1974

An exploratory study of cognitive learning style components for achievement using computer simulation games

Roger Allan Paul Smith
Iowa State University

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SMITH, Roger Allan Paul, 1947-
AN EXPLORATORY STUDY OF COGNITIVE LEARNING STYLE
COMPONENTS FOR ACHIEVEMENT USING COMPUTER
SIMULATION GAMES.

Iowa State University, Ph.D., 1974
Education, industrial

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THIS DISSERTATION HAS BEEN MICROFILMED EXACTLY AS RECEIVED.
An exploratory study of cognitive learning style components for achievement using computer simulation games

by

Roger Allan Paul Smith

A Dissertation Submitted to the Graduate Faculty in Partial Fulfillment of The Requirements for the Degree of DOCTOR OF PHILOSOPHY

Major: Industrial Education

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

For the Major Department

Signature was redacted for privacy.

For the Graduate College

Iowa State University
Ames, Iowa

1974
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER I. INTRODUCTION</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statement of the Problem</td>
<td>5</td>
</tr>
<tr>
<td>Statement of the Purpose</td>
<td>5</td>
</tr>
<tr>
<td>Statement of Need</td>
<td>6</td>
</tr>
<tr>
<td>Statement of Hypotheses</td>
<td>10</td>
</tr>
<tr>
<td>Statement of Assumptions</td>
<td>13</td>
</tr>
<tr>
<td>Limitations of the Study</td>
<td>14</td>
</tr>
<tr>
<td>Statement of Procedure</td>
<td>15</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHAPTER II. REVIEW OF LITERATURE</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Learning Style</td>
<td>20</td>
</tr>
<tr>
<td>Educational Sciences</td>
<td>27</td>
</tr>
<tr>
<td>Simulation Gaming</td>
<td>42</td>
</tr>
<tr>
<td>Summary</td>
<td>53</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHAPTER III. METHODOLOGY</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>55</td>
</tr>
<tr>
<td>Computer Simulation Games</td>
<td>57</td>
</tr>
<tr>
<td>Instruments and Variables</td>
<td>64</td>
</tr>
<tr>
<td>Design and Analysis</td>
<td>73</td>
</tr>
<tr>
<td>Data Collection</td>
<td>78</td>
</tr>
<tr>
<td>Summary</td>
<td>81</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHAPTER IV. FINDINGS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Hypothesis I</td>
<td>83</td>
</tr>
<tr>
<td>Research Hypothesis II</td>
<td>92</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Distribution of the experimental group on the pre- and post-&quot;Management Test&quot;</td>
<td>76</td>
</tr>
<tr>
<td>2.</td>
<td>Distribution of the experimental group on the pre- and post-&quot;Beef Breeding Test&quot;</td>
<td>77</td>
</tr>
<tr>
<td>3.</td>
<td>Interaction of time by treatment using the &quot;Management Test&quot;</td>
<td>88</td>
</tr>
<tr>
<td>4.</td>
<td>Interaction of time by treatment using the &quot;Beef Breeding Test&quot;</td>
<td>91</td>
</tr>
<tr>
<td>5.</td>
<td>Standard scores of means for management achievers and nonachievers on learning style traits</td>
<td>104</td>
</tr>
<tr>
<td>6.</td>
<td>Standard scores of means for beef achievers and nonachievers on learning style traits</td>
<td>118</td>
</tr>
<tr>
<td>7.</td>
<td>Standard scores of means for beef and management achievers and nonachievers on learning style traits</td>
<td>121</td>
</tr>
<tr>
<td>8.</td>
<td>Standard scores of means for combined achievers and nonachievers on learning style traits</td>
<td>131</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1. Chi-square test to determine management achievement for subject 001 74
Table 2. Summary of results for the "Management Test" 86
Table 3. Summary of results for the "Beef Breeding Test" 89
Table 4. Intercorrelation of variables 93
Table 5. Summary of results testing learning style trait differences between management achievers and nonachievers 103
Table 6. Predominant orientations of learning style traits for management achievers and nonachievers 106
Table 7. Summary of results testing learning style trait differences between beef achievers and nonachievers 117
Table 8. Predominant orientations of learning style traits for beef achievers and nonachievers 119
Table 9. Summary of results testing learning style trait differences between combined achiever groups and combined nonachiever groups 130
Table A-1. Description of sample by age 149
Table A-2. Description of sample by classification 149
Table A-3. Description of sample by major 150
Table A-4. Description of sample by state 151
Table A-5. Description of sample by their parents' home location 151
Table A-6. Description of sample by home town population 152
Table A-7. Description of sample by ACT scores 152
Table A-8. Description of sample by high school rank in percentile

Table B-1. Analysis of variance of differences in $T(VL)_1$ between management achievers and nonachievers

Table B-2. Analysis of variance of differences in $T(AL)$ between management achievers and nonachievers

Table B-3. Analysis of variance of differences in $T(VQ)$ between management achievers and nonachievers

Table B-4. Analysis of variance of differences in $T(VL)_2$ between management achievers and nonachievers

Table B-5. Analysis of variance of differences in $T(AQ)$ between management achievers and nonachievers

Table B-6. Analysis of variance of differences in $T(VL)_3$ between management achievers and nonachievers

Table B-7. Analysis of variance of differences in $Q(CEM)$ between management achievers and nonachievers

Table B-8. Analysis of variance of differences in $Q(CES)$ between management achievers and nonachievers

Table B-9. Analysis of variance of differences in $Q(CET)$ between management achievers and nonachievers

Table B-10. Analysis of variance of differences in $Q(CH)$ between management achievers and nonachievers

Table B-11. Analysis of variance of differences in $Q(CK)$ between management achievers and nonachievers

Table B-12. Analysis of variance of differences in $Q(CKH)$ between management achievers and nonachievers

Table B-13. Analysis of variance of differences in $Q(CP)$ between management achievers and nonachievers

Table B-14. Analysis of variance of differences in $Q(CS)$ between management achievers and nonachievers

Table B-15. Analysis of variance of differences in $Q(CT)$ between management achievers and nonachievers
| Table B-16. | Analysis of variance of differences in I between management achievers and nonachievers | 160 |
| Table B-17. | Analysis of variance of differences in A between management achievers and nonachievers | 160 |
| Table B-18. | Analysis of variance of differences in F between management achievers and nonachievers | 160 |
| Table B-19. | Analysis of variance of differences in M between management achievers and nonachievers | 161 |
| Table B-20. | Analysis of variance of differences in D between management achievers and nonachievers | 161 |
| Table B-21. | Analysis of variance of differences in R between management achievers and nonachievers | 161 |
| Table B-22. | Analysis of variance of differences in L between management achievers and nonachievers | 162 |
| Table B-23. | Analysis of variance of differences in (K) between management achievers and nonachievers | 162 |
| Table B-24. | Analysis of variance of differences in reading level between management achievers and nonachievers | 162 |
| Table B-25. | Analysis of variance of differences in Q(V) between management achievers and nonachievers | 163 |
| Table B-26. | Analysis of variance of differences in Q(A) between management achievers and nonachievers | 163 |
| Table C-1. | Analysis of variance of differences in T(VL)₁ between beef achievers and nonachievers | 165 |
| Table C-2. | Analysis of variance of differences in T(AL) between beef achievers and nonachievers | 165 |
| Table C-3. | Analysis of variance of differences in T(VQ) between beef achievers and nonachievers | 165 |
| Table C-4. | Analysis of variance of differences in T(VL)₂ between beef achievers and nonachievers | 166 |
| Table C-5. | Analysis of variance of differences in T(AQ) between beef achievers and nonachievers | 166 |
| Table C-6. | Analysis of variance of differences in $T(VL)_3$ between beef achievers and nonachievers | 166 |
| Table C-7. | Analysis of variance of differences in $Q(CEM)$ between beef achievers and nonachievers | 167 |
| Table C-8. | Analysis of variance of differences in $Q(CES)$ between beef achievers and nonachievers | 167 |
| Table C-9. | Analysis of variance of differences in $Q(CET)$ between beef achievers and nonachievers | 167 |
| Table C-10. | Analysis of variance of differences in $Q(CH)$ between beef achievers and nonachievers | 168 |
| Table C-11. | Analysis of variance of differences in $Q(CK)$ between beef achievers and nonachievers | 168 |
| Table C-12. | Analysis of variance of differences in $Q(CKH)$ between beef achievers and nonachievers | 168 |
| Table C-13. | Analysis of variance of differences in $Q(CP)$ between beef achievers and nonachievers | 169 |
| Table C-14. | Analysis of variance of differences in $Q(CS)$ between beef achievers and nonachievers | 169 |
| Table C-15. | Analysis of variance of differences in $Q(CT)$ between beef achievers and nonachievers | 169 |
| Table C-16. | Analysis of variance of differences in $I$ between beef achievers and nonachievers | 170 |
| Table C-17. | Analysis of variance of differences in $A$ between beef achievers and nonachievers | 170 |
| Table C-18. | Analysis of variance of differences in $F$ between beef achievers and nonachievers | 170 |
| Table C-19. | Analysis of variance of differences in $M$ between beef achievers and nonachievers | 171 |
| Table C-20. | Analysis of variance of differences in $D$ between beef achievers and nonachievers | 171 |
| Table C-21. | Analysis of variance of differences in $R$ between beef achievers and nonachievers | 171 |
| Table D-8. Analysis of variance of differences in Q(CES) between combined achievers and nonachievers | 177 |
| Table D-9. Analysis of variance of differences in Q(CET) between combined achievers and nonachievers | 177 |
| Table D-10. Analysis of variance of differences in Q(CH) between combined achievers and nonachievers | 178 |
| Table D-11. Analysis of variance of differences in Q(CK) between combined achievers and nonachievers | 178 |
| Table D-12. Analysis of variance of differences in Q(CKH) between combined achievers and nonachievers | 178 |
| Table D-13. Analysis of variance of differences in Q(CP) between combined achievers and nonachievers | 179 |
| Table D-14. Analysis of variance of differences in Q(CS) between combined achievers and nonachievers | 179 |
| Table D-15. Analysis of variance of differences in Q(CT) between combined achievers and nonachievers | 179 |
| Table D-16. Analysis of variance of differences in I between combined achievers and nonachievers | 180 |
| Table D-17. Analysis of variance of differences in A between combined achievers and nonachievers | 180 |
| Table D-18. Analysis of variance of differences in F between combined achievers and nonachievers | 180 |
| Table D-19. Analysis of variance of differences in M between combined achievers and nonachievers | 181 |
| Table D-20. Analysis of variance of differences in D between combined achievers and nonachievers | 181 |
| Table D-21. Analysis of variance of differences in R between combined achievers and nonachievers | 181 |
| Table D-22. Analysis of variance of differences in L between combined achievers and nonachievers | 182 |
| Table D-23. Analysis of variance of differences in (K) between combined achievers and nonachievers | 182 |
| Table D-24. Analysis of variance of differences in reading level between combined achievers and nonachievers | 182 |
| Table D-25. Analysis of variance of differences in Q(V) between combined achievers and nonachievers | 183 |
| Table D-26. Analysis of variance of differences in Q(A) between combined achievers and nonachievers | 183 |
| Table L-1. Chi-square analysis to determine management achievers and beef achievers | 295 |
CHAPTER I. INTRODUCTION

Education is currently in the midst of great change. In recent years topics such as student motivation, relevancy, and individualized instruction have been of interest to many educators. These concerns have led to curriculum changes, but more often to changes in teaching methodology. During the last decade instruction has been directed towards meeting the needs of individual students through child-centered teaching methods. Employed in these techniques are more extensive use of learning packages, performance contracts, films, television, and computers.

Because individuals learn or obtain meaning from their surroundings differently, one method of instruction does not bring equal degrees of success to all students. To optimize the learning process, instruction needs to be adapted to each individual's abilities and modes of learning. To date, most research involving educational methodology has compared the mean group differences in achievement between two educational methods. Those programs or methods which produce significant gain are then considered for implementation within the schools. However, because most newly developed programs do not report significant differences in achievement for the students, the search for better instructional techniques continues (54).
One factor which was often neglected in these studies was the unique set of abilities and learning techniques each individual brought to the learning situation. Many educators have recognized this factor and realized that "for every person there is a best treatment, and for every treatment a best type of person" (21, p. 143). Teaching and learning methods should be selected on the student's ability to attain maximum success employing them. Glaser has stated: "What is required is a measure of aptitude that predicts who will learn better from one curriculum or method of learning than from another" (31, p. 8).

This concept was expressed as early as 1933 when Tyler wrote:

No one series of learning experiences has proven equally effective with all students.... The expansion of learning activities should be supplemented by a means of discovering for the students where their difficulties are and of suggesting what kinds of activities will be most helpful to them in overcoming these difficulties in learning (65, p. 288).

With the need for expansion of learning activities or methodologies, as expressed by Tyler, came the realization that education must not adopt only one learning technique, but rather, develop many methods in an effort to meet the needs and styles of each individual.

One teaching technique which has recently been discussed in the literature is educational simulation gaming. Educational simulation games have been called by many terms.
They have been called models, games, simulations, simulated games, role-playing exercises, and simulated environments. The lacking commonality of terminology is due to the diversification of the technique's origin and the uniqueness of each educational simulation game produced.

Simulations are models of physical or social situations. These have two basic characteristics; the first being that reality is represented, whether physical or social, on a reduced scale. The second characteristic is that reality is portrayed in a simplified form with only selected components of reality included in the model (1).

Games are contests played under predetermined rules for the purpose of winning. This definition does not differentiate between casual games and educational games. There are many similarities between the two types except that educational games have explicit, preplanned, educational purposes and are not played just for entertainment. Student enjoyment and interest has been one of the strengths of educational games and this characteristic should not be destroyed but rather used to advantage. Dr. Clark Abt stated: "Games may be significant without being solemn, interesting without being humorless, and difficult without being frustrating" (2, p. 10).

Games may be simulations but they need not be. The primary distinguishing factor between games and nongames is
competition. Games stimulate competition between players and culminate in a definite winner and loser. Noncompetitive simulations, such as production lines, chemical reactions, or traffic patterns, are not considered games, whereas business simulations in which the participants try to increase their profits are considered games because they have definite winners and losers.

Even though the terminology and definitions of gaming and simulation have not been agreed upon by all, James McKenney of Harvard University summarized the components of a simulation game when he said:

The three basic components of a simulation game are an abstraction of an economic environment, or a model, a series of rules for manipulation of the model, or simulation, and a set of rules which govern the activity of the participants in relation to the simulation, a game (48, p. 2).

Those activities in which there is competition between members with definite winners and losers are games and those activities which reduce the complexity of the physical or social world are simulations. Those which combine both qualities can truly be called "simulation games" (49).
Statement of the Problem

The problem of this study was threefold:

1. To determine if learning could take place, as measured by objective test performance, by playing two computer simulation games: "The Management Game" and "The Beef Breeding Game".
2. To identify the cognitive learning style associated with successful performance on objective tests over two computer simulation games: "The Management Game" and "The Beef Breeding Game".
3. To identify cognitive learning style components associated with achievement using computer simulation games, based on common style elements of those who succeeded in two computer simulation games.

