>152</td>
<td>4.4</td>
<td>3.612</td>
<td>0.9903</td>
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<tr>
<td>Effect</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Experimental: Specific</td>
<td>82</td>
<td>160</td>
<td>4.4</td>
<td>3.012</td>
<td>1.2093</td>
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<tr>
<td>Input Effect</td>
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<td>Substantive and Sub-</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>generalizations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control: Specific Input</td>
<td>86</td>
<td>152</td>
<td>8.4</td>
<td>6.730</td>
<td>1.5652</td>
</tr>
<tr>
<td>Effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental: Specific</td>
<td>82</td>
<td>160</td>
<td>8.4</td>
<td>5.907</td>
<td>1.7132</td>
</tr>
<tr>
<td>Input Effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The N refers to the number of times the subjects of both the control and experimental groups utilized pattern two (specific inputs) for one or more of the five problem-solving exercises.
### TABLE 24

MEANS AND STANDARD DEVIATIONS: PAIRED STATEMENTS-
SPECIFIC INPUT EFFECT (CONTROL SUBJECTS) COMPARED
WITH SPECIFIC INPUT EFFECT (EXPERIMENTAL SUBJECTS)
ON PROBLEM-SOLVING SUCCESS

<table>
<thead>
<tr>
<th>Groups</th>
<th>Subjects</th>
<th>N*</th>
<th>No. of Pairs</th>
<th>( \bar{X} )</th>
<th>S. D.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Substantive Generalizations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific Input Effect</td>
<td>86</td>
<td>152</td>
<td>2.0</td>
<td>1.437</td>
<td>0.6691</td>
</tr>
<tr>
<td>Experimental:</td>
<td>82</td>
<td>160</td>
<td>2.0</td>
<td>1.270</td>
<td>0.7351</td>
</tr>
<tr>
<td><strong>Sub-generalizations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific Input Effect</td>
<td>86</td>
<td>152</td>
<td>2.0</td>
<td>1.093</td>
<td>0.9406</td>
</tr>
<tr>
<td>Experimental:</td>
<td>82</td>
<td>160</td>
<td>2.0</td>
<td>0.950</td>
<td>0.9126</td>
</tr>
<tr>
<td><strong>Substantive and Sub-generalizations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific Input Effect</td>
<td>86</td>
<td>152</td>
<td>4.0</td>
<td>2.530</td>
<td>1.3604</td>
</tr>
<tr>
<td>Experimental:</td>
<td>82</td>
<td>160</td>
<td>4.0</td>
<td>2.208</td>
<td>1.2532</td>
</tr>
</tbody>
</table>

*The N refers to the number of times the subjects of both the control and experimental groups utilized pattern two (specific inputs) for one or more of the five problem-solving exercises.*
input effect on the experimental group.

The means of the control subjects in tables 23 and 24 indicate that the specific inputs played a major role in the problem-solving success of the control group.

The posttest exercise means of the control subjects were larger than those of the experimental subjects for substantive generalizations, sub-generalizations, and the combined generalizations in both item statement form and paired statement form.

The data presented seem to substantiate the findings in tables 11 and 12 - that the greater problem-solving success of the control group can be attributed to the greater specific input effect.

Significance of the Difference of the Means:

The Posttest Item Statements and the Paired Item Statements

Tables 25 and 26 are presented to show if the difference between the means of the control subjects' specific input effect on problem-solving success is significantly greater than that of the experimental subjects.

A significant difference would help to substantiate the evidence presented in tables 13 and 14 that the direct effect of the specific inputs results in greater problem-solving success than the direct effect of the alternative questions.

This would further suggest that the control subjects guided by the non-alternative questions utilized the specific inputs more discriminately than did the experimental group aided by alternative type questions.

The t test employed to compare the means indicates a signifi-
### TABLE 25

**t TEST OF DIFFERENCE OF MEANS: ITEM STATEMENTS - SPECIFIC INPUT EFFECT (CONTROL SUBJECTS) COMPARED WITH SPECIFIC INPUT EFFECT (EXPERIMENTAL SUBJECTS) ON PROBLEM-SOLVING SUCCESS**

<table>
<thead>
<tr>
<th>Types of Generalizations</th>
<th>$\bar{X}_e - \bar{X}_c$</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive</td>
<td>-0.218</td>
<td>-1.678</td>
<td>310</td>
<td>&lt; .05</td>
</tr>
<tr>
<td>Sub</td>
<td>-0.600</td>
<td>-4.782</td>
<td>310</td>
<td>&lt; .0005</td>
</tr>
<tr>
<td>Combined</td>
<td>-0.823</td>
<td>-4.431</td>
<td>310</td>
<td>&lt; .0005</td>
</tr>
</tbody>
</table>

### TABLE 26

**t TEST OF DIFFERENCE OF MEANS: PAIRED STATEMENTS - SPECIFIC INPUT EFFECT (CONTROL SUBJECTS) COMPARED WITH SPECIFIC INPUT EFFECT (EXPERIMENTAL SUBJECTS) ON PROBLEM-SOLVING SUCCESS**

<table>
<thead>
<tr>
<th>Types of Generalizations</th>
<th>$\bar{X}_e - \bar{X}_c$</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substantive</td>
<td>-0.167</td>
<td>-2.084</td>
<td>310</td>
<td>&lt; .025</td>
</tr>
<tr>
<td>Sub</td>
<td>-0.143</td>
<td>-1.359</td>
<td>310</td>
<td>&gt; .05</td>
</tr>
<tr>
<td>Combined</td>
<td>-0.322</td>
<td>-2.171</td>
<td>310</td>
<td>&lt; .025</td>
</tr>
</tbody>
</table>
cant difference between the effects of the specific inputs on the control subjects as compared to the experimental group.

Table 25 shows the means to differ significantly at the .05 level for the substantive generalizations, at the .0005 level for sub-generalizations, and at the .0005 level for the combined generalization statement items.

Table 26 also indicates the means to differ significantly for the substantive generalization pairs at the .025 level, but not significantly different at the .05 level for the sub-generalization pairs. However, for the combined generalization item pairs, the mean for the exercises did differ significantly at the .025 level.

The significance of the means in tables 25 and 26 does substantiate the difference previously established in tables 13 and 14, that the direct effect of the specific inputs results in greater problem-solving success than does the direct effect of the alternative questions.

**Summary Statement**

Considering pattern two to reflect evidence of the direct effect of the specific inputs on problem-solving performance and pattern three to reflect evidence of the direct effect of the alternative and non-alternative questions, the data presented in the second half of this chapter strongly suggest that the control subjects guided by the non-alternative questions utilized the specific inputs more discriminately than did the experimental subjects aided by the alternative questions.

The data further suggest that the control subjects, perhaps be-
cause of the openness of the non-alternative type question found it necessary to rely on the specific inputs, while the experimental subjects having only to select an answer from the choices offered in the alternative question, utilized the specific inputs less discriminately.

The evidence seems to indicate that since the open non-alternative question encouraged more diverse thinking and the more discriminate attention to the specific inputs than did the closed alternative question, then this may account for the "no significant difference" reported in the first half of this chapter.
This study proposed to show the effect of alternative type questions as compared with non-alternative type questions on the problem-solving success (performance) of a random sample of sixth grade students from the Portage County, Ohio public schools. More specifically, this research attempted to determine whether the use of aids and hints in the form of alternative questions would lead to greater problem-solving success than the use of the non-aid questions of the non-alternative type.

The research reviewed on aids and hints clearly indicated that in psychological, laboratory type settings hints and aids did result in improved problem-solving performance. This study proposed to investigate the use of aids and hints in an educational classroom-like setting to determine if the theory was applicable to alternative type questions in class-like situations.

**Summary of Procedure**

To test the null hypothesis - that aid questions of the alternative type will not result in problem-solving performance differences as compared to non-aid, non-alternative questions, the following procedure was employed.

1. The posttest-only control experimental design discussed in
Experimental and Quasi-experimental Designs for Research by Campbell and Stanley was the research model utilized.

2. Five integrated problem-solving exercises in booklet form were developed by the investigator to serve as the treatment and the posttest instrument.

3. A problem-solving model was developed by the investigator to serve as the vehicle to introduce and present the alternative questions to the experimental group and the non-alternative questions to the control group; and to permit the logical transition into the posttest statements - the identification of the substantive and sub-generalizations used as the measure of problem-solving success.

4. A random sample of 214 sixth grade students - 107 each in the experimental and control groups - drawn from the population of sixth graders of the Portage county, Ohio schools, comprised the subjects for this study.

5. The investigator presented the problem-solving exercises in each separate school and administered the treatment to all of the subjects in the experimental and control groups simultaneously following the manual of direction appearing in Appendix C.

Immediately after each exercise situation, a posttest was

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72 Campbell and Stanley, pp. 195-196.

73 Six subjects were lost to the study because of illness or transfer out of the district.
administered to the subjects. Each exercise posttest was composed of substantive and sub-generalizations - a total of 42 statement items. The same 42 items were also considered as 10 substantive generalization pairs and 10 sub-generalization pairs.

6. To test the null hypothesis, the posttest data were analyzed in three forms, namely, substantive generalizations, sub-generalizations, and a combination of both types of generalizations; and in two major sets - statement items and statement item pairs.

A t test of the mean was employed to establish significance of the difference between the means of the control group exposed to non-alternative problem questions as compared to the experimental group exposed to alternative type problem questions.

7. In addition to the analysis of the posttest relative to the cumulative effect of the alternative questions as compared to the non-alternative questions, the investigator also analyzed the posttest data resulting from the direct effect of the problem questions and the specific inputs on problem-solving success.

These two direct effects were deduced from two of the five answer patterns produced by the problem-solving model utilized in this study. Only the posttest scores of those subjects whose answer pattern indicated the direct effect
either of the specific inputs (pattern two), or the alternative and non-alternative problem questions (pattern three) were included in this analysis.

**Summary of Findings**

Two models were used to determine significant difference for the two sets of posttest data: (1) the cumulative posttest effect of the alternative questions as compared to the non-alternative questions, and (2) the direct effect of the problem questions and the specific inputs on problem-solving success.

**Cumulative Posttest Effect of the Non-alternative Questions as Compared to the Alternative Questions**

The conclusion reached in this part of the study indicated no difference of effect between alternative type questions and non-alternative type questions. Non-alternative questions resulted in equal problem-solving success as compared to alternative questions.

The null hypothesis, stating that the alternative type questions would not result in greater problem-solving performance, is accepted. This failure to reach significance was evidenced by the analysis of the posttest in three forms, namely, substantive generalizations, sub-generalizations, and a combination of both types of generalizations; and in two major sub-sets - statement generalization items and statement generalization pairs.

In each form and in both sub-sets, the data indicated that the variation of treatment (alternative compared to non-alternative questions) produced equal problem-solving performance. The subjects using
nonaid questions of the non-alternative type were just as successful in correctly identifying substantive and sub-generalizations (the defined measure of problem-solving success) as the subjects that utilized aid questions of the alternative type.

While aids and hints have been shown to improve problem-solving performance in laboratory settings, this study leaves in doubt whether aids, at least in the form of alternative questions, produce any significant advantage in an educational setting.

Direct Effect of the Problem Questions and the Specific Inputs on Problem-solving Success

Of the five answer patterns produced by the problem-solving model only pattern two reflects a direct effect of the specific inputs relative to problem-solving performance, and only pattern three reflects a direct effect of the problem questions on problem-solving success. These two patterns were related and compared in four different ways to determine which (if either) had the greater effect on problem-solving success. The four comparisons are as follows:

1. Comparison of the Specific Input Effect (Control Subjects) with the Alternative Question Effect (Experimental Subjects) on Problem-solving Success;

2. Comparison of the Specific Input Effect (Experimental Subjects) with the Non-alternative Question Effect (Control Subjects) on Problem-solving Success;

3. Comparison of the Non-alternative Question Effect (Control Subjects) with the Alternative Question Effect (Experimental Subjects) on Problem-solving Success;
4. Comparison of the Specific Input Effect (Control Subjects) with the Specific Input Effect (Experimental Subjects) on Problem-solving Success.

Significant differences occurred in the first and fourth comparisons indicating that the specific input effect for the control subjects resulted in greater problem-solving success than either the alternative effect or the specific input effect on the experimental subjects.

This evidence strongly suggests that the control subjects guided by the non-alternative questions utilized the specific inputs more discriminately than did the experimental subjects aided by the alternative questions.

The data further suggest that the control subjects, perhaps because of the openness of the non-alternative type question found it necessary to rely on the specific inputs, while the experimental subjects having only to select an answer from the choices offered in the alternative question, utilized the specific inputs less discriminately.

Implications of the Study

The implications of this investigation are discussed in reference to the following: (1) utilization of specific inputs in the development of instructional materials for individual and group use, (2) the utilization of the writer's problem-solving model with other questioning strategies discussed in chapter two, (3) the utilization of the alternative - non-alternative questioning strategy with other subject areas, especially science, and (4) the administrative implementation of an instructional program that applies the tenets of the open non-alternative and the closed alternative questioning strategy
via the proposed problem-solving model.

When teachers want a student to accomplish a particular cognitive objective, they choose the type of question that will allow the learner to realize success. The direct effect of the specific inputs resulting in greater problem-solving success for the control subjects, suggests to teachers that if they wish a student to utilize specific information in pursuance of a particular cognitive objective, then they should develop instructional materials that utilize open type questions rather than questions that have but one answer.

However, considering the cumulative effect of alternative questions compared to non-alternative questions, teachers who desire that a student come to identify a particular sub-generalization or substantive generalization may consider the use of alternative questions in the development of instructional materials, since according to this study they produced at least equal problem-solving performance.

Perhaps the practical instructional problem-solving model developed by the investigator to implement the problem-solving situations in this study may be effectively utilized with the other questioning strategies discussed in chapter two. The model does offer an economical way to guide children through a sequential series of problem-solving steps, namely, (1) the introduction of the problem situation and the subsequent problem question, (2) the first reaction to the problem question, the hypothesis stage, (3) the testing of the hypothesis (first answer) through the use of readily available information in the form of specific inputs, and (4) the verification of the first answer and/or the restatement of a second answer to the problem question. If
used with individuals, additional specific inputs may be provided if the second answer needs to be restated. If used in group situations, discussion may be utilized to clarify the first and/or second answers.

The structured problem-solving model with its readily available problem question and specific inputs may also encourage problem-solving of a nature that requires the learner to initiate the problem-question through his own general inputs, and the subsequent testing of the first answer via specific inputs of his own choosing.

This study deals specifically with problem questions, content, and generalizations related to the social studies. However, while applicable to all curricular subjects, the alternative - non-alternative questioning strategy may be more adaptive to the more precise principles derived from science subject-matter. Perhaps, if the problem recognition step of the scientific method offered a choice of solutions in the form of alternative questions, then this may lead to greater problem-solving success as measured by the identification of the correct scientific principle, than would open type, non-alternative questions.

The implementation of the alternative - non-alternative questioning strategy perhaps could be realized through the development of what the writer regards as an independent system of learning. Figure two outlines the important components of such an independent system of learning. The model indicates that in phase seven the learner would be permitted to decide his own areas of study, his own inputs, set his own goal and determine his own strategies to realize his goal. (An Open System). In contrast, phase one indicates that these determinations are made by the teacher. (A Closed System). The proposed seven-phase
independent system of learning would permit a student to move from one phase to the next, as he gains competence in its major components and other supportive skills.

FIGURE TWO
INDEPENDENT SYSTEM OF LEARNING

Open System

Closed System

1 2

1. Decides area of study
2. Determines own inputs
3. Sets own goal
4. Realizes own goal

Teacher:

1. Decides area of study
2. Determines inputs
3. Sets goal
4. Helps student realize goal

Such a system of learning would utilize the closed alternative questioning strategy in its initial stage and the non-alternative question types in some later phase.

The administration of such a system of learning would require the development of the one-to-one curriculum proposed by Frymier, the changing of teachers from lecturers and dispensers of information to

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Recommmendations for Further Study

This study showed the effect of alternative type questions as compared to non-alternative type questions on the problem-solving success of a random sample of sixth grade children. Stratified random sampling on the basis of such factors as intelligence, and achievement was not included in this study. A replication of this study with a stratified sampling of low achievers and high achievers might reveal significant differences.

Replication of this investigation in the framework of the scientific model and adapted to the more precise principles derived from science subject-matter may also prove productive.

Replication of this study using other questioning strategies with higher level questions of a non-comparative type is likewise suggested.
APPENDIX A

STUDENT BOOKLET: EXPERIMENTAL GROUP
TWO MAKE-BELIEVE CIVILIZATIONS:

THE EKU

and

THE AZO
GENERAL INTRODUCTION

Once upon a time many, many hundreds of years ago there lived a group of people. Then one day a great crack in the earth divided these people into two separate groups. And to make matters worse, this gap grew wider and wider and a great sea formed between them.

For some unexplained reason the two areas remained identical in all ways - the same climate, the same available natural resources. In fact their environment was the same as we have in Portage County.
Introduction — Exercise One

Many, many more years passed and the two groups continued their ways, with one big exception. One group became more prosperous, that is, one group had more things.
Problem Question — Exercise One

Question:

Which made one group more prosperous than the other —

- their ways of making things were different;
- their ways of making things were better;
- their ways were the same, but one group were just better workers?