Statement of the Purpose

The purpose of this study was:

1. To determine whether students could learn concepts and facts using computer simulation games.
2. To determine whether specific computer simulation games had individual modes of understanding or cognitive learning styles associated with them.
3. To determine if computer simulation games have any common learning style elements.

4. To provide research evidence for the "educational sciences" regarding computer simulation games.

Statement of Need

Research dealing with the topics of educational games, simulations, and simulation games has been contradictory and tends to pose many questions. There are many who support the concept of educational simulation gaming as well as those who view it with skepticism. Most of the opinions of those taking both positions have been based on intuition and not on evidence. These feelings along with established research evidence can provide a strong need for a study of this nature.

For effective learning to take place, Jerome Bruner expressed the need to combine cognitive ideas with affective attitudes. He felt this could be done most beneficially in a problem solving atmosphere. He said:

Mastery of the fundamental ideas of a field involves not only the grasping of general principles, but also the development of an attitude toward learning and inquiry, toward guesses and hunches, toward the possibility of solving problems on one's own.

To instill such attitudes by teaching requires something more than the mere presentation of fundamental ideas. Just what it takes to bring off such teaching is something on which a great deal of research is needed, but it would seem that an important ingredient is a sense of excitement about discovery--discovery of regularities of previously unrecognized
relations and similarities between ideas, with a resulting sense of self confidence in one's own abilities (15, p. 20).

The ingredients of self-discovery, motivation, self-confidence, and synthesis mentioned by Bruner as important for effective learning are some of the unique characteristics of simulation games.

Sarane Boocock pointed out the uniqueness of simulation when she stated:

...the unique contribution of the simulation experience to feelings of efficacy may be in giving young people the confidence needed to act upon the intellectual information they have acquired about a...situation (11, p. 15).

Elliot Carlson also elaborated on some contributing factors of games in meeting the needs mentioned by Bruner.

There is no question that games, when properly used, can have value.... If nothing else, they can convey to the player a feeling for the complexity and multiplicity of factors that must be considered in decision-making. And conceivably they may increase the confidence of young people to deal with real world problems that seem impossibly remote from their own lives (16, p. 173).

Lois Edinger, in an article entitled "A Simulation Approach to Learning", pointed out that both simulations and games "requires the student to define the problems to determine the available alternative solutions and the possible consequences of those alternatives" (24, p. 474). Martin Shubik also reiterate the point that games provide insight into problem solving.
Experimental games can be used to discover, and demonstrate, important possibilities that might have been missed without it. The significance and relevance of these possibilities may still depend on reasoning and on evidence obtained elsewhere; but the existence of the possibilities, and some notion of how they relate to the structure of the game, can be discovered by the artificial game (56, p. 321).

Boocock, Carlson, Edinger, and Shubik each elaborated on the worth of games and simulations. The values they indicated closely parallel the needs mentioned by Bruner as necessary for effective learning to take place.

Many researchers in the fields of gaming and simulation have pointed out their applicability to education. In their book Management Games for Teaching and Research, Babb and Eisgruber indicated the need for continued research in these fields.

While the teaching value of business games should be the subject of more research, available studies certainly lend support to the hypothesis that games are an effective training device. In addition, the favorable consensus of educators regarding game usage is impressive (7, p. 153).

Research regarding simulation games still poses some major questions to be answered, as stated by Carlson:

Do students learn more facts from games than from conventional teaching methods? Do strategy games spur critical thinking? Do they really inculcate constructive values? So far there is little evidence to argue one way or the other... (16, pp. 170-171).

Clark Abt, a leading researcher and developer of games, has indicated the status of research on educational
Educational games and simulations may offer achievement and motivational gains at costs less than those of alternative instructional methods. No one is certain of this as yet, of course, mostly because it costs a lot more to evaluate an educational game than it does to design one. So far, the principal markets for educational games and simulations—schools and publishers of educational materials—are using them more and more with largely favorable results (1, p. 92).

Since the conception of educational simulation games, the achievement and educational gains offered by them have been a point of contention. While Babb, Eisgruber, Abt, Boocock, and others are convinced there are values in educational simulation games, Cherryholmes and others are more skeptical of the technique.

The critics of gaming point out that the research done fails to confirm that students can learn facts more effectively from this technique than from other methods. After evaluating six different research studies on gaming, Cherryholmes indicated his findings were disappointing (18). He said "students do not learn significantly more facts or principles by participating in a simulation than in a more conventional classroom activity" (18, p. 6).

June Chap has summarized some of the problems related to research in the field of simulation games when she said:

Little research has been completed in this relatively new field. The problems have been numerous: the lack of a theoretical framework; the influence of the teacher or director in set-
ting the tone; the question of whether or not outsiders should evaluate the effectiveness of the simulation game and their possible influence upon the activity; the particular environment and the type of students who engage in the games; the difficulty getting accurate and valid instruments for measuring both short term and long term attitude change; the consideration of the Hawthorne effect; and the immense problem of generalization about simulation games in general from one particular game. All of these factors have produced conflicting data, and in light of the difficulties in doing research in this field it is understandable.

However, with various degrees of certainty it can be said that simulation games are more effective than conventional methods in gaining the interest of students and in motivating the students to become more involved with learning activities (17, p. 803).

Research completed in the field of educational gaming has been limited. The findings have led to different conclusions. The research to date still leaves many questions unanswered. This along with the growing concern to individualize instruction and determine what characteristics are necessary for success on any given educational methodology indicated a strong need for a study of this nature.

Statement of Hypotheses

The following hypotheses were formulated and tested:

**Research Hypothesis I**

It was hypothesized that playing two computer simulation games would not significantly effect the scores on two objective content mastery tests.
Statistical null hypotheses

"The Management Game"

\[ \mu_{C_{PRE}} = \mu_{E_{PRE}} \]

\[ \mu_{E_{PRE}} = \mu_{E_{POST}} \]

\[ \mu_{C_{PRE}} = \mu_{C_{POST}} \]

\[ \mu_{C_{PRE}} - \mu_{C_{POST}} = \mu_{E_{PRE}} - \mu_{E_{POST}} \]

"The Beef Breeding Game"

\[ \mu_{C_{PRE}} = \mu_{E_{PRE}} \]

\[ \mu_{E_{PRE}} = \mu_{E_{POST}} \]

\[ \mu_{C_{PRE}} = \mu_{C_{POST}} \]

\[ \mu_{C_{PRE}} - \mu_{C_{POST}} = \mu_{E_{PRE}} - \mu_{E_{POST}} \]

Level of significance .05

Research Hypothesis II

It was hypothesized that there would be no significant difference between the achievers and nonachievers for each game on each of the 26 traits comprising the learning style test.

Statistical null hypotheses Twenty-six hypotheses were tested for "The Management Game" and 26 hypotheses were
tested for "The Beef Breeding Game", all with the following general format:

"The Management Game"

\[ \mu_A^{T(VL)} = \mu_{NA}^{T(VL)} \]
\[ \mu_A^{T(AL)} = \mu_{NA}^{T(AL)} \]
\[ \vdots \]
\[ \mu_A^{Q(A)} = \mu_{NA}^{Q(A)} \]

"The Beef Breeding Game"

\[ \mu_A^{T(VL)} = \mu_{NA}^{T(VL)} \]
\[ \mu_A^{T(AL)} = \mu_{NA}^{T(AL)} \]
\[ \vdots \]
\[ \mu_A^{Q(A)} = \mu_{NA}^{Q(A)} \]

Level of significance .05

**Research Hypothesis III**

It was hypothesized that there would be no cognitive learning style traits in common between the management achievers and the beef achievers, and between the management nonachievers and the beef nonachievers.
Statement of Assumptions

The following assumptions were made in pursuit of this study:

1. The sample was representative of the teacher education students at Iowa State University.

2. The Test For Cognitive Style Test Mapping was a valid and reliable measure of the cognitive learning style for the population under study.

3. The content mastery tests, the "Management Test" and the "Beef Breeding Test", were valid and reliable measures for the population of this study.

4. The cognitive learning style of an individual did not change over a nine week period.

5. Information presented to the sample in the form of orientations and directions for play of the games was uniform and presented with a minimum of bias.

6. There was no pretest treatment interaction.

7. Variables not controlled for in this study were uniformly distributed over the entire sample.

8. The Hawthorne effect, if present, was distributed equally throughout the entire sample.
Limitations of the Study

The study was conducted in view of the following limitations:

1. Only teacher education students at Iowa State University were included in the population under study.
2. The design did not allow separation of teacher effects or other effects associated with the games from the overall treatment effects.
3. Only those students volunteering for participation from two Educational Psychology classes and one Industrial Education class for winter quarter, 1974, were used as the sample.
4. The concept of cognitive learning style used in this study was limited to the 26 traits included in three sets, "S", "G", and "H", of the "educational sciences".
5. The results and implications from the data are restricted to the statistical analysis used.
6. This study was limited to the use of two computer simulation games, "The Management Game" and "The Beef Breeding Game".
Statement of Procedure

The following procedure was employed while conducting this study:

1. The subjects selected for this study were undergraduates enrolled in either Psychology 333 or Industrial Education 490Z at Iowa State University during the winter quarter, 1974. A total of 138 students volunteered to participate in this study.

2. The subjects were divided into an experimental group of 111 and a control group of 24.
   a. The experimental group played two computer simulation games, "The Management Game" and "The Beef Breeding Game", preceded and followed by an objective examination, testing the concepts and facts involved in the game.
   b. The experimental group took a three hour test to determine each student's individual learning style.
   c. The control group did not play the games but was given the two content mastery examinations.

3. The experimental group was divided into two specified subgroups, achievers and nonachievers.
   a. Management achievers were defined as those who scored significantly higher on the management
post-test over the pre-test as determined by a single sample chi-square test.

b. Beef breeding achievers were defined as those who scored significantly higher on the beef breeding post-test over the pre-test as determined by a single sample chi-square test.

4. The data collected during this study were analyzed to test the three stated hypotheses.
   a. Appropriate t-tests were calculated between the pre- and post-tests of the experimental and control groups to determine if students could learn using computer simulation games.
   b. One-way analyses of variance were calculated between the achievers and nonachievers on each of the 26 traits identified as a result of the learning style test. These were calculated to determine the differences in the cognitive learning styles of achievers and nonachievers for the two games.
   c. The common learning style traits associated with achievement in both games were compared through observation to determine those traits necessary for achievement using computer simulation games.
Definition of Terms

Definitions

The following terms used throughout the context of this study were defined as follows:

**Cartesian product** A mathematical set whose elements are a combination of the component sets making up the product set. The product of "x" sign does not denote any algebraic or numeric operation but depicts only the component sets from which the elements must be drawn.

**Cognitive learning style** A concept for describing an individual's mode of behavior in searching for meaning; a Cartesian product made up of three sets: S (symbols and their meaning), E (cultural determinants of the meanings of symbols), and H (modalities of inference) (37).

**Cognitive style map** A computer printout generated from the results of a battery of tests and inventories which depicts an individual's cognitive learning style (37). See Appendix I.

**Educational science** A common conceptual framework and scientific language within which inquiry of significance for the fundamental aspects of the applied field of education can be conducted (71).
**Game**  Contests played under predetermined rules for the purpose of winning. Educational games have explicit pre-planned educational purposes and are not played just for entertainment (1).

**Major orientation**  A score in the 50th to 99th percentile range for a given element of the cognitive learning style (37).

**Matching**  A prescribed technique for determining the most compatible teacher, student, learning environment, and learning materials (62).

**Minor orientation**  A score in the 26th to 49th percentile range for a given element of the cognitive learning style. Minor orientation is denoted with use of the prime symbol, such as T'(VL) (37).

**Negligible orientation**  A score in the 25th percentile or below of a distribution of scores for a given element in the cognitive learning style (37).

**Simulation games**  Those activities which combine the characteristics of both simulations and games. They are models of physical or social situations in which there is competition, with definite winners and losers (49).
Simulations

Simulations are models of physical or social situations which portray reality in a reduced scale and a simplified form (1).
CHAPTER II. REVIEW OF LITERATURE

A review of the literature was conducted to develop a background of the principles involved in this study. The review was divided into three sections. Section one was a presentation of the historical development and research of cognitive learning style. Section two reviewed the development of the "Educational Sciences" as they pertain to this study. It also presented findings of research studies on cognitive learning style conducted within the constructs of the "Educational Sciences". Section three briefly reviewed the historical background of simulation gaming and summarized the findings of research done in this area.

Cognitive Learning Style

The concept of individual differences within humans was not new. It first appeared in the literature of the early Greeks. Historically, this concept has been expanded by such scholars as Plato, Comenius, and Rousseau.

Plato is known to have recognized the existence of variability...and proposed tests to measure traits important to the military. Comenius too, treated individual differences at length, admonishing teachers to consider their pupils' ages, intelligence, and knowledge. He besought teachers to adjust methods and materials and start instruction at the pupil's level. Rousseau, recognizing variations both among and within individuals, almost advocated a tutorial system (36, pp. 1-3).
Even though individual differences were recognized throughout history, it was not until the development of intelligence tests in the early 1900's that differences in ability were measured.

The formation of cognitive learning style in the field of psychology began to formulate in the 1920's. Early studies of consistency and predictability of personality were carried out by such noted psychologists as Allport (3); Hartshorne, May, and Shuttleworth (34); and Lewin et al. (45). In the book *Personality, A Psychological Interpretation*, written in 1937, Gordon Allport referred to the "styles of life" and the "modes of adaptation" (5, p. 47) as a means of identifying individual personality types. A few years later, Allport again referred to "style" and described the concept as the consistency and pattern of behaviors which one displays while performing various tasks (4).

Application of the concepts of identifying personality types, developed during this period, was seen as relevant to educational behavior as well as to social behavior. Horst developed a model for the identification process which assisted in later research studies. Horst's system contained the following styles: 1) determination of the criterion for activity success; 2) analysis of the personal or situational factors associated with individual differences prior to the
activity; and 3) prediction for success based on the preceding analysis (41).

In the late 1940's many studies were conducted which investigated concept formation as a cognitive behavior and cognitive processing. Gardner noted that these studies considered a response to a stimulus as "...coerced not by stimulus alone, but also by the organizational dispositions of the responding system..." (29, p. 3).

In 1951 Klein (42) termed the organizational process identified by Gardner as "cognitive control principles". Later Gardner (30) himself delimited the term to "cognitive style" and concluded that the term should be applied to only those control principles within the individual. The work of Klein and Gardner was later analyzed by Broverman. As a result of this analysis and his own research, Broverman concluded:

...different cognitive styles are specific to certain classes of behavior, these classes seem sufficiently broad to enable the styles to manifest themselves in numerous cognitive and social activities. As such, cognitive styles seem promising parameters on which to order a perplexing array of individual differences in human behavior (14, p. 183).

The term "cognitive style", developed by Klein, Gardner, and Broverman became accepted and produced the basis for further study and the formulation of different theories regarding the constituents of cognitive learning style.
Many researchers have sought to study how individuals seek meaning from their surroundings, or exhibit cognitive learning style. Rogers has described learning and the role of the cognitive structure as a series of relationships between inputs and previously learned material. He described the relationships as follows:

...as experiences occur in the life of the individual, they are either (a) symbolized, perceived, and organized into some relationship to the self-structure, (b) ignored because there is no perceived relationship to the self-structure, (c) denied symbolization and given a distorted symbolization because the experience is inconsistent with the structure of the self (52, p. 503).

Cognitive style in learning has been demonstrated by individuals through the selection of stimuli perceived as relevant at the moment. The selection in turn determined which stimuli affected future behavioral outcomes.

Gagné expressed the pattern of individual differences and cognitive style as a series of subordinate activities he called "learning sets". He said:

...investigations of productive learning must deal intensively with the kind of variable usually classified as "individual differences". One cannot depend upon a measurement of general proficiency or aptitude to reveal much of the important variability in the capabilities people bring with them to a given task.... But, the measurement of their learning sets... (28, p. 365).

Gagné explained learning in terms of two categories: knowledge and instructions. The instructions provided a style of "learning sets" which were used to obtain the knowledge. He
explained this as follows:

...no individual could perform the final task /knowledge/ without having these subordinate capabilities, without being able to perform these simpler and more general tasks and that any superordinate task in the hierarchy could be performed by an individual provided suitable instructions were given, and provided the relevant subordinate knowledges could be recalled... (28, p. 356).

Gagné's theory of sets was only one of the many similar ideas¹ of hierarchies which conceived of the concept of style as a group of elements.

Since 1952 Witkin and his associates have investigated the concept of cognitive style. He said that the cognitive style approach to education:

...stresses individual uniqueness as well as diversity in the ways in which people may be different from each other. It can help us obtain a more balanced view of an individual's cognitive makeup than is now provided by our heavily verbal assessment procedures, which tend to penalize the culturally disadvantaged (68, p. 5).

Witkin has defined the construct of cognitive style in terms of field-dependence and field-independence. Persons who were identified as relatively field-dependent viewed objects and ideas in their context or surroundings. Their perception tended to be broad in nature. Those who tended to be field-independent viewed objects and ideas apart from the whole. They perceived their surroundings in an analytical

¹Katona proposed the theory of "organizations" in 1940, Harlow proposed "learning sets" in 1949, and Waltzman proposed "habit-family hierarchies" in 1956.
fashion (66).

As a result of extensive research Witkin concluded that field-dependence and field-independence was stable throughout most of life; it was related somewhat with sex, and affected the amount one learned in given subject areas. He has also found that it affected one's selection of elective courses, college majors, and vocational choices (67).

The Educational Testing Service (ETS) has directed much work towards the development of instruments to measure cognitive style. In 1951 a group of ETS researchers developed a battery of tests to identify 24 different aptitudes associated with learning style. This test was published in 1954. The work continued in this area and a second test battery was developed. The second test series identified and measured 24 different traits. These tests were published in 1963 (28). Since the early 1970's the "Personality and Social Behavior Research Group" of ETS has continued work in the further development of additional measures of cognitive style (68).

Summary

The concept of differences within individuals has been identified throughout history but it was not until the twentieth century that instruments were developed to measure these differences. It was noted that the single measure of
intelligence was not adequate to explain individual differences as mentioned by Bennett and others:

The research and theories of Thorndike, Kelley, Spearman, Thomson, Thurstone, and others have made us increasingly aware that so-called intelligence is not a unitary trait—it is composed of many abilities, which are present in different individuals in varying amounts (9, p. 1).

The constructs of cognitive style emerged throughout the 1950's. Many researchers studied the concept and developed various theories regarding its composition. Several of the accepted theories regarded learning style as a combination of elements or sets.

The development of instruments to measure traits of cognitive style was slow. The use of tests designed for other purposes, such as personality tests, have generally been used. The Educational Testing Service pioneered work in this area and continued its research in the development of instruments to measure cognitive style.

These factors have shown that the concept of learning style has been developed and is appropriate for further study. They have led to the review of the constructs of cognitive learning style developed in the "educational sciences".
Educational Sciences

If people in the field of education are to effectively communicate and establish a mutual understanding of the learning process and its problems, a conceptual framework and language commonly accepted by all in the profession are essential. Such a conceptual foundation and terminology has been set forth by the Institute for Educational Sciences at Wayne State University and the American Educational Sciences Association at Oakland Community College. Joseph E. Hill has been one of the major proponents and developers of the "Educational Sciences". The "Educational Sciences" have formulated seven sciences which approach the level of precision found in other professional fields enabling development of solutions to educational problems and explanations of educational phenomena. The seven sets have been identified as follows:

1. Science S, Symbols and Their Meanings
2. Science E, Cultural Determinants
3. Science H, Modalities of Inference
4. Science Y, Biochemical and Electrophysiological Aspects of Memory Function

Dr. Hill is currently President of Oakland Community College of Bloomfield Hills, Michigan. Since the early 1960's he and others (Nunney, Cotter, Dehnke, DeLoach, Fragale, Rankin, Robinson, Setz, Shuert, Svagr, Wasser, Wyette, and Zussman) have developed the "educational sciences".
5. Science G, Cognitive Styles

6. Science TAC, Teaching Style, Administrative Style, and Counseling Style

7. Science SAD, Systemic Analysis Decision.

The concept of cognitive style as developed by Hill in the "educational sciences" was an attempt to describe the broad pattern of behavior of an individual through use of symbolic language. Hill defined cognitive style as:

...a combination of the information included in the first four "sciences", by means of a cartesian product of these four sets, to provide a picture of the profiles distributed over the four sets that an individual employs in seeking meaning. These profiles reflect the cognitive style "strengths" of the individual, and are vehicles for determining educational prescriptions to help him in the educative process (37, p. 7).

Set G, or Cognitive Style, as developed by Hill consisted of a cartesian product of the first four sets of the "educational sciences". As of 1974, only the elements of the first three sets of the cartesian product were being tested. Science Y, Biochemical and Electrophysiological Aspects of Memory Function, has not been fully developed and therefore was not included. Recent works of biochemists and psychobiologists have provided information about the memory function. Work with selected biochemical elements and electrophysical measurements of brain waves has been enlightening, but a great deal more work is needed in this field.
Science S, symbols and their meanings

Science S, also known as symbologosics, is the study of symbols and their meanings. It has been primarily an extension of the work of Ernst Cassirer and John Dewey, as cited by Wasser (71). Two types of symbols created and used by man to obtain knowledge and meaning from his environment and personal experiences have been identified as part of the "educational sciences". They are theoretical and qualitative symbols. Hill explained that theoretical symbols such as words or numbers "present to the nervous system, and then represent to it, something different from that which they themselves are" (37, p. 4). Theoretical symbols include both visual and auditory symbols. A theoretical symbol might be a written or spoken word such as "plate" which represents an object or dish from which food is eaten. The theoretical symbol represents the concept or object associated with it, but not the object itself.

Specific theoretical symbols have been classified as:

1. Theoretical visual linguistic T(VL)--ability to find meaning from written words, such as one who has a high degree of comprehension from reading.

2. Theoretical auditory linguistic T(AL)--ability to find meaning from hearing the spoken word.
3. Theoretical visual quantitative T(VQ)—ability to acquire meaning in terms of numerical symbols and measurements when seen.

4. Theoretical auditory quantitative T(AQ)—ability to find meaning in terms of numerical symbols, relationships, and measurements when spoken (37).

Qualitative symbols such as sensory stimuli present to the nervous system that which they themselves represent. Meanings for qualitative symbols are derived from three sources which include: 1) sensory stimuli such as items one touches, sees, tastes, or smells; 2) programmatic effects which convey an almost automatic impression of intelligent images, events, or operations such as typing or driving an automobile; and 3) cultural codes which are humanly constructed, such as games or associations, such as flashing red lights associated with stopping.

To date, twenty qualitative symbols compose the symbolic set. Five of them are associated with the sensory stimuli, five with programmatic effects, and ten with cultural codes (37).

The five qualitative symbols associated with sensory stimuli have been identified as:

1. Qualitative auditory Q(A)—the ability to perceive meaning through the sense of hearing such as sounds or musical tones.
2. Qualitative olfactory $Q(O)$—the ability to perceive meaning through the sense of smell.

3. Qualitative savory $Q(S)$—the ability to perceive meaning through the sense of taste.

4. Qualitative tactile $Q(T)$—the ability to perceive meaning through touch, temperature, and pain.

5. Qualitative visual $Q(V)$—the ability to perceive meaning through sight.

The five qualitative symbols identified as programmatic in nature were:

1. Qualitative proprioceptive $Q(P)$—the ability to synthesize a number of experiences and related associations into performing a complex task such as playing a musical instrument.

2. Qualitative proprioceptive dextral $Q(PD)$—a subset of $Q(P)$ which demonstrates a predominance of right-eye, right-handed, and right-footed tendencies while synthesizing symbolic mediations in performing complex skills.

3. Qualitative proprioceptive kinematics $Q(PK)$—a subset of $Q(P)$ which demonstrates the ability to synthesize symbolic mediations into performing complex physical activities involving motion.
4. Qualitative proprioceptive sinistral Q(PS)—a subset of Q(P) which demonstrates a predominance of left-eye, left-handed, and left-footed tendencies while performing complex physical skills.

5. Qualitative proprioceptive temporal Q(PT)—a subset of Q(P) which exhibits the ability to synthesize a number of symbolic mediations into performing complex physical activities involving timing.

The remaining ten qualitative symbols were associated with cultural codes:

1. Qualitative code empathetic Q(CEM)—sensitivity toward the feelings of others; the ability to place oneself in the place of another.

2. Qualitative code esthetic Q(CES)—the ability to enjoy the beauty of an object, idea, or situation.

3. Qualitative code ethic Q(CET)—a commitment to a set of values, principles, obligations, and/or duties.

4. Qualitative code histronics Q(CH)—the ability to play a role or exhibit a deliberate behavior or emotion to produce a particular effect on other persons.

5. Qualitative code kinetics Q(CK)—the ability to understand and communicate by nonlinguistic
expressions and motions of the body.

6. Qualitative code kinesthetic Q(CKH)—the ability to perform motor skills according to recommended, or acceptable, form.

7. Qualitative code proxemics Q(CP)—the ability to judge the social and physical distance between oneself and another person as perceived by the other person.

8. Qualitative code synnoetics Q(CS)—the personal knowledge of oneself in all qualitative and theoretical symbolic forms in relation to one's environment.

9. Qualitative code transactional Q(CT)—the ability to maintain a positive communicative interaction which significantly influences the goals of those persons involved in the interaction.

10. Qualitative code temporal Q(CT5i)—the ability to respond in accordance with social expectations or social timing (37).

Theoretical symbols are used to convey an idea in a connected, consecutive manner in accordance with common logic. Qualitative symbols, on the other hand, are used to relay feelings, values, and commitments and provide insights into the domain of self. The theoretical and qualitative symbol relationship has been explained by Hill and Setz (38) in terms
of a continuum. On one end of the continuum was a theoretical predominance and on the other end was a total utilization in the qualitative realm known as qualitative independence. Between these ends were two other areas on the continuum identified in the "educational sciences" as qualitative predominance and reciprocity (38).

Science E, cultural determinants

Science E, known as determantics, was developed under the premise that learning could not be understood unless it was interpreted in its social context. Each person in a society interprets the theoretical and qualitative symbols to which he is exposed as an individual within a particular role, with given past experiences, and with specific expectations. These expectations and his definitions of what is good or bad, pleasant or unpleasant, right or wrong are determined on how he views the influences of social norms, peers, or associates, and his family. Each person deals with these factors in a positive or negative manner throughout life and is influenced by a given combination of these forces (62).

The specific cultural determinants identified were:

1. Individuality I—inclination toward solving problems on one's own; individualistic in making decisions and deciding what is right; making explanations in one's own frame of reference.
2. Associates A—inclination toward seeking the aid of peers or associates in solving one's own problems; interpreting actions in the expectations of others; using analogous situations involving others in making explanations of one's own situation.

3. Family F—inclination toward accepting the value system of one's family; requesting assistance from family members in making one's own decisions.

Each determinant has an influence on an individual's interpretation of symbols in the pursuit of knowledge and the search for meaning. The influence and strength of the determinant will vary with the age of the learner. Young learners identify very strongly with their family. However, as they grow older the sphere of influences broadens and they develop their own unique set of cultural determinants. The conditions of the learning task also influence one's determinants. The uniqueness of every situation, in part, determines how a learner will be influenced (71).

**Science H, modalities of inference**

Inferensics, the system of modalities of inference, has been identified as one distinguishing characteristic between man and other animals. The process of inference or logical conclusion from evidence presented is the mode or pattern an individual employees in trying to derive meaning
from his surroundings. Two distinct classifications of modalities of inference were identified in the "educational sciences": the inductive process, and the deductive process. These processes were further classified into the following:

1. Magnitude M—an inductive inferential process which tends to use categorical thinking; a tendency toward use of rules, definitions, or classifications in solving problems.

2. Difference D—an inductive process utilizing one-to-one contrasts or comparisons in making decisions; determining "what is" by learning "what is not"; persistent and attentive to details; a tendency toward innovative and creative thinking.

3. Relationship R—the ability to synthesize a number of dimensions or incidents into a unified whole; ability to analyze a situation to discover its component parts; a tendency toward lengthy explanations incorporating the use of examples.

4. Appraisal L—the use of M, D, and R modalities in the reasoning process; a tendency to analyze, question, or appraise that which is under consideration; ambivalence and dissatisfaction with an inference even after it has been made; a tendency to make rapid decisions in familiar situations but slow to reach decisions in new situations.
5. Deductive (K)—an inferential process of reasoning in which conclusions follow from stated premises; reasoning from the general to the specific (62).

Research in the "educational science" of cognitive style

A great deal of research\(^1\) has been completed utilizing the conceptual framework developed in the "educational sciences". Doctoral studies have provided most of the research efforts in this area. Studies have dealt with numerous phases of the "educational sciences" with the major emphasis on the "science" of cognitive style. Some studies have dealt with styles associated with specific subject areas while others were concerned with specific educational methodologies. Studies have also dealt with the effect of cognitive style on teacher-student relationships and the effect of cognitive style on curriculum choice.

A study conducted in 1970 by Shuert (57) determined the cognitive styles of those students who were successful and of those who were unsuccessful in mathematics. He found that the following traits of the learning style were unique to the group of students who succeeded: 1) major orientation in theoretical

\(^1\)As of July, 1973, 53 doctoral dissertations had been completed using the constructs developed in the "educational sciences". Most of these studies were done at Wayne State University, the University of Michigan, and Michigan State University.
visual quantitative, $T(VQ)$; 2) major orientation in theoretical auditory quantitative, $T(AQ)$; 3) minor orientation in theoretical auditory linguistic, $T(AL)$; 4) minor orientation in qualitative code transactional, $Q(CT)$; 5) major orientation in the appraisal inferential process, $L$; and 6) major orientation in the deductive inferential process, $(K)$. He also found that those who did not succeed in mathematics courses had a minor orientation toward the associates, $A$, determinant while those who succeeded did not. Shuert concluded that there was a set of elements of cognitive style associated with success in mathematics courses.