Write Your First Answer Here:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Write Your Second Answer Here:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(3)
Specific Inputs — Exercise One

The Eku

The Eku consisted of meat, plants, and fruits. The Eku moved from place to place in search of food.

The Eku clothed themselves with the skins of the animals they had killed for food. They draped them around their shoulders for protection in the winter. In the summer lighter skins of animals were worn for protection against the hot sun.

The houses that the Eku erected were made for temporary dwelling. The framework of their houses were made of sticks tied together with vines. The walls and roof were then covered with large pieces of animal skins. In the winter the houses were covered with heavy furs.

The Azo

The Azo diet consisted of meat, vegetables, cereals, fruits, and fish. The Azo domesticated some of the animals that roamed the countryside. They found that certain wild plants could be cultivated and made to yield vegetables and cereals of various kinds. Fish in abundance was gathered from the sea.

Clothing was made of furs, skins, and a coarse kind of cloth sewn together with vegetable fibers.

The houses that the Azo built were permanent structures. The roof was supported by six posts sunk into the ground. The sides were covered with long poles tied together with vegetable fibers. During the winter season animal furs were hung over the walls.
1. The Eku were more influenced by their environment than were the Azo.

2. The level of technology (ways of making things) of the Eku was higher than that of the Azo.

3. The Eku made greater use of the resources in their environment than did the Azo.

4. The Azo were more influenced by their environment than were the Eku.

5. The level of technology (ways of making things) of the Azo was higher than that of the Eku.

6. The Azo made greater use of the resources in their environment than did the Eku.

7. As the level of technology increases, the influence of the environment decreases.

8. As the level of technology increases, the influence of the environment increases.

9. If the level of technology is high, then a people will make less use of the resources in their environment.

10. If the level of technology is high, then a people will make greater use of the resources in their environment.
Introduction — Exercise Two

Every society has some way to divide the work among its members in order to produce the things they need. This way of dividing work is called division of labor.
Problem Question — Exercise Two

Question:
For which reason did the economic system of the Eku and the Azo require a different division of labor —

they produced the same things but in different amounts;
they produced different things but in the same amounts;
they produced different things in different amounts?

Write Your First Answer Here:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

Write Your Second Answer Here:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
Specific Inputs — Exercise Two

The Eku

Members of the Eku society arose at dawn to begin searching for food. Men, women, and children were all involved in looking for food.

Women and children were sent to pick wild plants, berries, and fruits. While the boys hunted for small animals the men hunted for large animals.

The Azo

Members of the Azo society arose at dawn to begin their work. Some worked as farmers, some raised animals, others were fishermen. A small number manufactured tools and other articles.

The men and older boys worked the farm and did the fishing. Young boys took care of the animals. The women and girls took care of the cooking and the making of clothes. Some of the older men of the community manufactured tools.
Statements — Exercise Two

C NC 1. The Azo had a more diverse division of labor than did the Eku.

C NC 2. The Eku had a less diverse division of labor than did the Azo.

C NC 3. The Eku had a simpler type of economic system than did the Azo.

C NC 4. The Azo had a more complex type of economic system than did the Eku.

C NC 5. If the people of an area have a more complex type of economic system, then they will have a more diverse division of labor.

C NC 6. If the people of an area have a more complex type of economic system, then they will have a less diverse division of labor.

C NC 7. If the people of an area have a simple type of economic system, then they will have a more diverse division of labor.

C NC 8. If the people of an area have a simple type of economic system, then they will have a less diverse division of labor.

(9)
Introduction - Exercise Three

The practice of trading one thing for another is called barter. Sometime money is used to buy or sell things rather than by trading.
Problem Question — Exercise Three

Question:

Which is the reason why the Eku and the Azo had different systems of exchange —

one had different things to trade;

one did not know how to use money, the other one did;

one did a great deal of trading, the other did very little?

Write Your First Answer Here:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________

Write Your Second Answer Here:

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________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
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(11)
Specific Inputs — Exercise Three

The Eku

The Eku made their living almost entirely by hunting and gathering.

The Eku household was barely able to find enough food to supply its own needs.

The Azo

The Azo made their living by farming, animal raising, fishing, and manufacturing.

The Azo had a surplus of food and other things. That is, a household usually raised or made more than it needed for its own use.
Statements — Exercise Three

C NC 1. The economy of the Eku was considered to be more advanced than the Azo economy.
C NC 2. The economy of the Eku was considered to be less advanced than the Azo economy.
C NC 3. The Eku used money while the Azo used a system of barter.
C NC 4. The Eku used a system of barter while the Azo used money.
C NC 5. If the economy of a people requires the use of money, then that economy is considered to be less advanced.
C NC 6. If the economy of a people use a system of barter, then that economy is considered to be more advanced.
C NC 7. If the economy of a people requires the use of money, then that economy is considered to be more advanced.
C NC 8. If the economy of a people use a system of barter, then that economy is considered to be less advanced.
Introduction — Exercise Four

In all societies some means must be provided to enforce rules, settle disputes, and protect private and group property. Every group must have rules to maintain control. The Eku and the Azo needed different rules and a different number of rules to maintain control.
Problem Question — Exercise Four

Question:
Which caused the Eku and the Azo to need different rules and a different number of rules to maintain control —

one group was more violent than the other;
one group lived in larger groups than the other;
one group was less civilized than the other?

Write Your First Answer Here:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Write Your Second Answer Here:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(15)
Specific Inputs — Exercise Four

The Eku

The Eku lived in kinship groups known as households. The Eku household consisted of the primary father, called the Old Father, and his wife, unmarried sons and daughters, married sons and their wives, grandchildren, servants, and the children of servants.

Leadership of the Eku household was in the Old Father. He owned everything. He made the important decisions. He directed the work of the household.

Each Eku household lived in a definite territory, which it claimed the right to use.

The Azo

The Azo community was made up of households combined into local groups called clans. Each clan had its own farmland, grazing land, and fishing rights.

The clan chief was the head of the largest and richest household in the clan. He served as clan spokesman and decided differences among households. The community council was made up of the clan chiefs. The council decided differences that occurred among the clans.
Statements — Exercise Four

C NC 1. The Eku society may be classified as more complex than the Azo society.

C NC 2. The Eku society needed more controls over the people than did the Azo society.

C NC 3. The Azo society may be classified as simpler than the Eku society.

C NC 4. The Azo society needed less controls over the people than did the Eku society.

C NC 5. If a society is classified as simple, then it will need less controls over the people.

C NC 6. If a society is classified as simple, then it will need more controls over the people.

C NC 7. If a society is classified as complex, then it will need more controls over the people.

C NC 8. If a society is classified as complex, then it will need less controls over the people.
Introduction — Exercise Five

Culture is man's way of adapting to and modifying his environment. Even though the Eku and the Azo had identical environments, they developed different cultures. That is, each developed different ways of modifying and adapting to the environment.
Problem Question - Exercise Five

Question:

Which made the Eku and the Azo develop different cultures, that is, different ways of modifying and adapting to the environment —

one group had better and more cutting tools;
one group communicated with one another better;
one group learned faster than the other group?

Write Your First Answer Here:

Write Your Second Answer Here:

(19)
Specific Inputs — Exercise Five

The Eku

The Eku males used spear throwers to kill animals for food. The spear thrower had a stone point on one end for use as a chisel to make other tools. It was also used to make fire by friction.

A chipped-flint hand ax was used as a chopper, a knife, and a scraper to prepare the animals for eating. It was also used for cutting sticks and vines for houses and preparing the skins of animals for clothing.

The Azo

The Azo tool makers using chipping and grinding techniques made knives, axes, chisels, scrapers, and spears from stone, wood, and bone.

The Azo farmers used digging sticks and hoes made of wood to cultivate the soil. They used flint sickles to harvest their cereal crops.

Long poles with sharp points were used by wading fishermen. Small rafts were constructed to carry fishermen away from shore to cast their nets.
Statements – Exercise Five

C NC 1. The Azo were able to modify the environment to a high degree.

C NC 2. The Azo had learned to adapt to the environment to a high degree.

C NC 3. The Eku were able to modify the environment to a high degree.

C NC 4. The Eku had learned to adapt to the environment to a high degree.

C NC 5. If the people of an area have been able to modify the environment to a high degree, then it has learned to adapt to the environment to a high degree.

C NC 6. If the people of an area have been able to modify the environment to a low degree, then it has learned to adapt to the environment to a low degree.

C NC 7. If the people of an area have been able to modify the environment to a low degree, then it has learned to adapt to the environment to a high degree.

C NC 8. If the people of an area have been able to modify the environment to a high degree, then it has learned to adapt to the environment to a low degree.
APPENDIX B

STUDENT BOOKLET: CONTROL GROUP
Student Booklet

TWO MAKE-BELIEVE CIVILIZATIONS:

THE EKU

and

THE AZO
GENERAL INTRODUCTION

Once upon a time many, many hundreds of years ago there lived a group of people. Then one day a great crack in the earth divided these people into two separate groups. And to make matters worse, this gap grew wider and wider and a great sea formed between them.

For some unexplained reason the two areas remained identical in all ways - the same climate, the same available natural resources. In fact their environment was the same as we have in Portage County.
Introduction — Exercise One

Many, many more years passed and the two groups continued their ways, with one big exception. One group became more prosperous, that is, one group had more things.
Problem Question — Exercise One

Question:

Why did one group become more prosperous than the other group?

Write Your First Answer Here:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Write Your Second Answer Here:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(3)
Specific Inputs — Exercise One

The Eku

The Eku consisted of meat, plants, and fruits. The Eku moved from place to place in search of food.

The Eku clothed themselves with the skins of the animals they had killed for food. They draped them around their shoulders for protection in the winter. In the summer lighter skins of animals were worn for protection against the hot sun.

The houses that the Eku erected were made for temporary dwelling. The framework of their houses were made of sticks tied together with vines. The walls and roof were then covered with large pieces of animal skins. In the winter the houses were covered with heavy furs.

The Azo

The Azo diet consisted of meat, vegetables, cereals, fruits, and fish. The Azo domesticated some of the animals that roamed the countryside. They found that certain wild plants could be cultivated and made to yield vegetables and cereals of various kinds. Fish in abundance was gathered from the sea.

Clothing was made of furs, skins, and a coarse kind of cloth sewn together with vegetable fibers.

The houses that the Azo built were permanent structures. The roof was supported by six posts sunk into the ground. The sides were covered with long poles tied together with vegetable fibers. During the winter season animal furs were hung over the walls.
Statements — Exercise One

C NC 1. The Eku were more influenced by their environment than were the Azo.

C NC 2. The level of technology (ways of making things) of the Eku was higher than that of the Azo.

C NC 3. The Eku made greater use of the resources in their environment than did the Azo.

C NC 4. The Azo were more influenced by their environment than were the Eku.

C NC 5. The level of technology (ways of making things) of the Azo was higher than that of the Eku.

C NC 6. The Azo made greater use of the resources in their environment than did the Eku.

C NC 7. As the level of technology increases, the influence of the environment decreases.

C NC 8. As the level of technology increases, the influence of the environment increases.

C NC 9. If the level of technology is high, then a people will make less use of the resources in their environment.

C NC 10. If the level of technology is high, then a people will make greater use of the resources in their environment.

(5)
Introduction — Exercise Two

Every society has some way to divide the work among its members in order to produce the things they need. This way of dividing work is called division of labor.
Problem Question — Exercise Two

Question:

Why did the economic system of the Eku and the Azo require a different division of labor?

Write Your First Answer Here:

Write Your Second Answer Here:
Members of the Eku society arose at dawn to begin searching for food. Men, women, and children were all involved in looking for food.

Women and children were sent to pick wild plants, berries, and fruits. While the boys hunted for small animals the men hunted for large animals.

Members of the Azo society arose at dawn to begin their work. Some worked as farmers, some raised animals, others were fishermen. A small number manufactured tools and other articles.

The men and older boys worked the farm and did the fishing. Young boys took care of the animals. The women and girls took care of the cooking and the making of clothes. Some of the older men of the community manufactured tools.
Statements — Exercise Two

C  NC  1. The Azo had a more diverse division of labor than did the Eku.

C  NC  2. The Eku had a less diverse division of labor than did the Azo.

C  NC  3. The Eku had a simpler type of economic system than did the Azo.

C  NC  4. The Azo had a more complex type of economic system than did the Eku.

C  NC  5. If the people of an area have a more complex type of economic system, then they will have a more diverse division of labor.

C  NC  6. If the people of an area have a more complex type of economic system, then they will have a less diverse division of labor.

C  NC  7. If the people of an area have a simple type of economic system, then they will have a more diverse division of labor.

C  NC  8. If the people of an area have a simple type of economic system, then they will have a less diverse division of labor.
Introduction — Exercise Three

The practice of trading one thing for another is called barter. Sometime money is used to buy or sell things rather than by trading.
Problem Question — Exercise Three

Question:

Why did the Eku and the Azo have different systems of exchange?

Write Your First Answer Here:

Write Your Second Answer Here:
Specific Inputs — Exercise Three

The Eku

The Eku made their living almost entirely by hunting and gathering.

The Eku household was barely able to find enough food to supply its own needs.

The Azo

The Azo made their living by farming, animal raising, fishing, and manufacturing.

The Azo had a surplus of food and other things. That is, a household usually raised or made more than it needed for its own use.
Statements — Exercise Three

1. The economy of the Eku was considered to be more advanced than the Azo economy.

2. The economy of the Eku was considered to be less advanced than the Azo economy.

3. The Eku used money while the Azo used a system of barter.

4. The Eku used a system of barter while the Azo used money.

5. If the economy of a people requires the use of money, then that economy is considered to be less advanced.

6. If the economy of a people use a system of barter, then that economy is considered to be more advanced.

7. If the economy of a people requires the use of money, then that economy is considered to be more advanced.

8. If the economy of a people use a system of barter, then that economy is considered to be less advanced.
Introduction — Exercise Four

In all societies some means must be provided to enforce rules, settle disputes, and protect private and group property. Every group must have rules to maintain control. The Eku and the Azo needed different rules and a different number of rules to maintain control.
Problem Question — Exercise Four

Question:

Why did the Eku and the Azo need different rules and a different number of rules to maintain control?

Write Your First Answer Here:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

Write Your Second Answer Here:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
specific inputs — exercise four

the eku

the eku lived in kinship groups known as households. the eku household consisted of the primary father, called the old father, and his wife, unmarried sons and daughters, married sons and their wives, grandchildren, servants, and the children of servants.

leadership of the eku household was in the old father. he owned everything. he made the important decisions. he directed the work of the household.

each eku household lived in a definite territory, which it claimed the right to use.

the azo

the azo community was made up of households combined into local groups called clans. each clan had its own farmland, grazing land, and fishing rights.

the clan chief was the head of the largest and richest household in the clan. he served as clan spokesman and decided differences among households. the community council was made up of the clan chiefs. the council decided differences that occurred among the clans.
**Statements — Exercise Four**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Eku society may be classified as more complex than the Azo society.</td>
<td>C NC</td>
</tr>
<tr>
<td>2. The Eku society needed more controls over the people than did the Azo society.</td>
<td>C NC</td>
</tr>
<tr>
<td>3. The Azo society may be classified as simpler than the Eku society.</td>
<td>C NC</td>
</tr>
<tr>
<td>4. The Azo society needed less controls over the people than did the Eku society.</td>
<td>C NC</td>
</tr>
<tr>
<td>5. If a society is classified as simple, then it will need less controls over the people.</td>
<td>C NC</td>
</tr>
<tr>
<td>6. If a society is classified as simple, then it will need more controls over the people.</td>
<td>C NC</td>
</tr>
<tr>
<td>7. If a society is classified as complex, then it will need more controls over the people.</td>
<td>C NC</td>
</tr>
<tr>
<td>8. If a society is classified as complex, then it will need less controls over the people.</td>
<td>C NC</td>
</tr>
</tbody>
</table>
Culture is man's way of adapting to and modifying his environment. Even though the Eku and the Azo had identical environments, they developed different cultures. That is, each developed different ways of modifying and adapting to the environment.
Problem Question — Exercise Five

Question:

Why did the Eku and the Azo develop different cultures, that is, different ways of modifying and adapting to the environment?

Write Your First Answer Here:

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

Write Your Second Answer Here:

________________________________________

________________________________________

________________________________________

________________________________________

(19)
Specific Inputs — Exercise Five

The Eku

The Eku males used spear throwers to kill animals for food. The spear thrower had a stone point on one end for use as a chisel to make other tools. It was also used to make fire by friction.

A chipped-flint hand ax was used as a chopper, a knife, and a scraper to prepare the animals for eating. It was also used for cutting sticks and vines for houses and preparing the skins of animals for clothing.

The Azo

The Azo tool makers using chipping and grinding techniques made knives, axes, chisels, scrapers, and spears from stone, wood, and bone.

The Azo farmers used digging sticks and hoes made of wood to cultivate the soil. They used flint sickles to harvest their cereal crops.