In order to determine whether a cognitive style could be associated with those receiving different final grades in two English courses at Oakland Community College, Hoogasian (40) analyzed the grades and style maps of 472 subjects. He found that it was possible to identify various cognitive styles associated with final grades in two English courses. He was cautious to point out that his findings did not lend themselves to definitive predictors of final grades but rather "gross predictors" of success or failure in the courses.

A study was conducted by Hand (32) in 1972 to investigate the significance of the degree of match between students' cognitive learning styles and the style associated with programmed instruction. Two groups ($N=36$, $N=20$) were selected from a class in Foundational Science at Oakland Community
College and both groups completed a different programmed science unit. Each group was subdivided into three levels, "highest", "middle", or "lowest", according to the degree of match between student cognitive style and the mode of understanding required of the programmed instruction. Hand analyzed gain scores between the pre- and post-test using the Kolmogorov-Smirnov one-tailed, two sample, test. He found that there was no significant difference in gain scores between any of the groups at a .10 alpha level.

In a study similar to that of Hand's, Warner (69) found significant differences between groups of successful and unsuccessful students using a self-instructional learning method and a lecture/discussion method. A sample group of 67 freshmen enrolled in a Life Science course at Oakland Community College was composed of 34 students who utilized a self-instructional, multi-media approach while the remaining 33 students were taught by a lecture/discussion method. The two groups were divided into those who were successful and those who were unsuccessful based on post-test gains over pre-test scores. Using the cognitive style and the gain-score data from each subject, Warner identified those elements as predominant which appeared in the style maps of 70 percent or more of the successful or unsuccessful students in each group.

In comparing the successful with the unsuccessful
students who used the self-instruction approach he found that a major orientation in an appraisal inferential pattern, \( L \), was unique to the successful group. He also found that a major qualitative code-proxemics orientation, \( Q(CP) \), was unique to the unsuccessful group. The students within the unsuccessful self-instruction group also exhibited a major orientation in difference, \( D \), and a minor orientation in magnitude, \( M' \), more frequently than did the successful group. This increased frequency was statistically significant at a .05 alpha level.

Comparing the successful with the unsuccessful students who used the lecture method, Warner found that the successful group exhibited a major theoretical visual linguistic orientation, \( T(VL) \), which did not appear in the style of the unsuccessful group. Those in the successful group also exhibited a major qualitative code-esthetic orientation, \( Q(CES) \), to a significantly greater extent than did the unsuccessful group of students included in the lecture/demonstration sample. Those in the unsuccessful group employing the lecture method had a major qualitative code-proxemics orientation, \( Q(CP) \); a major qualitative visual orientation, \( T(VQ) \); a minor qualitative code-transactional orientation, \( Q'(CT) \); a major family determinant, \( F \); and the appraisal, \( L \), inferential process to a significantly greater extent than did the successful group using the same method.
As a result of this study, Warner concluded that cognitive style provided a means of identifying learning style traits which interact with a learning methodology.

Using the conceptual framework of the "educational sciences", seven studies have been identified which were completed in an effort to identify the effects on learning of matching students' cognitive styles and preferred teaching style with instructor's cognitive style and teaching style. Studies by Lange (44), Schroeder (55), Blanzy (10), Fragale (27), Wasser (70), and McAdam (47), each found that there was a significant effect on the educative process based on the degree of match between individual faculty and student cognitive styles. Students whose style tended to match the style of their instructor received higher grades than those students with styles dissimilar to their instructors.

In a comparable study, Ort (51) related the cognitive styles of successful foreign language students to those of the instructors in two language classes. She found that there was no significant difference between the degree to which successful and unsuccessful students shared common style elements with their instructors.
Summary

The research efforts conducted in the "educational sciences" have been of an exploratory nature, and in pilot study dimensions. The findings of these studies support the concept that the "educational sciences" have provided a framework for conducting educational research and evaluating educational phenomena. The specific research reviewed demonstrated that specific style traits can be associated with teachers and educational methodologies. The research revealed that the concept of cognitive style identified as part of the "educational sciences" was viable and appropriate for this study.

Simulation Gaming

Many reasons for initiating the use of the computer in educational methodology have been put forth. The most important of those stated was the contribution it makes toward meeting the instructional needs of individuals. As Suppes has expressed:

...the more an educational curriculum can adapt in a unique fashion to individual learners--each of whom has his own characteristic initial ability, rate and even "style" of learning--the better the chance is of providing the student with a successful learning experience (61, p. 208).

Computers have offered the technology to provide instructional systems necessary to meet the needs of the individual learner.
Roth envisioned the technological instructional system as a means of individualization.

The only line of endeavor currently in sight which provides real hope for the ultimate individualization of education is the development of educational systems based heavily on technologically supported auto-instruction. The programs will be largely self-selected, with defined entry and exit behaviors. They will be branched to provide for a variety of learning styles... (53, p. 61).

Torkelson concurred with Roth's thought that technology provides a means of individualizing curriculum but only if the unique characteristics of the individual and modes of instruction are fully understood.

The most conservative level of individualization provides optional ways for individuals to learn a prescribed curriculum. The potentials of the new technology for the individualization of instruction are reliable only out of an adequate perception of what is really meant by the new technology and upon a system of instruction which consciously organizes to determine the uniqueness of all means of media of instruction for different kinds of learners and for different kinds of instructional purposes (64, p. 315).

Torkelson's precaution to determine the values of individual learning methodologies reinforced the need of this study to determine the cognitive learning style associated with computer simulation gaming.

Games have their origin steeped in history but were not used in education for learning purposes much before the early 1960's. Games in education originated from simulation games in the business community. The business community, in turn,
borrowed the technique from military training (63).

The first use of educational simulation and gaming as reported by Tansey and Univin (63), and, Boocock and Schild (12) was in 1962 in a project known as "Jefferson Township School District". This early use of simulation games was developed to train educational administrators, similar to that used in business. The administrators were presented various situations and were asked to react to them (12).

Since its early development, the technique of simulation gaming has grown and many researchers have indicated that the technique offers advantages to the educational process. The most predominant characteristic of simulation gaming agreed upon by most researchers is the enthusiasm generated within students. According to Cruickshank (22) simulation games are highly motivational because students enjoy them, making them more desirable for use than some other educational methods. Edinger commented that the research of Garvey and Seiler:

...indicated conclusively that the students involved in the simulation technique enjoyed class more than did students in the control group. Students often spend more time in preparation when the simulation technique is used and often do independent study to understand better the problem. There is a high level of student involvement and enjoyment (24, p. 476).

In addition to the motivational effects, Edinger mentioned the high level of involvement of the students who
participated in the simulation game. The simulation game provided direct experience with the topics dealt with in the game. Students learned through the actual manipulation of game components. They analyzed individual components in the simulation game model and learned how these should be combined to obtain desired interaction to win or succeed. This allowed an opportunity to sense the structure of the game variables. Abt expressed this value of simulation games in the following manner:

Games for the sciences, then offer students the opportunity to engage actively and imaginatively in the learning of abstract, scientific, and increasingly technological concepts. They provide the means by which action and thought can be integrated in a meaningful and dramatic way. Their involvement in the game process is total: They have little time for intellectual withdrawal (2, p. 39).

Those who have played simulation games have expanded their interest in the subject of the game and have gained intellectual confidence. The degree of complexity and structure of games has had a direct relationship with the degree of concentration, understanding, confidence, and satisfaction experienced through the simulation game (16).

Simulation games have provided the opportunity for learners to discover for themselves. Hogan explained this when he said:

Gaming, or simulation, teaches by putting the student in an environment and making him respond to its demands. By so doing, the student discovers for himself the results of his actions and is led to
abstract the fundamental relationships present in the situation (39, p. 242).

Through discovery using simulation games, Boocock (11) reported that students learn a feeling of efficacy. They learn that they can have an effect on their surroundings. Success in most simulation games depends on the action and the ability of the student to apply what he has learned. Through simulation games students have the opportunity to observe that behavior has a direct relationship to the outcome of events.

While students learn that they are able to affect their own environment, they also learn that in life, as in most simulation games, there is an element of chance or fate. The element of chance adds realism to the experience and teaches that misfortune cannot be avoided but its effects can be reduced through good planning (49).

Nesbitt (49) also stated that simulation games provide a means for students to learn peer interaction. Game participants experience competition and tension in overcoming the obstacles of the game in trying to win. In some games the competition takes the form of the player individually competing against another. In other games cooperation among players is needed to successfully compete. Finally, some games require that a player compete against himself or against a standard.
Another advantage of simulation games was pointed out by Tansey and Univin (63) regarding evaluation. In the conventional classroom the teacher must play a role as guide and evaluator. He must lead pupils through learning and at the same time criticize and judge them. Games and simulations tend to break down the interaction between the teacher and the individual student and open up communication between students. The teacher acts only as a guide because the game itself acts as the evaluator by "rewarding" or "punishing" certain behavior or actions. The winner is determined within the framework of the rules of the game and not by an evaluation from the teacher.

Simulation games acquaint students with situations found in real life. They provide experience more rapidly and without the long lasting consequences found in real life. Abt addressed himself to this topic when he said:

Since so many real-life activities are game-like in nature and since so few people wish to risk the consequences of experimenting with alternative decisions in the real-world situation, the creation of simulation games is a valuable educational technique. Students of all ages can experiment with alternative strategies while engaging in realistic and active learning environments. Players assume roles, face problems, formulate strategies, make decisions, and get fast feedback on the consequences of their actions. Motivation, fact-learning, the application of facts to problem solving, and the examination of alternative strategies are all improved through the use of efficient and realistic educational games (2, p. 36).
The fear of reproof and failure has often deterred students from entering into traditional instructional methods. In simulation gaming a student is not held to the effects of his mistakes and is only beaten by the "system" rather than being criticized by a teacher (22).

Like any other teaching methodology, simulation gaming has its disadvantages as well as its advantages. Ivor Kraft has been one of the most outspoken critics of simulation games. He expressed the feeling that simulation games are a gross distortion of reality. In expressing his opinion of the "Game of Legislature" developed at Johns Hopkins University he said the game "indoctrinated the players into a number of naive misconceptions" (43, p. 71). Kraft felt that by having students play games in which values are set, the students do not have the opportunity to establish their own values. He also felt games tend to stifle students' sense of self-evaluation. He thought students should not be indoctrinated with values of a mechanized or computerized simulated society.

Clayton and Rosenbloom (19) have also been critical of simulation games. They concluded from their research that simulation games tended to be excessively disruptive in the classroom because young players often failed to maintain their appropriate role. They also expressed a concern for what students learned from simulation games. They felt that
students learned human behavior from simulation games, but it was the behavior of children responding to unfamiliar situations, not the suggested psychological model of the simulation. In discussing the "Seal Hunting" game, they concluded:

...if a student does successfully perceive the structure of the situation for himself and figures out a good strategy, and if he is really behaving as, for example, a Netsilik would, he may be left with the impression that structure is discovered and strategy worked out anew by each member of a culture. In a conventional game setting it is hard to create an impression of gradual cultural adaptation as knowledge and technique are passed on from one generation to the next (19, pp. 89-90).

They also said:

Another related difficulty is that the only kind of reward that can be realistically built into a game situation is maximization of some countable entity, be it money, token food, points or stars. This imposes a very unrealistic picture of psychological motivation in other cultures.... Students may learn to cooperate in a game to show that cooperation is better than competition, but they are cooperating to maximize an outcome of the game, rather than some inner feeling unconnected with the game (19, pp. 91-92).

Clayton and Rosenbloom have indicated some of the limitations of simulation games, especially as they relate to psychological and social models. Kalman Cohen agreed with these points, as mentioned by Carlson (16) in his book Learning Through Games, and claimed that simulation games tend to "de-humanize" students by allowing them to manipulate the "lives" of others within the constraints of an unreal world.

Another disadvantage of computer simulation games have been their cost. Beck and Monroe (8) indicated that computer
simulation games have a higher per pupil cost than do conventional instructional techniques.

**Research results of studies using simulation games**

Numerous attempts have been made to compare simulation gaming with other instructional methodologies. The findings from such studies have varied and the conclusions drawn have been incomplete.

In 1972 Lunetta (46) developed and evaluated a series of "computer simulated dialogs" for use in high school physics. Students participating in Lunetta's study were placed in one of three instructional groups: 1) computer interactive dialogs and loop films, 2) loop films and simulated "non-computer" data and problem solving, and 3) interaction with teacher and laboratory materials. He found that students in the computer simulation and film group (group 1) achieved significantly more than those in the other two groups. Those in the simulated data and film group achieved significantly higher than those in the control group. It was also found that students in the control group spent 8.3 times as long in instructional activities than the computer simulation and film group (group 1). The control group also spent 3.2 times as long in learning activities as those in the simulated data and loop film group (group 2).

A study to determine whether a simulation game entitled
"Consumer", was more effective than conventional classroom approaches in learning factual information about credit was conducted by Anderson (6) in 1969. He found that there was no significant difference in achievement resulting from the two methods. Anderson also found that there were significant differences between subjects' sex and the method of instruction. He found that simulation games were more effective for males than the conventional approach. According to Anderson those students with majors in business education or general education learned to compare available sources of credit more effectively through simulation gaming than with conventional methods.

In a study similar to Anderson's, Harvey (35) sought to determine the effects of playing a science simulation game on the cognitive and affective processes of black graduate students. He found that those who played the simulation game scored significantly higher on the post-test than those who were in a group taught with the lecture-discussion method. He also found that low achievers in science benefited more from the simulation gaming technique than did high achievers. Based on his study, Harvey concluded that simulation games can teach conceptual material.

Using a group of 160 sixth grade volunteers, Conte (20) conducted a study to determine the effectiveness in increasing knowledge using the simulation game "Life Career".
An experimental group of 80 students played the game for 21 hours while the control group engaged in unrelated game activity. Data were collected from a pre-test taken one week prior to the experiment, from a post-test taken one week after the termination of the games, and from a second post-test taken to test retention six weeks after the experiment. Conte reported a significant gain in the knowledge of life career planning of the group who played the career game. He also reported that the knowledge learned from the "Life Career" game did not decrease over the six week retention period.

In a study for the United States Office of Education Curry and Brooks (23) also used the "Life Career" game. They compared the data from a group who played the game with that collected from a group who were taught using a teacher-directed method to determine if students could learn using simulation games. They found that the "Life Career" game worked no more effectively than the teacher-directed method in helping students learn career information.

Stadsklev (60) conducted a study to determine the cognitive and affective effects of two teaching methods on tenth grade students in a unit on the Constitution of America. An experimental group played a simulation game while a control group was taught using the lecture method. He found that there was no significant difference in the
acquisition of factual or conceptual knowledge between the two groups.