Long poles with sharp points were used by wading fishermen. Small rafts were constructed to carry fishermen away from shore to cast their nets.
Statements — Exercise Five

C NC 1. The Azo were able to modify the environment to a high degree.

C NC 2. The Azo had learned to adapt to the environment to a high degree.

C NC 3. The Eku were able to modify the environment to a high degree.

C NC 4. The Eku had learned to adapt to the environment to a high degree.

C NC 5. If the people of an area have been able to modify the environment to a high degree, then it has learned to adapt to the environment to a high degree.

C NC 6. If the people of an area have been able to modify the environment to a low degree, then it has learned to adapt to the environment to a low degree.

C NC 7. If the people of an area have been able to modify the environment to a low degree, then it has learned to adapt to the environment to a high degree.

C NC 8. If the people of an area have been able to modify the environment to a high degree, then it has learned to adapt to the environment to a low degree.
APPENDIX C

SIMULATION MANUAL FOR THE TWO MAKE-BELIEVE CIVILIZATIONS:

THE EKU AND THE AZO
The Simulation Manual

for

TWO MAKE-BELIEVE CIVILIZATIONS:

THE EKU

and

THE AZO
Opening Instructions:

Distribute the appropriate booklet to each of the subjects in the experimental and control groups.

SAY: This booklet tells about two make-believe civilizations — the Eku and the Azo civilizations. The booklet includes a set of five exercises to help find out how well you can answer questions about these two civilizations.

Now turn to page one.
GENERAL INTRODUCTION

Instructions:

SAY:
As I read the General Introduction aloud
you are to read it silently

READ:
General Introduction, page one.

THEN SAY:
Now turn to page 2.
Introduction — Exercise One

Instructions:

SAY:
I will read the Introduction for Exercise One while you follow along silently.

READ:
Introduction — Exercise One, page 2

THEN SAY:
Now turn to page 3
Problem Question — Exercise One

Instructions:

SAY:
You will have two chances to answer this question — once at the beginning of the exercise and once toward the end.

Now read the question carefully and write what you think the answer is.

Write your first answer under the space that says: Write Your First Answer Here.

Close your booklet after writing your first answer. Place your pencil in the booklet to keep the place.

After all of the students have finished SAY:
Now turn to page 4.
Specific Inputs — Exercise One

Instructions:

SAY:
On this page is some specific information about the Eku and the Azo civilizations.
As I read the information follow along silently.

READ:
Specific Inputs — Exercise One, page 4.

THEN SAY:
Now turn back to page 3.
With this information in mind write your second answer under the space that says: Write Your Second Answer Here.
Even if your second answer is the same as your first answer, please write it again.
Close your booklet after writing your second answer.

After all of the students have finished SAY:
Now turn to page 5.
Statements — Exercise One

Instructions:

SAY:
On page 5 are some statements. After
I read each statement you are to circle
the C if the statement is correct or
the NC if the statement is not correct.

Do not make your circle until I have
finished reading the statement.

READ:
Statements — Exercise One, page 5.

----------------------------------------------------------

THEN SAY:
Now turn to page 6.
Introduction — Exercise Two

Instructions:

SAY:
Follow along silently as I read the Introduction for Exercise Two.

READ:

THEN SAY:
Now turn to page 7.
Problem Question — Exercise Two

Instructions:

SAY:
Read the question carefully and write what you think the answer is.

Write your first answer under the space that says: Write Your First Answer Here.

Close your booklet after writing your first answer.

After all of the students have finished SAY:
Now turn to page 8.
Specific Inputs — Exercise Two

Instructions:

SAY:
As I read the information follow along silently.

READ:
Specific Inputs — Exercise Two, page 8.

THEN SAY:
Now turn to page 7.

Write your second answer where it says: Write Your Second Answer Here.

Even if your second answer is the same as your first answer, please write it again.

Close your booklet after writing your second answer.

After all of the students have finished SAY:
Now turn to page 9.
Statements — Exercise Two

Instructions:

SAY:
After I read each statement circle the
C  if the statement is correct or the
NC if the statement is not correct.

READ:

THEN SAY:
Now turn to page 10.
Introduction — Exercise Three

Instructions:

SAY:
Follow along silently as I read the Introduction for Exercise Three.

READ:

THEN SAY:
Now turn to page 11.
Problem Question — Exercise Three

Instructions:

SAY:
Read the question carefully and write your first answer.

After all of the students have finished SAY:
Now turn to page 12.
Specific Inputs — Exercise Three

Instructions:

SAY:
As I read the information follow along silently.

READ:
Specific Inputs — Exercise Three, page 12.

THEN SAY:
Now turn back to page 11.
Write your second answer.
Even if your second answer is the same as your first answer, please write it again.
Close your booklet after writing your second answer.

After all of the students have finished SAY:
Now turn to page 13.
Statements — Exercise Three

Instructions:

SAY:
After I read each statement circle the
C if the statement is correct or the
NC if the statement is not correct.

READ:

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REST:
Have the students close their booklets.
SAY: Remain in your seats and stretch for
for a minute or so.

THEN SAY:
Now turn to page 14.
Introduction — Exercise Four

Instructions:

SAY:
Follow along silently as I read the
Introduction for Exercise Four.

READ:
Introduction — Exercise Four, page 14

THEN SAY:
Now turn to page 15.
Problem Question — Exercise Four

Instructions:

SAY:
Read the question carefully and write your first answer.

Close your booklet after writing your first answer.

After all of the students have finished SAY:
Now turn to page 16.
Specific Inputs — Exercise Four

Instructions:

SAY:
As I read the information follow along silently.

READ:
Specific Inputs — Exercise Four, page 16.

THEN SAY:
Now turn back to page 15.
Write your second answer.
Close your booklet after writing your second answer.

After all of the students have finished SAY:
Now turn to page 17.
Statements — Exercise Four

Instructions:

SAY:

After I read each statement circle the
C if the statement is correct or the
NC if the statement is not correct.

READ:

Statements — Exercise Four, page 17.

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THEN SAY:

Now turn to page 18.
Introduction — Exercise Five

Instructions:

SAY: Follow along silently as I read the Introduction for Exercise Five.


THEN SAY: Now turn to page 19.
Problem Question — Exercise Five

Instructions:

SAY:
Read the question carefully and write what you think the answer is.

Write your first answer under the space that says: Write Your First Answer Here.

Close your booklet after writing your first answer.

After all of the students have finished SAY:
Now turn to page 20.
Specific Inputs — Exercise Five

Instructions:

SAY:
As I read the information follow along silently.

READ:
Specific Inputs — Exercise Five, page 20.

THEN SAY:
Now turn back to page 19.
Write your second answer where it says: Write Your Second Answer Here.
Even if your second answer is the same as your first answer, please write it again.
Close your booklet after writing your second answer.

After all of the students have finished SAY:
Now Turn to page 21.
Statements — Exercise Five

Instructions:

SAY:
After I read each statement circle the
C if the statement is correct or the
NC if the statement is not correct.

READ:
APPENDIX D

STATEMENTS BOOKLET: STUDENTS’
STATEMENTS — SET I

C NC 1. As the level of technology (ways of making things) increases, the influence of the environment decreases.

C NC 2. As the level of technology increases, the influence of the environment increases.

C NC 3. If the level of technology is high, then a people will make less use of the resources in their environment.

C NC 4. If the level of technology is high, then a people will make greater use of the resources in their environment.
STATEMENTS - SET II

C NC 1. If the people of an area have a more complex type of economic system, then they will have a more diverse division of labor.

C NC 2. If the people of an area have a more complex type of economic system, then they will have a less diverse division of labor.

C NC 3. If the people of an area have a simple type of economic system, then they will have a more diverse division of labor.

C NC 4. If the people of an area have a simple type of economic system, then they will have a less diverse division of labor.
STATEMENTS -- SET III

C NC 1. If the economy of a people requires the use of money, then that economy is considered to be less advanced.

C NC 2. If the economy of a people use a system of barter, then that economy is considered to be more advanced.

C NC 3. If the economy of a people requires the use of money, then that economy is considered to be more advanced.

C NC 4. If the economy of a people use a system of barter, then that economy is considered to be less advanced.
STATEMENTS — SET IV

C NC 1. If a society is classified as simple, then it will need less controls over the people.

C NC 2. If a society is classified as simple, then it will need more controls over the people.

C NC 3. If a society is classified as complex, then it will need more controls over the people.

C NC 4. If a society is classified as complex, then it will need less controls over the people.
STATEMENTS — SET V

C NC 1. If the people of an area have been able to modify the environment to a high degree, then it has learned to adapt to the environment to a high degree.

C NC 2. If the people of an area have been able to modify the environment to a low degree, then it has learned to adapt to the environment to a low degree.

C NC 3. If the people of an area have been able to modify the environment to a low degree, then it has learned to adapt to the environment to a high degree.

C NC 4. If the people of an area have been able to modify the environment to a high degree, then it has learned to adapt to the environment to a low degree.
APPENDIX E

STATEMENTS BOOKLET: ADMINISTRATOR'S
Name ____________________________
  first       last

School ____________________________

Teacher ____________________________

Date ____________________________
  Month    date    year

STATEMENTS BOOKLET

(Administrator's)
STATMENTS — SET I

C NC 1. As the level of technology (ways of making things) increases, the influence of the environment decreases.

C NC 2. As the level of technology increases, the influence of the environment increases.

C NC 3. If the level of technology is high, then a people will make less use of the resources in their environment.

C NC 4. If the level of technology is high, then a people will make greater use of the resources in their environment.

Terms defined:

Instructions:

If the students ask or seem to need any of the words underlined defined use the definitions listed below.

increases ..... gets higher, rises

decreases ..... gets less
STATEMENTS — SET II

C NC 1. If the people of an area have a more complex type of economic system, then they will have a more diverse division of labor.

C NC 2. If the people of an area have a more complex type of economic system, then they will have a less diverse division of labor.

C NC 3. If the people of an area have a simple type of economic system, then they will have a more diverse division of labor.

C NC 4. If the people of an area have a simple type of economic system, then they will have a less diverse division of labor.

Terms defined:

more complex .......... more complicated
economic system ....way of producing
more diverse .......... more different
less diverse .......... less different

(2)
STATEMENTS — SET III

C NC 1. If the economy of a people requires the use of money, then that economy is considered to be less advanced.

C NC 2. If the economy of a people use a system of barter, then that economy is considered to be more advanced.

C NC 3. If the economy of a people requires the use of money, then that economy is considered to be more advanced.

C NC 4. If the economy of a people use a system of barter, then that economy is considered to be less advanced.

Terms defined:

economy ............ way of producing and distributing things

barter ............ practice of trading one thing for another.
STATEMENTS — SET IV

C NC 1. If a society is classified as simple, then it will need less controls over the people.

C NC 2. If a society is classified as simple, then it will need more controls over the people.

C NC 3. If a society is classified as complex, then it will need more controls over the people.

C NC 4. If a society is classified as complex, then it will need less controls over the people.

Terms defined:

complex ....... complicated
STATEMENTS — SET V

C NC 1. If the people of an area have been able to modify the environment to a high degree, then it has learned to adapt to the environment to a high degree.

C NC 2. If the people of an area have been able to modify the environment to a low degree, then it has learned to adapt to the environment to a low degree.

C NC 3. If the people of an area have been able to modify the environment to a low degree, then it has learned to adapt to the environment to a high degree.

C NC 4. If the people of an area have been able to modify the environment to a high degree, then it has learned to adapt to the environment to a low degree.

Terms defined:

modify .......... change
adapt .......... get along in

(5)
APPENDIX F

INSTRUCTIONS FOR ADMINISTERING STATEMENTS
INSTRUCTIONS FOR ADMINISTERING STATEMENTS

SAY:  (Before students open booklet)

Please fill in the information at the upper right hand corner of the statement booklet. Do not open the booklet until you are instructed to do so.

SAY: This booklet contains five sets of statements.

THEN SAY:

Now open your booklet to statements — set I on page one.

After I read each statement you are to circle the C if the statement is correct or the NC if the statement is not correct.

Do not make your circle until I have finished reading the statement.

READ:  (Read the statement for set I ).

(Read the statements one at a time pausing after each in order for the students to circle the C or the NC. Give the proper emphasis to the words underlined.

---------------------------------------------------------------

(After reading the statements for set I say:)

SAY: Now turn to statements — set II on page two.

Remember do not make your circle until I have
finished reading the statement.

READ:  (Read the statements for set II).

SAY:  Now turn to statements — set III on page three.

READ:  (Read the statements for set III).

SAY:  Now turn to statements — set IV on page four.

Remember do not make your circle until I have finished reading the statement.

READ:  (Read the statements for set IV).

SAY:  Now turn to statements — set V on page five.

READ:  (Read the statements for set V).
APPENDIX G

STATEMENTS: CORRECT RESPONSES

This appendix includes the posttest items—substantive and sub-generalization statements. If the statement is correct the "C" before the generalization is circled. If the statement item is incorrect the "NC" is circled.
Statements — Exercise One

1. The Eku were more influenced by their environment than were the Azo.

2. The level of technology (ways of making things) of the Eku was higher than that of the Azo.

3. The Eku made greater use of the resources in their environment than did the Azo.

4. The Azo were more influenced by their environment than were the Eku.

5. The level of technology (ways of making things) of the Azo was higher than that of the Eku.

6. The Azo made greater use of the resources in their environment than did the Eku.

7. As the level of technology increases, the influence of the environment decreases.

8. As the level of technology increases, the influence of the environment increases.

9. If the level of technology is high, then a people will make less use of the resources in their environment.

10. If the level of technology is high, then a people will make greater use of the resources in their environment.
Statements — Exercise Two

© NC 1. The Azo had a more diverse division of labor than did the Eku.
© NC 2. The Eku had a less diverse division of labor than did the Azo.
© NC 3. The Eku had a simpler type of economic system than did the Azo.
© NC 4. The Azo had a more complex type of economic system than did the Eku.
© NC 5. If the people of an area have a more complex type of economic system, then they will have a more diverse division of labor.
© NC 6. If the people of an area have a more complex type of economic system, then they will have a less diverse division of labor.
© NC 7. If the people of an area have a simple type of economic system, then they will have a more diverse division of labor.
© NC 8. If the people of an area have a simple type of economic system, then they will have a less diverse division of labor.
Statements — Exercise Three

1. The economy of the Eku was considered to be more advanced than the Azo economy.

2. The economy of the Eku was considered to be less advanced than the Azo economy.

3. The Eku used money while the Azo used a system of barter.

4. The Eku used a system of barter while the Azo used money.

5. If the economy of a people requires the use of money, then that economy is considered to be less advanced.

6. If the economy of a people use a system of barter, then that economy is considered to be more advanced.

7. If the economy of a people requires the use of money, then that economy is considered to be more advanced.

8. If the economy of a people use a system of barter, then that economy is considered to be less advanced.
Statements — Exercise Four

C NC 1. The Eku society may be classified as more complex than the Azo society.

C NC 2. The Eku society needed more controls over the people than did the Azo society.

C NC 3. The Azo society may be classified as simpler than the Eku society.

C NC 4. The Azo society needed less controls over the people than did the Eku society.

C NC 5. If a society is classified as simple, then it will need less controls over the people.

C NC 6. If a society is classified as simple, then it will need more controls over the people.

C NC 7. If a society is classified as complex, then it will need more controls over the people.

C NC 8. If a society is classified as complex, then it will need less controls over the people.
1. The Azo were able to modify the environment to a high degree.

2. The Azo had learned to adapt to the environment to a high degree.

3. The Eku were able to modify the environment to a high degree.

4. The Eku had learned to adapt to the environment to a high degree.

5. If the people of an area have been able to modify the environment to a high degree, then it has learned to adapt to the environment to a high degree.

6. If the people of an area have been able to modify the environment to a low degree, then it has learned to adapt to the environment to a low degree.

7. If the people of an area have been able to modify the environment to a low degree, then it has learned to adapt to the environment to a high degree.

8. If the people of an area have been able to modify the environment to a high degree, then it has learned to adapt to the environment to a low degree.
APPENDIX H

PROBLEM QUESTIONS: EXPERIMENTAL GROUP—
CORRECT ANSWER CHOICES

This appendix contains the problem questions for the experimental group. The correct choice of answer for each exercise is prefaced by a check mark (✓).
Problem Question — Exercise One

Question:

Which made one group more prosperous than the other —

their ways of making things were different;

✓ their ways of making things were better;

their ways were the same, but one group were just better workers?

Write Your First Answer Here:

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Write Your Second Answer Here:

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Problem Question — Exercise Two

Question:

For which reason did the economic system of the Eku and the Azo require a different division of labor —

- they produced the same things but in different amounts;
- they produced different things but in the same amounts;
- √ they produced different things in different amounts?

Write Your First Answer Here:

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Write Your Second Answer Here:

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Problem Question – Exercise Three

Question:

Which is the reason why the Eku and the Azo had different systems of exchange –

one had different things to trade;

one did not know how to use money, the other did;

✓ one did a great deal of trading, the other did very little?

Write Your First Answer Here:

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Write Your Second Answer Here:

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Problem Question — Exercise Four

Question:

Which caused the Eku and the Azo to need different rules and a different number of rules to maintain control —

- one group was more violent than the other;
- one group lived in larger groups than the other;
- one group was less civilized than the other?