Summary

The research studies reviewed have varied in purpose and results. Lunetta (46) indicated that students learned significantly more using "computer simulation dialogs" and loop films in combination than students who were taught using a traditional approach.

Studies by Harvey (35) and Conte (20) indicated that students could learn factual information using simulation games. Anderson (6), Curry and Brooks (23), and Stadsklev (60) concluded that students could not learn significantly more using simulation games over traditional methods.

Summary

This chapter discussed the literature related to this study. Section one reviewed the historical background and studies of the development of cognitive learning styles. It was found that the concept of cognitive style was recognized throughout history but instruments to measure learning style were not developed until the 1950's. Section two discussed the theory behind the "educational sciences" and reviewed research conducted within the "educational sciences". The literature indicated that the "educational
sciences" have identified specific style traits associated with teachers and instructional methodologies. The final section, section three, discussed the advantages and disadvantages of simulation games and reviewed pertinent studies using this educational methodology. Research conducted using simulation games indicated that factual material could be learned, however, this methodology was no more effective than other teaching techniques.
CHAPTER III. METHODOLOGY

This chapter presents the instrumentation and procedure used in the study. The chapter is divided into five sections with the first being a discussion of the subjects. Part two reviews the two specific computer simulation games. The third part describes the objective tests and the cognitive learning style battery. The fourth part of the chapter explains the research design and analysis. The final section describes the data collection procedure.

Subjects

Students participating in this study were selected from the 16,039 undergraduates enrolled at Iowa State University during the winter quarter 1974. The target population for the study consisted of teacher education candidates enrolled in Psychology 333, "Educational Psychology", and Industrial Education 490Z, "Introduction to Materials and Processes". Two sections of psychology and one of industrial education were asked by their professors to participate in an educational research study using computer simulation games, upon completion of which they would receive extra credit. The sample which volunteered for participation in the experimental group consisted of: 1) 77 of 157 students from section A, Psychology 333; 2) 12 of 138 students from section B,
Psychology 333; and 3) 25 of 36 students from Industrial Education 490Z. There were three students from section A of Psychology 333 which were unable to complete the study. Thus, the experimental group consisted of 111 students.

The same three classes as asked before were again asked by their professors for volunteers to take four tests involved with the study. The subjects were given extra credit commensurate with the time involved. Those who volunteered formed the control group and consisted of 17 students from section A of Psychology 333 and 7 students from Industrial Education 490Z.

The experimental group consisted of 48 (43.2%) males and 63 (56.8%) females. The age of those participating varied from 18 to 31, with the median age of 20.44 (see Table A-1). Most of the subjects were either sophomores (54.1%) or juniors (34.2%) (see Table A-2). Twenty-five different majors were represented in the study (see Table A-3).

The control group consisted of 11 (45.8%) males and 13 (54.2%) females with the median age of the group being 20.56 (see Table A-1). The control group contained 9 (37.5%) sophomores, 7 (29.2%) juniors, 4 (16.7%) freshmen, and 4 (16.7%) seniors (see Table A-2).

The geographic background of the sample was somewhat similar. The percent of the experimental group indicating their home town was in Iowa was 90.1%; however, only 36.9%
had lived on a farm. Of the control group, 95.8% were from Iowa and 41.7% had lived on a farm. The population of the home towns of those in the sample varied considerably. The largest percentage (26.1%) of the experimental group lived in a town with a population less than 1,000 while the largest percentage of the control group (33.3%) indicated they were from a town with a population of 1,000 to 5,000 (see Tables A-4, A-5, and A-6).

The academic background of the sample was diverse. The mean score for the 99 of the experimental group who took the ACT Test was 24.49 with a standard deviation of 3.54. The 24 people in the control group had a mean of 23.43 with a standard deviation of 3.62 (see Table A-7). The subjects' high school rank in the graduating class given in percentiles varied from a high of 1 percentile to a low of 96 percentile. The median percentile of the experimental and control groups were 21.95 and 32.17 respectively (see Table A-8).

Computer Simulation Games

Two computer simulation games were used in the study. The first was "The Management Game" and the second was "The Beef Breeding Game".
"The Management Game"

"The Management Game" was modeled after the business strategy game constructed by Richard Bellman, Franco Ricciordi and others for the American Management Association. Since the game's origin, a number of innovations have been added by IBM and the staff at Iowa State University.

Each subject within the experimental group was given a simulated manufacturing firm to control. The firms were arranged into groups of five. The five simulated firms competed with each other and each manufactured similar low profit products. The object of the game was to try and maximize profits over the time of game play.

Participation in the exercise was relatively simple: five individuals were each given a firm to operate. Within the industry all firms produced a product which was an imperfect substitute for the other. The individuals made decisions for the firms which they controlled by choosing output levels, price, advertising expenditures, and the like. The decisions chosen by all five firms were fed into a computer processing system, which translated these decisions into results for each player. The results, in the form of financial position, were transmitted to the individuals, who then repeated the decision-making process. This continued for nine fiscal quarters, or two and one-fourth simulated years.
The basic decision problem involved in this game was that of deciding on courses of action with only a vague knowledge of the outcome of such actions. The results of decisions made for each firm depended not only on these decisions alone, but also on decisions made by the other four competitors. Thus, an "unwise" decision might have occurred because of an opponent's unpredictable action, rather than the unreasonableness of the decision itself.

Each player had direct control over eight "decision variables": price, marketing expenditures, research and development expenditures, investment in additional plant and equipment, discard of plant, expenditures on market research, production, and dividends. The values of all other variables in the game were determined by the model, using the decisions made by each firm.

At the beginning of the exercise, each participant was presented with a statement which included the following information:

1. The annual statements of all companies.
2. The financial position of the company that the player controlled, showing the amount of cash, the number of units held in inventory, the value of each unit and the total value of inventory, the gross value of plant and equipment, the depreciation reserve, the capacity of plant and equipment, the
value of each unit of capacity, the net value of plant and equipment, the amount of loans outstanding, and the total assets less liabilities.

3. The results of operation for the previous period of the company controlled, showing number of units sold, marketing expenditures, research expenditures, market research expenditures, inventory carrying costs, interest costs for the previous period, income before taxes, taxes and profit after taxes, dividends paid, and profit retained in business.

4. A decision worksheet showing a summary of funds available for the next quarter (cash plus depreciation plus line of credit available, less loans outstanding), together with a form for entering planned expenditures.

5. Market information listing the prices charged by all companies the previous period, the stock price of each company, the total industry market (in units) in the previous period, the share of market for the company the player controlled, the potential sales in the previous quarter for the company, and dividends paid by each company in the previous quarter.

6. Operating and decision information showing alternatives available to the firm for the next period.
The above represents the information which was available to each individual at the beginning of the game. All five participants competing against each other were started with identical data and with identical decision alternatives. On the basis of the above information, each person made his decisions for the next period. These decisions were used by the computer to determine the results for each company for the first period of play. By analyzing these results new decisions were then made by each player. The process continued to the end of the game.

A copy of the explanation of the game given to the participants and typical computer printouts resulting from the game can be found in Appendices E and F.

"The Beef Breeding Game"

The beef genetic simulation program was written in 1970 by Dr. Richard L. Willham, Professor of Animal Science at Iowa State University. Conversion to disk storage and modifications in five subroutines were made for more convenient and efficient handling of data for use in the study.

The game was played by giving each participant a unique beef herd consisting of 5 sires and 50 dams, and their offspring. The purpose of the game was to select parents which would produce the greatest gains in yearling weight.

Each player was given a number of weights and other
information on standard record of performance sheets for each of his animals. Also included on the form was a section called the "selection worksheet" where the yearling weight performance data on the individual animal, his paternal and maternal half-siblings, and progeny, if any, were combined into an estimated breeding value. With the use of this information the player selected sires from those in service or those from the current calf crop to be mated with selected cows or young heifers. The simulation program used these selections to produce a second calf crop. This sequence was repeated for seven calf crops.

As with the breeder in real life, the player of "The Beef Breeding Game" could not see the genes or breeding value of his cattle. The players had to make estimates of genetic value based on animal breeding value theory and information given, and try to increase the genetic worth of each animal in meat production. In this game each player was given his own individual herd which was in no way influenced by other participants. Each player was competing only against himself; trying to improve his herd.

Each player was given the following information about each of his animals throughout the duration of the game:

1. The pedigree of each animal was given including its sex, the number of the bull and cow which produced it.
2. Information about the animals' physical condition was given. Included was the weaning weight and the ratio between the animal's weight and the mean of the calf crop, the feedlot gain and ratio, and the yearling score, weight, and ratio.

3. The estimated breeding value for yearling weight for each animal was given. Included was the individual record; the number and average of paternal half-siblings, maternal half-siblings, and progeny; the accuracy or theoretical correlation between the estimated and true breeding value of the animal; and, the estimated breeding value.

4. A selection sheet listing all possible bull and cow prospects and an area for indicating the next calf crop was also included.

Each player had all of the above information for the animals in his herd. Based on this information, participants selected which animals were to be mated. These data were processed by the computer which produced a calf crop as well as update data on existing animals. This process continued for the duration of the game.

Copies of printouts for this game can be found in Appendix G.
Instruments and Variables

Data were collected on the subjects of the study using cumulative records held in administrative offices of Iowa State University and three test instruments. The variables studied and the data collection instruments are described in this portion of the chapter.

Demographic information

Demographic information such as age, sex, major, home town, and home location was obtained from the subjects while filling out answer sheets for content mastery tests. The composite score on the American College Test was secured from the student cumulative files.

The student's rank in the high school graduating class expressed in percentiles was achieved by dividing the student's rank by the number of students in the graduating class. This information was found in the student cumulative files.

Test For Cognitive Style Test Mapping

The Test For Cognitive Style Test Mapping, known hereafter as the "Style Test", developed at Oakland Community College by Joseph E. Hill, was administered to each subject. The "Style Test" was part of a battery of tests which were used as both diagnostic and descriptive measures by the
O.C.C. staff in its Personalized Education Program. The "Style Test" consisted of ten tests arranged into two sections; requiring approximately two and three-quarter hours to administer. The test provided information on students' abilities in reading, mathematics, auditory language and mathematics, and visual organization. The tests also provided descriptive information concerning one's qualitative codes, cultural determinants of the meanings of symbols, and modalities of inference.

Items used in the "Style Test" were either developed by Hill or taken from a variety of other standardized tests. Question items were selected from the Iowa Tests of Educational Development, the Nelson-Denney Reading Test, the Differential Aptitude Test, the Mueller Auditory Test, the Vineland Social Maturity Scale, the Science Research Associates batteries, and the Raven Matrices Survey.

A copy of the "Style Test" can be found in Appendix H.

Content validation and reliability of the "Style Test"
The tests in the "Style Test" have had content validity calculated for them. In a study by Niles (50) the content validity for the battery was calculated to be .84. Hand (32) indicated that with cognitive styles mapped for over twenty thousand community college students the reliability coefficient of .98 was calculated. Values of .84 to .96,
using the Kuder-Richardson Formula, were reported by Setz\(^1\) for reliability based on a population of two thousand subjects. Included in the population were approximately 1,000 elementary school teachers, 400 school administrators, and 600 high school and community college students.

**Test 1: verbal reasoning test -- T(VL)**

This test consisted of 25 sentences in which the first and last words were omitted. The subject was asked to select, from a choice of five, the correct pair of words to make the sentence true and sensible. This test had a time limit of 15 minutes.

**Test 2: listening comprehension test -- T(AL)**

This test consisted of a brief story concerning the food gathering habits of young people on a south sea island. The test directions and story were presented with the use of an audio tape recording. After listening to the recording, students were given eight questions to which they wrote short answer responses. There was a five minute limit on this test.

**Test 3: visual quantitative test -- T(VQ)**

This test consisted of 20 basic numerical problems including

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\(^1\)Personal correspondence from Betty D. Setz, Director of Community Relations, Oakland Community College, Bloomfield Hills, Michigan. April 16, 1974.
addition, subtraction, multiplication, division, square and cube roots, fractions, and percentages. Five responses were given including a fifth choice of "none of these". A limit of 15 minutes was placed on this test.

Test 4: reading comprehension test -- T(VL) This test consisted of eight reading selections about which the student answered multiple choice questions. Selections varied from approximately 750 words to 250 words and covered a range of topics. The test contained 36 questions and had a time limit of 20 minutes.

Test 5: oral arithmetic test -- T(AQ) Test five was made up of ten story problems which necessitated the use of the common arithmetic analyses. The directions and problems were presented by means of an audio tape recorder. The students were allowed to use scratch paper if they desired. Problems were presented at approximately 20 to 30 second intervals.

Test 6: English structure test -- T(VL) This test contained 50 items and was to be completed in 40 minutes. The questions covered such subjects as topic selections for paragraphs and themes, grammar, sentence structure, and expression of thought.
Test 7: qualitative codes test — $Q(CEM)$, $Q(CH)$, $Q(CES)$, $Q(CET)$, and $Q(CK)$  

Forty statements were used in test seven to assess students' interests, beliefs, conduct, and attitudes. The subject was asked to rate each statement as to how well it represented him. The four responses available were: usually, sometimes, seldom, and never. This test was untimed; however, students were urged to answer the questions rapidly and rely heavily on their first impression.

Test 8: qualitative codes test — $Q(CKH)$, $Q(CP)$, $Q(CS)$, and $Q(CT)$  

Tests seven and eight were similar in nature in that the student was asked to rate the degree to which he felt that the statement represented his charter. Test eight contained 32 items and was untimed. Again, the student was urged not to spend a great deal of time on any one item.

Test 9: cultural determinants test — I, A, and F  

Ten stories or incidents which may have happened to people were used in this test. The student was then asked how he would respond in a similar situation and required to respond to two of three statements with least likely and most likely. No time requirement was placed on this test.

Test 10: test for inferential patterns and deductive reasoning — M, D, R, L, and (K)  

In this test there were ten situations in which the student was asked to imagine
himself. Each situation had four possible responses. The student was asked to indicate which response he would most likely make as his first choice or solution, his second choice, third choice, and fourth choice.

**Visual test -- Q(V)** A visual test, the directions for which were given on an audio tape recorder, was administered to each subject. The test consisted of eight slides showing a visual analogy composed of three patterns with a place for a fourth. The subject was to select the appropriate missing pattern from six alternatives presented on the slide. The eight slides were presented in 20 second intervals.

**Auditory test -- Q(A)** The auditory test was composed of five questions given on an audio tape recorder. Each item consisted of a pattern of sounds presented in groups of "bees" and "baas". Upon completion of the pattern, the subject was asked to write the next group of sounds to complete the pattern.

The tests described above make up the "Style Test" as developed by Hill. Upon completion of the test the answer cards were returned to Oakland Community College Testing Center, Bloomfield Hills, Michigan, for computer scoring and printing of learning style "maps". An example of a "style map" may be found in Appendix I.
"Management Test"

The "Management Test", especially developed by the author for the study, was an instrument designed to measure understanding of concepts associated with industrial management. This instrument was used as both the pre- and post-test for testing achievement associated with the "Management Game".