Write Your First Answer Here:

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Write Your Second Answer Here:

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Problem Question — Exercise Five

Question:
Which made the Eku and the Azo develop different cultures, that is, different ways of modifying and adapting to the environment —

√ one group had better and more cutting tools;
one group communicated with one another better;
one group learned faster than the other group?

Write Your First Answer Here:

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Write Your Second Answer Here:

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APPENDIX I

ANSWER PATTERNS: SAMPLES — EXPERIMENTAL GROUP

Included in this appendix are samples of each answer pattern — one through five — for the experimental subjects. One of the choices offered in the problem question itself is regarded as the one correct answer. (See: Appendix H)
Pattern One: 
First Answer — Correct 
Second Answer — Correct
Problem Question — Exercise One

Question:

Which made one group more prosperous than the other —

- their ways of making things were different;
- their ways of making things were better;
- their ways were the same, but one group were just better workers?

Write Your First Answer Here:

Their ways of making things were better.

Write Your Second Answer Here:

Their ways of making things were better.
Problem Question — Exercise Two

Question:

For which reason did the economic system of the Eku and the Azo require a different division of labor —

they produced the same things but in different amounts;
they produced different things but in the same amounts;
they produced different things in different amounts?

Write Your First Answer Here:

they produced different things
in different amounts.

Write Your Second Answer Here:

they produced different things in different amounts.
Problem Question – Exercise Three

Question:

Which is the reason why the Eku and the Azo had different systems of exchange –

one had different things to trade;

one did not know how to use money, the other one did;

one did a great deal of trading, the other did very little?

Write Your First Answer Here:

one did a great deal of trading, the
other did very little.

Write Your Second Answer Here:

one did a great deal of trading, the
other did very little.
Problem Question — Exercise Four

Question:
Which caused the Eku and the Azo to need different rules and a different number of rules to maintain control —

one group was more violent than the other;
one group lived in larger groups than the other;
one group was less civilized than the other?

Write Your First Answer Here:

One group lived in larger groups than the other.

Write Your Second Answer Here:

One group lived in larger groups than the other.
Problem Question - Exercise Five

Question:
Which made the Eku and the Azo develop different cultures, that is, different ways of modifying and adapting to the environment —

one group had better and more cutting tools;
one group communicated with one another better;
one group learned faster than the other group?

Write Your First Answer Here:

One group had better and more cutting tools.

Write Your Second Answer Here:

One group had better and more cutting tools.
First Answer = Incorrect

Pattern Two:
Second Answer = Correct
Problem Question — Exercise One

Question:

Which made one group more prosperous than the other —

- their ways of making things were different;
- their ways of making things were better;
- their ways were the same, but one group were just better workers?

Write Your First Answer Here:

Their ways were the same. In the group were just better workers.

Write Your Second Answer Here:

Their ways of making things were better.
Problem Question — Exercise Two

Questions:

For which reason did the economic system of the Eku and the Azo require a different division of labor —

they produced the same things but in different amounts;
they produced different things but in the same amounts;
they produced different things in different amounts?

Write Your First Answer Here:

they produced different things but in the same amount

Write Your Second Answer Here:

they produced different things in different amounts.
Problem Question - Exercise Three

Question:
Which is the reason why the Eku and the Azo had different systems of exchange -

one had different things to trade;
one did not know how to use money, the other one did;
one did a great deal of trading, the other did very little?

Write Your First Answer Here:

One did not know how to use money, the other one did.

Write Your Second Answer Here:

One did a great deal of trading, the other did very little.
Problem Question — Exercise Four

Question:
Which caused the Eku and the Azo to need different rules and a different number of rules to maintain control —

one group was more violent than the other;
one group lived in larger groups than the other;
one group was less civilized than the other?

Write Your First Answer Here:

one group was less civilized than the other.

Write Your Second Answer:

one group lived in larger groups than the other.
Problem Question - Exercise Five

Question:

Which made the Eku and the Azo develop different cultures, that is, different ways of modifying and adapting to the environment —

one group had better and more cutting tools;
one group communicated with one another better;
one group learned faster than the other group?

Write Your First Answer Here:

One group learned faster than the other group.

Write Your Second Answer Here:

One group had better and more cutting tools.
Pattern Three:

First Answer — Correct
Second Answer — Incorrect
Problem Question — Exercise One

Question:
Which made one group more prosperous than the other —
their ways of making things were different;
their ways of making things were better;
their ways were the same, but one group were just better workers?

Write Your First Answer Here:
Their ways of making things were better.

Write Your Second Answer Here:
Their diet consisted of meat, plants, and fruit.
The crop diet consisted of meat, vegetable, cereal, fruit, and fish.
Problem Question — Exercise Two

Question:

For which reason did the economic system of the Eku and the Azo require a different division of labor —

they produced the same things but in different amounts;
they produced different things but in the same amounts;
they produced different things in different amounts?

Write Your First Answer Here:

They produced different things in different amounts.

Write Your Second Answer Here:

They produced different things but in the same amounts.
Problem Question — Exercise Three

Question:

Which is the reason why the Eku and the Azo had different systems of exchange —

one had different things to trade;
one did not know how to use money, the other one did;
one did a great deal of trading, the other did very little?

Write Your First Answer Here:

One did a great deal of trading, the other did very little.

Write Your Second Answer Here:

The Eku always had to go hunting, and the Azo had farming and hunting for living.
Problem Question — Exercise Four

Question:

Which caused the Eku and the Azo to need different rules and a different number of rules to maintain control —

one group was more violent than the other;
one group lived in larger groups than the other;
one group was less civilized than the other?

Write Your First Answer Here:

One group lived in larger
groups than the others?

Write Your Second Answer Here:

One group was less civilized
than the other.
Problem Question — Exercise Five

Question:

Which made the Eku and the Azo develop different cultures, that is, different ways of modifying and adapting to the environment —

one group had better and more cutting tools;
one group communicated with one another better;
one group learned faster than the other group?

Write Your First Answer Here:

one group had better and more cutting tools.

Write Your Second Answer Here:

one had more tools than the other and using mete.
Pattern Four:

First Answer  --- Incorrect

Second Answer  --- Incorrect/different
Problem Question - Exercise One

Question:

Which made one group more prosperous than the other —

- their ways of making things were different;
- their ways of making things were better;
- their ways were the same, but one group were just better workers?

Write Your First Answer Here:

Their ways of things were different.

Write Your Second Answer Here:

Their clothing were made of fur, skins, and wool; together we vegetable fibers, they draped these clothing over them.
Problem Question — Exercise Two

Question:

For which reason did the economic system of the Eku and the Azo require a different division of labor —

they produced the same things but in different amounts;
they produced different things but in the same amounts;
they produced different things in different amounts?

Write Your First Answer Here:

they produced different things
but in the same amounts

Write Your Second Answer Here:

they produced the same things
but in different amounts
Problem Question — Exercise Three

Question:

Which is the reason why the Eku and the Azo had different systems of exchange —

one had different things to trade;
one did not know how to use money, the other did;
one did a great deal of trading, the other did very little?

Write Your First Answer Here:

One did not know how to use money, the other one did.

Write Your Second Answer Here:

One had different things to trade.
Problem Question - Exercise Four

Question:
Which caused the Eku and the Azo to need different rules and a different number of rules to maintain control —

one group was more violent than the other;
one group lived in larger groups than the other;
one group was less civilized than the other?

Write Your First Answer Here:

One group was less civilized than the other.

Write Your Second Answer Here:

One group was more violent than the other groups.
Problem Question — Exercise Five

Question:

Which made the Eku and the Azo develop different cultures, that is, different ways of modifying and adapting to the environment —

one group had better and more cutting tools;
one group communicated with one another better;
one group learned faster than the other group?

Write Your First Answer Here:

One group communicated with one another better.

Write Your Second Answer Here:

One group learned faster than the other group.
Pattern Five:

First Answer — Incorrect
Second Answer — Incorrect/same
Problem Question — Exercise One

Question:

Which made one group more prosperous than the other —

- their ways of making things were different;
- their ways of making things were better;
- their ways were the same, but one group were just better workers?

Write Your First Answer Here:

Their ways were the same, but one group were just better workers.

Write Your Second Answer Here:

Their ways were the same, but one group were just better workers.
Problem Question — Exercise Two

Question:

For which reason did the economic system of the Eku and the Azo require a different division of labor —

they produced the same things but in different amounts;
they produced different things but in the same amounts;
they produced different things in different amounts?

Write Your First Answer Here:

They produced the same things but in different amounts.

Write Your Second Answer Here:

They produced the same things but in different amounts.
Problem Question — Exercise Three

Question:

Which is the reason why the Eku and the Azo had different systems of exchange —

one had different things to trade;
one did not know how to use money, the other one did;
one did a great deal of trading, the other did very little?

Write Your First Answer Here:

One had different things to trade.

Write Your Second Answer Here:

One had different things to trade.
Problem Question — Exercise Four

Question:

Which caused the Eku and the Azo to need different rules and a different number of rules to maintain control — one group was more violent than the other; one group lived in larger groups than the other; one group was less civilized than the other?

Write Your First Answer Here:

One group was less civilized than the other.

Write Your Second Answer Here:

One was less civilized than the other.
Problem Question — Exercise Five

Questions:
Which made the Eku and the Azo develop different cultures, that is, different ways of modifying and adapting to the environment —

one group had better and more cutting tools;
one group communicated with one another better;
one group learned faster than the other group?

Write Your First Answer Here:

one group learned faster than the other group.

Write Your Second Answer Here:

one group learned faster than the other group.
APPENDIX J

ANSWER PATTERNS: SAMPLES — CONTROL GROUP

Included in this appendix are samples of each answer pattern — one through five — for the control subjects.

Each of the problem questions have a number of acceptable answers. However, a particular problem question answer was judged correct only if it reflected, either directly or by inference, the one answer regarded as correct for the problem question for the experimental group.
Pattern One:  First Answer — Correct

Pattern One:  Second Answer — Correct
Problem Question — Exercise One

Question:
Why did one group become more prosperous than the other group?

Write Your First Answer Here:
Because they had more things than the other group.

Write Your Second Answer Here:
Because they had more things then the other group.
Problem Question - Exercise Two

Question:

Why did the economic system of the Eku and the Azo require a different division of labor?

Write Your First Answer Here:

The economic system of the Eku and the Azo required a different division of labor because they made different things and did different things.

Write Your Second Answer Here:

The economic system of the Eku and the Azo required a different (handwritten: same).
Problem Question — Exercise Three

**Question:**

Why did the Eku and the Azo have different systems of exchange?

**Write Your First Answer Here:**

Became they had different items to trade. The Azo had more things to trade than the Eku did in their time.

**Write Your Second Answer Here:**

They had different things to trade. The Eku had more things to trade than the Azo. They had more music to sing on so the Eku had little to trade with. The same answer in the first answer.
Problem Question — Exercise Four

Question:
Why did the Eku and the Azo need different rules and a different number of rules to maintain control?

Write Your First Answer Here:

Because they have a different number of people.

Write Your Second Answer Here:

Because they have a different number of people.
First Answer — Incorrect

Pattern Two:
Second Answer — Correct
Problem Question — Exercise One

Question:

Why did one group become more prosperous than the other group?

Write Your First Answer Here:

They became more prosperous because the people in one group might have been more intelligent and invented more things. They also might have been weather and able to do more things.

Write Your Second Answer Here:

They became prosperous because one civilization's diet was better than the first and there was an abundance in food. Also, some houses were built better and clothing was better.
Problem Question — Exercise Two

Question:

Why did the economic system of the Eku and the Azo require a different division of labor?

Write Your First Answer Here:

Because the Azo was in one place and raised crops but the Eku weren't. The Azo had more work because they stayed in one place.

Write Your Second Answer Here:

Because the Eku did one thing, hunt for food, whereas the Azo did a variety of things.
Problem Question — Exercise Three

Question:

Why did the Eku and the Azo have different systems of exchange?

Write Your First Answer Here:

The Eku had less things to trade. The Azo had different things to trade.

Write Your Second Answer Here:

The Eku hardly had enough things for itself. They didn't have something left for trading. The Azo had more than it needed. They could sell or trade some of their products that they had left over.
Question:

Why did the Eku and the Azo need different rules and a different number of rules to maintain control?

Write Your First Answer Here:

Because the people decided to make different kind of rules. They were not the same as the others decided.

Write Your Second Answer Here:

Because they had a different number of people. (Azo)
Problem Question — Exercise Five

Question:

Why did the Eku and the Azo develop different cultures, that is, different ways of modifying and adapting to the environment?

Write Your First Answer Here:

The Azo tried harder than the Eku.

Write Your Second Answer Here:

The Azo tools were a lot better than the Eku.
Pattern Three:

First Answer — Correct
Second Answer — Incorrect
Problem Question — Exercise One

Question:

Why did one group become more prosperous than the other group?

Write Your First Answer Here:

One group had better things than the other group had.

Write Your Second Answer Here:

Clothing was made of fur, skins, and a coarse kind of cloth sewn together with vegetable fibers.
Problem Question — Exercise Two

Question:

Why did the economic system of the Eku and the Azo require a different division of labor?

Write Your First Answer Here:

The Azo had more things or jobs to do where they lived. The Eku did not have much work as the Azo people had so they could not divide equally if they had the same number of people as the Azo people had.

Write Your Second Answer Here:

The Azo people rose at dawn to work while it was cool. The Eku people had to look for food at dawn. This means to me, the Azo people had food and the Eku people did not have food, so they had to look for food.
Problem Question — Exercise Three

Question:

Why did the Eku and the Azo have different systems of exchange?

Write Your First Answer Here:

The one country has more to trade than another.

Write Your Second Answer Here:

The Azo had a good way of having
Problem Question - Exercise Four

Question:

Why did the Eku and the Azo need different rules and a different number of rules to maintain control?

Write Your First Answer Here:

Because the Eku's is a smaller community than the Azo's.

Write Your Second Answer Here:

Because the Eku's the Old Father was the head of the household and the Azo's the clan chief was the head.
Pattern Four:

First Answer — Incorrect
Second Answer — Incorrect/different
Problem Question — Exercise One

Question:
Why did one group become more prosperous than the other group?

Write Your First Answer Here:
The group that became more prosperous could have not used their land up. The other ones did. The ones that were more prosperous knew more about what they were doing having their land for later on.

Write Your Second Answer Here:
The ones (Eku) that moved from place to place never knew what the environment was going to be. They researched on the things that were around them. They found things that Eku didn't even try to learn about.
Problem Question - Exercise Two

Question:

Why did the economic system of the Eku and the Azo require a different division of labor?

Write Your First Answer Here:

The Eku must not have been divided equal and I think it should
The Azo is ok and think it should stay the same.

Write Your Second Answer Here:

The Azo did more different jobs and the Eku did not. I think the Eku should have different kinds of jobs.
Problem Question - Exercise Three

Question:

Why did the Eku and the Azo have different systems of exchange?

Write Your First Answer Here:

The Azo had more ways of getting places than the Eku.

Write Your Second Answer Here:

The Azo had farms that they could get things from and the Eku had to hunt for their foods.
Problem Question — Exercise Four

Question:

Why did the Eku and the Azo need different rules and a different number of rules to maintain control?

Write Your First Answer Here:

Write Your Second Answer Here:
Problem Question — Exercise Five

Question:

Why did the Eku and the Azo develop different cultures, that is, different ways of modifying and adapting to the environment?

Write Your First Answer Here:

Because the Azo environment had invented more and were prosperous, had a different environment and better life with all of its resources.

Write Your Second Answer Here:

The Azo environment was more complex, they had a better way of doing things then the Eku.
Pattern Five:

First Answer — Incorrect

Second Answer — Incorrect/same
Problem Question — Exercise One

Question:

Why did one group become more prosperous than the other group?

Write Your First Answer Here:

I think one group became more prosperous because one group had smarter people than the other and thought up more things.

Write Your Second Answer Here:

I think one group became more prosperous because one group had smarter people than the other and thought up more things.
Problem Question — Exercise Two

Question:

Why did the economic system of the Eku and the Azo require a different division of labor?

Write Your First Answer Here:

Because they made greater use of their economic system.

Write Your Second Answer Here:

Because the Azo made greater use of their economic system.
Problem Question — Exercise Three

Question:

Why did the Eku and the Azo have different systems of exchange?

Write Your First Answer Here:

Because the Eku had berries and animals to trade, the Azo had vegetables, tools, and maybe animals to trade. (fish)

Write Your Second Answer Here:

Because the Eku had berries and animals to trade, the Azo had vegetables, tools, animals to trade. (fish)
Problem Question - Exercise Four

Question:

Why did the Eku and the Azo need different rules and a different number of rules to maintain control?

Write Your First Answer Here:

They did because they lived differently.

Write Your Second Answer Here:

They did because they lived differently.
Problem Question — Exercise Five

Question:

Why did the Eku and the Azo develop different cultures, that is, different ways of modifying and adapting to the environment?

Write Your First Answer Here:

Because they were two different sets of people and they did things differently.

Write Your Second Answer Here:

They were two different sets of people with different ways of doing things.
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