The instrument was directed toward the content concepts associated with the "Management Game". Specifics related only to the mathematic model of the game were avoided. Only questions covering the concepts of the game which were felt to be answerable by those knowledgeable of industry and business were included.

The instrument in its final form consisted of 25 true-false items and 20 multiple choice items for a total of 45 questions. A copy of the final "Management Test" has been included in Appendix J. The validation of the "Management Test" was established with use of a panel of raters.

Validation of the "Management Test" The trial form of the "Management Test" and the administrative directions were reviewed by four professors from Iowa State University. Each of the raters had administered the game and was familiar with management concepts. Raters represented the following departments: Industrial Engineering, Industrial
Administration, Engineering Extension, and Economics. Each rater was given a copy of the test and asked to rate each item as valid or invalid. Items were to be marked valid if they were felt to be an appropriate measure of the cognitive facts and concepts representative of the real business world which could be learned through playing the game.

After completing their individual form the raters were brought together to discuss each item and present their evaluations. Only those questions which had been determined valid by at least three of the four raters were used on the test.

Reliability of the "Management Test" The reliability of the "Management Test" was established by administering it to a group of 65 undergraduates at Iowa State University. This group consisted of students enrolled for the fall quarter, 1973, in each of the following classes: 31 students from Industrial Engineering 404, "Engineering Economy"; 10 students in Economics 444, "Management Theory and Practice"; and 24 students from Industrial Education 121, "Introduction to Graphic Communications". Those students in Economics and Industrial Engineering had completed the game and those from Industrial Education had not played the game. Using the Kuder-Richardson Formula 20, the coefficient of reliability was calculated as .59.
"Beef Breeding Test"

The "Beef Breeding Test", written by the author specifically for the study, was used as both the pre- and post-test with the "Beef Breeding Game" and was developed to ascertain one's cognitive knowledge of beef breeding. The test was developed in an effort to measure cognition of facts and concepts presented in the game. The final instrument consisted of 25 true-false and 18 multiple choice items for a total of 43 questions. A copy of the "Beef Breeding Test" in its final form is located in Appendix K.

Content validation of the "Beef Breeding Test" Content validity for this instrument was determined by a panel consisting of two professors, including the author of the game, and two graduate students from the Department of Animal Science. Each rater had experience with the game and its administration. Each rater was given a copy of the test and asked to rate each item as a measure of the cognitive facts and concepts stressed in the "Beef Breeding Game".

An evaluation meeting was held for the purpose of reviewing each test item. Each item was discussed and modified as seemed appropriate by the raters. Only those items rated valid by three or more of the judges were accepted for inclusion in the test.
Reliability of the "Beef Breeding Test"  The re-
liability was established by giving the test to 35 under-
graduates during the winter quarter, 1974. Included in the
group were 23 students enrolled in Animal Science 427, "Beef
Production", who had played the Beef Breeding Game. Also
included in the reliability group were 12 students enrolled
in Industrial Education 122, "Technical Graphics", who
had not played the game. A reliability coefficient of .84
was obtained using the Kuder-Richardson Formula 20.

Design and Analysis

The first problem of the study was to determine whether
students could learn concepts and facts by playing computer
simulation games. Because two individual games were played,
two sets of comparisons were made between the pre- and post-
test scores of the control and experimental groups. The fol-
lowing comparisons were made with the use of t-tests: 1)
pre-test of the control group and the pre-test of the experi-
mental group; 2) pre-test of the experimental group and the
post-test of the experimental group; 3) pre-test of the
control group and the post-test of the control group; and
4) test gain over the pre-test of the control group and the
post-test gain over the pre-test of the experimental group.
These four t-tests were calculated on both the "Management
Test" and the "Beef Breeding Test".
Reliability of the "Beef Breeding Test"  

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Since there were two individual games used for this study and one of the problems of the study was to identify the cognitive learning style for successful performance on objective tests for each of the two games, two separate analyses were necessary. To determine the cognitive style associated with successful performance on "The Management Game" the experimental group was divided into two subgroups: management achievers and management nonachievers. Management achievers were identified as those who scored significantly higher on the management post-test over the management pre-test. To determine this significance a single sample chi-square test (59, p. 21) was used on each subject's pre- and post-tests. The 111 chi-square tests calculated used the pre-test score as the expected value and the post-test score as the observed value. Table 1 exemplifies this procedure for subject number 001.

Table 1. Chi-square test to determine management achievement for subject 001

<table>
<thead>
<tr>
<th>Items</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>((f-F)^2/F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>20</td>
<td>26</td>
<td>1.80</td>
</tr>
<tr>
<td>Incorrect</td>
<td>25</td>
<td>19</td>
<td>1.44</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>45</td>
<td>3.24</td>
</tr>
</tbody>
</table>
Using this procedure 21 management achievers and 90 management nonachievers were identified. See Figure 1. Table L-1 summarizes the chi-square computations for all subjects.

The means of each of the 26 variables identified on the "style test" were computed for the management achievers and the management nonachievers. To determine if there was any significant difference between these two groups for each of the traits, separate analyses of variance were performed for each of the 26 variables.

The analysis to determine the cognitive learning style for those who achieved on "The Beef Breeding Game" was identical to that for "The Management Game". The subjects of the experimental group were divided into the beef breeding achievers and beef breeding nonachievers using the single sample chi-square test. There were 22 beef breeding achievers and 89 beef breeding nonachievers identified. See Figure 2 and Table L-1. There were 26 analyses of variance calculated to determine significant differences on each of the learning style traits between these two groups.

The third problem involved in this study was to identify those cognitive learning style components which were in common for achievement on both games. The common components were determined through an observational comparison between the learning style traits found significant under the second
Management Achievers

Management Nonachievers

Figure 1. Distribution of the experimental group on the pre- and post-
"Management Test"
Figure 2. Distribution of the experimental group on the pre- and post- "Beef Breeding Test"
problem of the study.

Data Collection

Data were collected from the students' cumulative files and from tests administered by the investigator. The procedure used for the collection of this information is outlined below for both the experimental and control groups.

Experimental group

First session

1. Introduction to gaming and the research (20 minutes)

2. Administration of the "Management Test" pre-test (30 minutes)

3. Slide tape presentation over "The Management Game" (20 minutes)

4. Discussion and questions answered (20 minutes)

The 111 subjects in the experimental group played "The Management Game" for nine simulated business quarters over a three week time period. The students filled out the decision worksheets and returned them to their scheduled psychology or industrial education class each Monday, Wednesday, and Friday. The sheets were collected, key punched, and analyzed the same afternoon. The results for that period of play were delivered to each participant that
Second session
1. Administration of the "Management Test" post-test (30 minutes)

Between the second and third sessions there was a two week University vacation period.

Third session
1. Administration of the "Test For Cognitive Style Test Mapping" (180 minutes)

Fourth session
1. Administration of the "Beef Breeding Test" pre-test (30 minutes)
2. Slide tape presentation over "The Beef Breeding Game" (20 minutes)
3. Discussion and questions answered (20 minutes)

All subjects in the experimental group played "The Beef Breeding Game" for seven calf crops during a two week period of time. The students returned the decision sheets to their scheduled classes as they had done for the previous game. The decisions were analyzed and the results were returned to each subject that evening.
Fifth session
1. Administration of the "Beef Breeding Test" post-test (30 minutes)

Each of the five sessions was offered twice except for the third session, the "style test", which was offered eight times. This was done to allow for conflicts in schedules.

Control group

First session
1. Introduction to the research study (10 minutes)
2. Administration of the "Management Test" pre-test (30 minutes)

There was a three week time lapse between sessions one and two.

Second session
1. Administration of the "Management Test" post-test (30 minutes)

There was a four week time period between the second and third sessions.

Third session
1. Administration of the "Beef Breeding Test" pre-test (30 minutes)

There were two weeks between sessions three and four.
Fourth session

1. Administration of the "Beef Breeding Test" post-test (30 minutes)

Summary

This chapter presented the instrumentation and procedure used in the study. The chapter was divided into five sections: the subjects, the computer simulation games, the instruments used, the research design and analysis, and the data collection procedure.

The subjects for the study were 135 volunteers from Psychology 333, "Educational Psychology", and Industrial Education 490Z, "Introduction to Materials and Processes". There were 111 subjects in the experimental group and 24 subjects in the control group.

Two computer simulation games were used in the study. "The Management Game" was an industrial simulation in which each subject was given a firm to operate which competed against four other firms. Each player made decisions for the firm he controlled by choosing output levels, advertising expenditures, and the like. The purpose of the game was to maximize profits.

An individual beef herd was given to each player of "The Beef Breeding Game". Based on the information in the game, each player made decisions on which animals of his herd to mate.
The purpose of the game was to maximize the genetic value for yearling weight of the herd.

The instruments used in the study included the **Test For Cognitive Style Mapping** developed by the Institute for Educational Sciences. It was used to measure learning style traits. Two other tests, the "Management Test" and the "Beef Breeding Test", were developed by the investigator to test the cognitive knowledge associated with the two computer simulation games used in the study.

The unequal control-group quasi-experimental design was used in the study. Analyses of differences between achievers and nonachievers, identified through use of a chi-square test, were calculated using t-tests and one-way analyses of variance.

The data were collected from cumulative files and at five group sessions. The first session included a pre-test and explanation of "The Management Game". The second session was a post-test over the game. During the third session the subjects took the "Style Test". The fourth session was a pre-test and introduction to "The Beef Breeding Game". The final session was the beef breeding post-test.
CHAPTER IV. FINDINGS

The findings of the study are reported in reference to the problems and purposes stated in Chapter I. The data collected and presented were analyzed to test the hypotheses set forth in this study. Discussion of these data was limited to that needed to describe the statistics cited.

Research Hypothesis I

The first research hypothesis was formulated to test the effect of computer simulation games on the scores of two content mastery tests. Under this hypothesis, eight statistical null hypotheses were tested using a t-test to compare the means of the groups under analysis. Six of the eight statistical null hypotheses were of the following form:

\[ H_0 : \mu_1 = \mu_2 \]

\[ H_A : \mu_1 \neq \mu_2 \]

where \( \mu_1 \) and \( \mu_2 \) were means of the experimental or control groups on the content mastery pre- or post-tests.

Three specific t-tests were used to test research hypothesis one. The first t-test used tested the difference between two independent samples, of unequal size, with equal variances. The following formula (59, p. 102) was used:
\[ t = \frac{\overline{X}_1 - \overline{X}_2}{S_{\overline{X}_1 - \overline{X}_2}} \]

where,

\[ S_{\overline{X}_1 - \overline{X}_2} = S^2 \left( \frac{n_1 + n_2}{n_1 \cdot n_2} \right) \]

\[ S^2 = \frac{\sum x_1^2 + \sum x_2^2}{(n_1 - 1) + (n_2 - 1)} \]

This \( t \)-test was used to test Null Hypotheses 1 and 5.

The second \( t \)-test was used to determine the difference between means of paired dependent samples with equal variances. The following formula (71, p. 94) was used:

\[ t = \frac{D}{S_D} \]

where,

\[ D = \sum (X_1 - X_2) \]

\[ \overline{D} = \frac{D}{n} \]

\[ S_{\overline{D}} = \frac{S^2_D}{n} \]

\[ S_D = \frac{\sum d^2}{(n-1)} \]

\[ d = D - \overline{D} \]

This test was used on null hypotheses 2, 3, 6, and 7.
Null Hypotheses 4 and 8 were to test the gains in mean scores between pre- and post-tests, or interaction effect, for given treatments. These hypotheses were of the following form:

\[ H_0 : \mu_1 - \mu_2 = \mu_3 - \mu_4 \]

\[ H_A : \mu_1 - \mu_2 \neq \mu_3 - \mu_4 \]

The following t-test was used to compare the mean gains between two independent samples:

\[ t = \frac{\bar{D}_1 - \bar{D}_2}{S_{D_1-D_2}} \]

where,

\[ S_{D_1-D_2}^2 = s^2 \left( \frac{n_1 + n_2}{n_1 n_2} \right) \]

\[ s^2 = \frac{\Sigma d_1^2 + \Sigma d_2^2}{(n_1-1) + (n_2-1)} \]

The first four null hypotheses were formulated to test the effectiveness of "The Management Game" in teaching cognitive knowledge as measured by the "Management Test". Table 2 presents the measures of central tendency and dispersion for the treatment and control groups on the "Management Test".
Table 2. Summary of results for the "Management Test"

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**Null Hypothesis 1**

Null Hypothesis 1: There was no significant difference between the means of the control group and the experimental group on the "Management Test" pre-test.

The t-value for Null Hypothesis 1 was calculated as .73, with 133 degrees of freedom. A value of 1.98 was required for rejection at the .05 level. Therefore, null hypothesis 1 was retained. There was no significant difference between the control group and the experimental group on the pre-test of the "Management Test".

**Null Hypothesis 2**

Null Hypothesis 2: There was no significant difference between the means of the pre- and post-test scores on the "Management Test" for the experimental group. A value of 6.82, with 110 degrees of freedom, was calculated for Null
Hypothesis 2. This value indicated a highly significant difference between the two means.

Null Hypothesis 2 was rejected and the alternative hypothesis was retained. The experimental group scored significantly higher on the post-test than on the pre-test.

Null Hypothesis 3

Null Hypothesis 3: There was no significant difference between the means of the pre- and post-test scores on the "Management Test" for the control group.

A t-value of .24, with 23 degrees of freedom, was calculated for Null Hypothesis 3. A value of 1.71 was required to reject the hypothesis at a .05 alpha level. There was no significant difference between the pre- and post-test scores on the "Management Test" for the control group.

Null Hypothesis 4

Null Hypothesis 4: There was no significant difference between the mean gains of the control group on the pre- and post-test and the experimental group on the pre- and post-test.

A value of 3.15 with 133 degrees of freedom, was calculated on the t-test and indicated a highly significant interaction which allowed the rejection of Null Hypothesis 4 and the acceptance of the alternative hypothesis. The gain
of the experimental group between the pre- and post-tests
on the "Management Test" was significantly higher than the
gain of the control group. The interaction is shown in
Figure 3.

Null Hypotheses 5 through 8 were formulated to test the
effect of "The Beef Breeding Game" in teaching facts and
concepts concerning animal breeding as measured by the "Beef
Breeding Test". Table 3 summarizes the results of the
experimental and control groups on the "Beef Breeding Test".
Table 3. Summary of results for the "Beef Breeding Test"

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Null Hypothesis 5

Null Hypothesis 5: There was no significant difference between the means of the control and experimental group on the "Beef Breeding Test" pre-test.

With a 133 degrees of freedom a value of .88 was calculated using the t-test. A value of 1.98 was needed to reject the null hypothesis. Null Hypothesis 5 was not rejected. There was no significant difference between the control and experimental groups on the pre-test of the "Beef Breeding Test".

Null Hypothesis 6

Null Hypothesis 6: There was no significant difference between the means of the pre- and post-test scores on the "Beef Breeding Test" for the experimental group.

The t-test for Null Hypothesis 6 was calculated as 8.38, with 110 degrees of freedom. A value of 1.98 and 2.62 was
necessary to reject the hypothesis at the .05 and .01 level respectively. The calculated t-value was sufficiently large to reject Null Hypothesis 6 and retain the alternative hypothesis. The experimental group scored significantly higher on the post-test of the "Beef Breeding Test" than on the pre-test.

**Null Hypothesis 7**

Null Hypothesis 7: There was no significant difference between the means of the pre- and post-test scores for the control group on the "Beef Breeding Test".

A t-value of .40, with 23 degrees of freedom, was calculated for Null Hypothesis 7. Based on a t-value of .40 Null Hypothesis 7 was not rejected. There was no significant difference between the pre- and post-test on the "Beef Breeding Test" for the control group.

**Null Hypothesis 8**

Null Hypothesis 8: There was no significant difference between the mean gains of the control group and the experimental group on the pre- and post-test scores on the "Beef Breeding Test".

The t-value calculated for Hypothesis 8 was 3.30, with 133 degrees of freedom. A value of 2.62 was necessary to reject the hypothesis at the .01 level. The calculated t-value indicated the presence of a highly significant inter-
action and allowed the rejection of Null Hypothesis 8. The gain between the pre- and post-tests on the "Beef Breeding Test" by the experimental group was significantly higher than the gain by the control group. The interaction is shown in Figure 4.

![Graph showing interaction of time by treatment using the "Beef Breeding Test".](image)

**Figure 4. Interaction of time by treatment using the "Beef Breeding Test"**

**Summary of results for Research Hypothesis I**

The eight null hypotheses associated with Research Hypothesis I indicated that there were no significant differences between the pre-tests of the control group and the experimental group on the "Management Test" and the "Beef
Breeding Test". The hypotheses also indicated that there was a significant gain between the pre- and post-test scores by the experimental group on both sets of tests. This was not true for the scores of the control group; there was no significant gain between the pre- and post-test scores on either test. Null Hypotheses 4 and 8 denoted a time by treatment interaction indicating that students in the experimental group gained significantly more than did the students in the control group.

Research Hypothesis II

The second research hypothesis was formulated to test the difference between achievers and nonachievers for each of two computer simulation games on 26 traits comprising the learning style test.

The 52 null hypotheses used to test Research Hypothesis II each took the following statistical form:

\[ H_0 : \mu_A = \mu_{NA} \]

\[ H_A : \mu_A = \mu_{NA} \]

where \( \mu_A \) and \( \mu_{NA} \) indicated the means of achievers and non-achievers on tests measuring traits of cognitive learning style.

As a measure of independence, the intercorrelations of the variables were determined. Table 4 shows the inter-
Table 4. Intercorrelation of variables$^a$

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<td>29</td>
<td>12</td>
<td>65</td>
<td>35</td>
<td>33</td>
<td>97</td>
<td>34</td>
<td>53</td>
<td>17</td>
<td>26</td>
</tr>
<tr>
<td>Q(V)</td>
<td>07</td>
<td>10</td>
<td>27</td>
<td>07</td>
<td>18</td>
<td>08</td>
<td>05</td>
<td>13</td>
<td>24</td>
<td>-05</td>
<td>09</td>
<td>07</td>
<td>-09</td>
<td>-07</td>
</tr>
<tr>
<td>Q(A)</td>
<td>18</td>
<td>12</td>
<td>14</td>
<td>06</td>
<td>04</td>
<td>06</td>
<td>20</td>
<td>04</td>
<td>22</td>
<td>20</td>
<td>06</td>
<td>25</td>
<td>-16</td>
<td>-04</td>
</tr>
</tbody>
</table>

$^a$Decimals omitted
correlation of the 26 traits within the learning style test, the pre- and post test scores on the "Management Test", results on "The Management Game", the pre- and post-test scores on the "Beef Breeding Test", and the results on "The Beef Breeding Game".

The first 26 null hypotheses under the second research hypothesis were formulated to determine those learning style traits for which there were significant differences between achievers and nonachievers associated with "The Management Game".

The analyses of variance tables of differences between management achievers and nonachievers associated with Null Hypotheses 9 through 34 can be found in Appendix B.

**Null Hypothesis 9**

Null Hypothesis 9: There was no significant difference between management achievers and nonachievers on scores of verbal analogies, \( T(\text{VL}) \).

The results of the analysis of variance for this variable revealed a nonsignificant \( F \)-value of .228. As a result, Null Hypothesis 9 was retained.

**Null Hypothesis 10**

Null Hypothesis 10: There was no significant difference between management achievers and nonachievers on listening comprehension, \( T(\text{AL}) \).
An F-value of .171 was calculated. The F-value was non-significant and therefore the null hypothesis was retained.

Null Hypothesis 11

Null Hypothesis 11: There was no significant difference between management achievers and nonachievers on scores of mathematical ability as expressed in the trait theoretical visual quantitative, T(VQ).

An F-value of .392 was calculated and determined as non-significant. Null Hypothesis 11 was retained.

Null Hypothesis 12

Null Hypothesis 12: There was no significant difference between the means of management achievers and nonachievers on reading ability as determined in style trait T(VL).²

Null Hypothesis 12 was retained due to a nonsignificant F-value of .584 at the .05 level.

Null Hypothesis 13

Null Hypothesis 13: There was no significant difference between the means of management achievers and nonachievers in oral arithmetic computational ability, T(AQ).

An F-value of .892 was not sufficient to reject the null hypothesis at the .05 level.
Null Hypothesis 14

Null Hypothesis 14: There was no significant difference between the means of management achievers and nonachievers on an examination testing knowledge of the basic structure of the English language, as measured by the style trait $T(VL)_3$.

An F-value of .183 was calculated on an analysis of variance. Null Hypothesis 14 was retained.

Null Hypothesis 15

Null Hypothesis 15: There was no significant difference between the management achievers and nonachievers on the trait qualitative code empathetic, $Q(CEM)$.

A .012 F-value was determined which was not significant at the .05 level and therefore the hypothesis was retained.

Null Hypothesis 16

Null Hypothesis 16: There was no significant difference between the management achievers and nonachievers on the trait qualitative code esthetic, $Q(CES)$.

A nonsignificant F-value of .033 was calculated. The null hypothesis was retained.

Null Hypothesis 17

Null Hypothesis 17: There was no significant difference between the management achievers and nonachievers on the trait qualitative code ethic, $Q(CET)$. 
The analysis of variance produced an F-value of .031. This value was not sufficiently large to reject the null hypothesis.

**Null Hypothesis 18**

**Null Hypothesis 18:** There was no significant difference between the management achievers and nonachievers on the trait qualitative code histronics, Q(CH).

An F-value of .533 was calculated using an analysis of variance. Null Hypothesis 18 was retained.

**Null Hypothesis 19**

**Null Hypothesis 19:** There was no significant difference between management achievers and nonachievers on the trait qualitative code kinetics, Q(CK).

The analysis of variance for this variable revealed a nonsignificant F-value of .014. As a result, Null Hypothesis 19 was retained.

**Null Hypothesis 20**

**Null Hypothesis 20:** There was no significant difference between management achievers and nonachievers on the trait qualitative code kinesthetic, Q(CKH).

An F-value of .101 was calculated. The F-value .101 was nonsignificant and therefore the null hypothesis was retained.
Null Hypothesis 21

Null Hypothesis 20: There was no significant difference between management achievers and nonachievers on the trait qualitative code proxemics, Q(CP).

A nonsignificant F-value of .230 was calculated. Null Hypothesis 20 was retained.

Null Hypothesis 22

Null Hypothesis 21: There was no significant difference between management achievers and nonachievers on the trait qualitative code synnoetics, Q(CS).

An F-value of 1.714 was calculated on an analysis of variance. Null Hypothesis 21 was retained due to a nonsignificant F-value at a .05 alpha level.

Null Hypothesis 23

Null Hypothesis 22: There was no significant difference between management achievers and nonachievers on the trait qualitative code transactional, Q(CT).

The analysis of variance, produced an F-value of .769. This value was not sufficiently large to reject the null hypothesis.

Null Hypothesis 24

Null Hypothesis 23: There was no significant difference between management achievers and nonachievers on the trait
"individuality", I.

An F-value of 1.059 was calculated and determined as nonsignificant. The null hypothesis was retained.

Null Hypothesis 25

Null Hypothesis 25: There was no significant difference between management achievers and nonachievers on the trait "associates", A.

An F-value of 5.304 was calculated. This value proved to be significant at the .05 level, which allowed the rejection of the null hypothesis and the acceptance of the alternative hypothesis.

The management achievers scored significantly lower on the style trait "associates" than the management non-achievers.

Null Hypothesis 26

Null Hypothesis 26: There was no significant difference between management achievers and nonachievers on the trait "family", F.

Null Hypothesis 26 was retained due to a nonsignificant F-value of .578 at the .05 level.

Null Hypothesis 27

Null Hypothesis 27: There was no significant difference between management achievers and nonachievers on the trait "magnitude", M.
An F-value of .342 was calculated and determined as non-significant. Null Hypothesis 27 was retained.

Null Hypothesis 28

Null Hypothesis 28: There was no significant difference between management achievers and nonachievers on the trait "difference", D.

An F-value of .342 was not sufficient to reject the null hypothesis at the .05 level.

Null Hypothesis 29

Null Hypothesis 29: There was no significant difference between management achievers and nonachievers on reading level, as measured in the "Style Test".

Null Hypothesis 29 was retained due to a nonsignificant F-value of 1.881 at the .05 level.

Null Hypothesis 30

Null Hypothesis 30: There was no significant difference between management achievers and nonachievers on the trait "appraisal", L.

A nonsignificant F-value of .575 was calculated. Null Hypothesis 30 was retained.

Null Hypothesis 31

Null Hypothesis 31: There was no significant difference between management achievers and nonachievers on the deductive
inferential process (K).

An F-value of .197 was calculated on an analysis of variance. Null Hypothesis 31 was retained.

Null Hypothesis 32

Null Hypothesis 32: There was no significant difference between management achievers and nonachievers on the trait "relationship", R.

The analysis of variance produced an F-value of .552. This value was not sufficiently large to reject the null hypothesis.

Null Hypothesis 33

Null Hypothesis 33: There was no significant difference between management achievers and nonachievers on the trait qualitative visual, Q(V).

The analysis of variance for this variable revealed a nonsignificant F-value of 1.018. As a result, Null Hypothesis 33 was retained.

Null Hypothesis 34

Null Hypothesis 34: There was no significant difference between management achievers and nonachievers on the trait qualitative auditory, Q(A).

An F-value of .002 was calculated. The F-value was nonsignificant and therefore the null hypothesis was
Summary of the null hypotheses under Research Hypothesis II associated with "The Management Game"

The 26 null hypotheses tested differences in scores on learning style traits between achievers and nonachievers on the "Management Test". These hypotheses indicated no significant difference between the two groups on 25 of the 26 traits. The one trait which indicated a significant difference between the management achievers and nonachievers was "associates", A. Table 5 summarizes the results of the 26 null hypotheses. Figure 5 depicts the mean scores of each of the 26 traits in terms of standardized $Z$ scores.

Tabulation of the predominant orientation and unique predominant orientation of style traits associated with "The Management Game"

Tabulation of the learning style traits exhibited by the management achievers and nonachievers was performed to portray the predominant orientation of each of the traits as defined in the "educational sciences". A frequency count for major, minor, and negligible orientations was made for each of the 26 traits.

A technique used in studies by Zussman (72) and Warner (69), known as Flanagan's upper end of the distribution technique (25, 26), was used to identify predominant orientations associated with each learning style trait. Warner
Table 5. Summary of results testing learning style trait differences between management achievers and non-achievers

<table>
<thead>
<tr>
<th>Null Hypothesis Number</th>
<th>Variable</th>
<th>$F_{(1, 109)}$</th>
<th>Results of Test $H_0$ was:</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>$T(VL)_1$</td>
<td>.228</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>10</td>
<td>$T(AL)$</td>
<td>.171</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>11</td>
<td>$T(VQ)$</td>
<td>.392</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>12</td>
<td>$T(VL)_2$</td>
<td>.584</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>13</td>
<td>$T(AQ)$</td>
<td>.892</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>14</td>
<td>$T(VL)_3$</td>
<td>.183</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>15</td>
<td>$Q(CEM)$</td>
<td>.012</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>16</td>
<td>$Q(CES)$</td>
<td>.033</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>17</td>
<td>$Q(CET)$</td>
<td>.031</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>18</td>
<td>$Q(CH)$</td>
<td>.533</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>19</td>
<td>$Q(CK)$</td>
<td>.014</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>20</td>
<td>$Q(CKH)$</td>
<td>.101</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>21</td>
<td>$Q(CP)$</td>
<td>.230</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>22</td>
<td>$Q(CS)$</td>
<td>1.714</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>23</td>
<td>$Q(CT)$</td>
<td>.769</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>24</td>
<td>I</td>
<td>1.509</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>25</td>
<td>A</td>
<td>5.304*</td>
<td>Rejected</td>
</tr>
<tr>
<td>26</td>
<td>F</td>
<td>.578</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>27</td>
<td>M</td>
<td>.342</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>28</td>
<td>D</td>
<td>.384</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>29</td>
<td>READ</td>
<td>1.881</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>30</td>
<td>L</td>
<td>.575</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>31</td>
<td>(K)</td>
<td>.197</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>32</td>
<td>R</td>
<td>.552</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>33</td>
<td>$Q(V)$</td>
<td>1.018</td>
<td>Not Rejected</td>
</tr>
<tr>
<td>34</td>
<td>$Q(A)$</td>
<td>.002</td>
<td>Not Rejected</td>
</tr>
</tbody>
</table>

* $0.95 F_{1, 109} = 3.93$
Figure 5. Standard scores of means for management achievers and nonachievers on learning style traits
explained the technique as follows:

A predominant element of cognitive style was said to exist when seventy (70) per cent of the members of a particular category demonstrated that particular element. A unique predominant element was said to exist when a predominant element...was found in one, and only one, category (69, pp. 72-73).

The above technique identified the major, minor, or negligible orientation levels for each learning style trait. Predominant and unique predominant orientations were found for both the achievers and nonachievers on "The Management Game". The results of the tabulation are shown in Table 6.

The predominant orientations of the management achievers and nonachievers paralleled one another very closely. The unique predominant orientations associated with the management achievers were major orientations associated with qualitative code histronics, Q(CH), and a minor orientation toward the trait "relationship", R'. The unique predominant orientations of the management nonachievers were major orientations associated with qualitative code kinetics, Q(CK); qualitative code proxemics, Q(CP); qualitative code temporal, Q(CT); and a minor orientation associated with "associates", A'.

The second series of 26 hypotheses under the second research hypothesis were formulated to determine those learning traits for which there were significant differences between achievers and nonachievers associated with "The Beef
Table 6. Predominant orientations of learning style traits for management achievers and nonachievers

<table>
<thead>
<tr>
<th>Style Trait</th>
<th>Management Achievers</th>
<th>Management Nonachievers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Major</td>
<td>Minor</td>
</tr>
<tr>
<td>T(VL)</td>
<td>18^a</td>
<td>3</td>
</tr>
<tr>
<td>T(AL)</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>T(VQ)</td>
<td>21^a</td>
<td>0</td>
</tr>
<tr>
<td>T(AQ)</td>
<td>19^a</td>
<td>2</td>
</tr>
<tr>
<td>Q(CEM)</td>
<td>21^a</td>
<td>0</td>
</tr>
<tr>
<td>Q(CES)</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Q(CET)</td>
<td>20a</td>
<td>1</td>
</tr>
<tr>
<td>Q(CH)</td>
<td>3</td>
<td>16^a</td>
</tr>
<tr>
<td>Q(CK)</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Q(CHK)</td>
<td>17^a</td>
<td>4</td>
</tr>
<tr>
<td>Q(CP)</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Q(CS)</td>
<td>20a</td>
<td>1</td>
</tr>
<tr>
<td>Q(CT)</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>I</td>
<td>18^a</td>
<td>3</td>
</tr>
<tr>
<td>A</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>F</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>M</td>
<td>5</td>
<td>16^a</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>R</td>
<td>6</td>
<td>15^a</td>
</tr>
<tr>
<td>L</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>(K)</td>
<td>4</td>
<td>17^a</td>
</tr>
<tr>
<td>Q(V)</td>
<td>16^a</td>
<td>5</td>
</tr>
<tr>
<td>Q(A)</td>
<td>16^a</td>
<td>3</td>
</tr>
</tbody>
</table>

^a Predominant trait exhibited by 70%(15) of the management achievers

^b Predominant trait exhibited by 70%(63) of the management nonachievers
Breeding Game”.

The analyses of variance tables of differences between beef achievers and nonachievers associated with Null Hypotheses 35 through 60 can be found in Appendix C.

**Null Hypothesis 35**

Null Hypothesis 35: There was no significant difference between beef achievers and nonachievers on scores of verbal analogies, T(VL)

Null Hypothesis 35 was retained due to a nonsignificant F-value of .071 at the .05 level.

**Null Hypothesis 36**

Null Hypothesis 36: There was no significant difference between beef achievers and nonachievers on listening comprehension, T(AL).

An F-value of 2.961 was calculated and determined as nonsignificant. Null Hypothesis 36 was retained because the calculated F-value was not nonsignificant at the .05 level.

**Null Hypothesis 37**

Null Hypothesis 37: There was no significant difference between beef achievers and nonachievers on the trait theoretical visual qualitative, T(VQ).

An F-value of 2.417 was not sufficient to reject the null hypothesis at the .05 level.
Null Hypothesis 38

Null Hypothesis 38: There was no significant difference between beef achievers and nonachievers on reading ability as determined in style trait T(VL)^2.

An F-value of .478 was calculated. The F-value was nonsignificant and therefore the null hypothesis was retained.

Null Hypothesis 39

Null Hypothesis 39: There was no significant difference between beef achievers and nonachievers in oral arithmetic computational ability, T(AQ).

The results of the analysis of variance for this variable revealed a nonsignificant F-value of .862. As a result, Null Hypothesis 39 was retained.

Null Hypothesis 40

Null Hypothesis 40: There was no significant difference between beef achievers and nonachievers on the basic structure of the English language, as measured by style trait T(VL)^3.

An F-value of 1.025 was calculated. The F-value was nonsignificant and therefore the null hypothesis was retained.

Null Hypothesis 41

Null Hypothesis 41: There was no significant difference between beef achievers and nonachievers on the trait qualitative code empathetic, Q(CEM).
Null Hypothesis 41 was retained due to a nonsignificant F-value of .326 at the .05 level.

**Null Hypothesis 42**

Null Hypothesis 42: There was no significant difference between beef achievers and nonachievers on the trait qualitative code esthetics, Q(CES).

An F-value of .003 was calculated and determined as nonsignificant. Null Hypothesis 42 was retained.

**Null Hypothesis 43**

Null Hypothesis 43: There was no significant difference between beef achievers and nonachievers on the trait qualitative code ethic, Q(CET).

An F-value of .165 was not sufficient to reject the null hypothesis at the .05 level.

**Null Hypothesis 44**

Null Hypothesis 44: There was no significant difference between beef achievers and nonachievers on the trait qualitative code histronics, Q(CH).

A nonsignificant F-value of 2.321 was calculated at an alpha level of .05. Null Hypothesis 44 was not rejected.

**Null Hypothesis 45**

Null Hypothesis 45: There was no significant difference between beef achievers and nonachievers on the trait qualit-
tive code kinesics, Q(CK).

An F-value of .000 was calculated on an analysis of variance. The null hypothesis was retained.

Null Hypothesis 46

Null Hypothesis 46: There was no significant difference between beef achievers and nonachievers on the trait qualitative code kinesthetic, Q(CKH).

The analysis of variance produced an F-value of .410. This value was not sufficiently large to reject the null hypothesis at the .05 level.

Null Hypothesis 47

Null Hypothesis 47: There was no significant difference between beef achievers and nonachievers on the trait qualitative code prxemics, Q(CP).

An F-value of 5.424 was calculated which was significant at the .05 level.

In testing the variances for homoscedasticity it was found that the variances were not equal. The test criterion $F = \frac{S_1^2}{S_2^2}$ (59, p. 117) was used and an F-value of 2.44 was calculated. A value of 2.06, at the .05 level, was necessary to reject the hypothesis that the variances of the two groups were equal. This hypothesis was rejected.

In a discussion of the effects of not meeting the underlying assumptions of the analysis of variance Box (13, p.
300) contended that the magnitude of type 1 error was not seriously affected by moderate differences in variances. Box concluded that the test was robust with respect to the assumptions of normality of distributions and homogeneity of variance.

To further test Null Hypothesis 47 a nonparametric Kruskal-Wallis one-way analysis of variance (58, p. 184) was calculated. The formula used was:

\[ H = \frac{12}{N(N+1)} \sum \frac{R_j^2}{n_j} - 3(N+1) \]

where

- \( k \) = number of samples
- \( n_j \) = number of cases in the \( j^{th} \) sample
- \( N = n_j \) the number of cases in all samples combined
- \( R_j \) = sum of ranks in \( j^{th} \) sample

The Kruskal-Wallis test produced a significant \( H \)-value of 5.22. A value of 3.84 was necessary to reject the null hypothesis at the .05 level.

Using two different techniques, a significant value at the .05 level allowed the rejection of Null Hypothesis 47 and the acceptance of the alternative hypothesis. There was a significant difference between beef achievers and nonachievers on the style trait qualitative code proximics,
Null Hypothesis 48

Null Hypothesis 48: There was no significant difference between beef achievers and nonachievers on the trait qualitative code synnoetics, $Q(CS)$. The results of the analysis of variance for this variable revealed a nonsignificant $F$-value of .109. As a result, Null Hypothesis 48 was retained.

Null Hypothesis 49

Null Hypothesis 49: There was no significant difference between beef achievers and nonachievers on the trait qualitative code transactions, $Q(CT)$. An $F$-value of 1.772 was calculated. The $F$ value was nonsignificant and therefore the null hypothesis was retained.

Null Hypothesis 50

Null Hypothesis 50: There was no significant difference between beef achievers and nonachievers on the trait "individuality", $I$. An $F$-value of 5.558 was sufficient to reject the null hypothesis at the .05 level and accept the alternative hypothesis. The beef achievers scored significantly higher on the style test measuring the trait $I$ than did the beef nonachievers.
Null Hypothesis 51

Null Hypothesis 51: There was no significant difference between beef achievers and nonachievers on the trait "associates", A.

Null Hypothesis 51 was not rejected due to a nonsignificant F-value of .295 at the .05 level.

Null Hypothesis 52

Null Hypothesis 52: There was no significant difference between beef achievers and nonachievers on the trait "family", F.

An F-value of 5.424 was calculated for the trait "family". This value was statistically significant at the .05 level. Therefore, Null Hypothesis 52 was rejected and the alternative hypothesis accepted. The beef achievers scored significantly lower on the "family" trait than did the nonachievers.

Null Hypothesis 53

Null Hypothesis 53: There was no significant difference between achievers and nonachievers on the trait "magnitude", M.

A nonsignificant F-value of .297 was calculated. Null Hypothesis 52 was retained.
Null Hypothesis 54

Null Hypothesis 54: There was no significant difference between beef achievers and nonachievers on the trait "difference", D.

An F-value of .029 was calculated on an analysis of variance. Null Hypothesis 54 was retained.

Null Hypothesis 55

Null Hypothesis 55: There was no significant difference between beef achievers and nonachievers on reading level, as measured in the "Style Test".

The analysis of variance, produced an F-value of .116. This was not sufficiently large to reject the null hypothesis.

Null Hypothesis 56

Null Hypothesis 56: There was no significant difference between beef achievers and nonachievers on the trait "appraisal", L.

The results of the analysis of variance for this variable revealed a nonsignificant F-value of 1.389. As a result, the null hypothesis was retained.

Null Hypothesis 57

Null Hypothesis 57: There was no significant difference between scores of beef achievers and nonachievers on the "Style Test", measuring the deductive inferential process, (K).
An F-value of 3.432 was calculated. The F-value was nonsignificant and therefore the null hypothesis was retained.

Null Hypothesis 58

Null Hypothesis 58: There was no significant difference between beef achievers and nonachievers on the trait "relationship", R.

Null Hypothesis 58 was not rejected due to a nonsignificant F-value of .931 at the .05 level.

Null Hypothesis 59

Null Hypothesis 59: There was no significant difference between beef achievers and nonachievers on the trait qualitative visual, Q(V).

An F-value of 2.509 was calculated and determined as nonsignificant. The null hypothesis was retained.

Null Hypothesis 60

Null Hypothesis 60: There was no significant difference between beef achievers and nonachievers on the trait qualitative auditory, Q(A).

An F-value of .004 was calculated which was not sufficient to reject the null hypothesis at the .05 level.
Summary of the null hypotheses under Research Hypothesis II associated with "The Beef Breeding Game"

The 26 null hypotheses associated with achievement on "The Beef Breeding Game" tested differences in scores on learning style traits between achievers and nonachievers on the "Beef Breeding Test". The hypotheses tested indicated no significant difference between the groups on 23 of the 26 traits. Those traits which indicated a significant difference between the beef achievers and nonachievers were qualitative code proxemics, Q(CP), "individuality", I, and "family", F. Table 7 summarizes the results of the 26 null hypotheses. Figure 6 depicts the mean scores of each of the 26 traits in terms of standardized Z scores.

Tabulation of the predominant orientation and unique predominant orientation of style traits associated with "The Beef Breeding Game"

The predominant orientation of each of the cognitive learning style traits exhibited by the beef achievers and nonachievers was tabulated. A frequency count for major, minor, and negligible orientations was made for each of the 26 traits. The results of the tabulation are shown in Table 8.

The unique predominant orientations, those predominant orientations demonstrated by one group and not the other, associated with the beef achievers were major orientations toward qualitative code esthetics, Q(CES), and minor
Table 7. Summary of results testing learning style trait differences between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Null Hypothesis Number</th>
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* $0.95^{F_1, 109} = 3.93$
Figure 6. Standard scores of means for beef achievers and nonachievers on learning style traits
Table 8. Predominant orientations of learning style traits for beef achievers and nonachievers

<table>
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<td>(K)</td>
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<td>18^a</td>
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<tr>
<td>Q(A)</td>
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<td>6</td>
</tr>
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</table>

^aPredominant trait exhibited by 70%(15) of the beef achievers

^bPredominant trait exhibited by 70%(62) of the beef nonachievers
orientations associated with "family", F'; "difference", D';
and "relationship", R'. The unique predominant orientation
of the beef nonachievers was a major orientation toward qual-
itative auditory, Q(A).

Research Hypothesis III

The third research hypothesis was formulated to identify
those cognitive learning style components which were in
common for achievement and nonachievement associated with
both "The Management Game" and "The Beef Breeding Game".

An observational comparison was made between the learn-
ing style traits found statistically significant under the
two phases of the second research hypothesis. There were no
traits found in which there was a significant difference
between achievers and nonachievers for both games. The only
trait in which there was a significant difference between the
achievers and nonachievers on "The Management Game" was the
trait "associates", A. The traits qualitative code proxemics,
Q(CP); "individuality", I; and "family", F; had significant
differences between beef achievers and nonachievers. Based
on these findings, Research Hypothesis III could not be reject-
ed. However, similarity of magnitude and direction was noted
for management achievers and beef achievers versus management
nonachievers and beef nonachievers on scores of many traits
(see Figure 7). The parallelism exhibited warranted further
Figure 7. Standard scores of means for beef and management achievers and nonachievers on learning style traits
The additional investigation led to the formulation of the hypothesis that there would be no significant difference between the mean score of the combined achievers and the mean score of the combined nonachievers. The combined achievers were defined as those subjects which were identified as either management achievers or beef achievers. The combined nonachievers were those subjects which were identified as nonachievers on both games.

The following 26 null hypotheses were formulated to test the above research hypothesis. The analyses of variance tables of the differences between combined achievers and nonachievers associated with Null Hypotheses 61 through 86 can be found in Appendix D.

**Null Hypothesis 61**

Null Hypothesis 61: There was no significant difference between the combined achievers and nonachievers on scores of verbal analogies, $T(VL)$. An $F$-value of 0.276 was calculated for this trait using an analysis of variance. The value was determined as nonsignificant and Null Hypothesis 61 was retained.

**Null Hypothesis 62**

Null Hypothesis 62: There was no significant difference between the combined achievers and nonachievers on listening comprehension, $T(AL)$. 
An F-value of 2.295 was not sufficient to reject the null hypothesis at the .05 level.

**Null Hypothesis 63**

Null Hypothesis 63: There was no significant difference between the combined achievers and nonachievers on the trait theoretical visual quantitative, $T(VQ)$.

An F-value of 2.405 was calculated. The F-value was nonsignificant and therefore the null hypothesis was retained.

**Null Hypothesis 64**

Null Hypothesis 64: There was no significant difference between the combined achievers and nonachievers on reading ability as determined in style trait $T(VL)^2$.

The results of the analysis of variance for this variable revealed a nonsignificant F-value of .000. As a result, Null Hypothesis 64 was retained.

**Null Hypothesis 65**

Null Hypothesis 65: There was no significant difference between the combined achievers and nonachievers in oral arithmetic computational ability, $T(AQ)$.

Null Hypothesis 65 was retained due to a nonsignificant F-value of 1.774 at the .05 level.
Null Hypothesis 66

Null Hypothesis 66: There was no significant difference between the combined achievers and nonachievers on knowledge of the basic structure of the English language, as measured by style trait T(VL)$_3$.

A nonsignificant F-value of .176 was calculated. The null hypothesis was retained.

Null Hypothesis 67

Null Hypothesis 67: There was no significant difference between the combined achievers and nonachievers on the trait qualitative code empathetic, Q(CEM).

An F-value of .236 was calculated on an analysis of variance. Null Hypothesis 67 was retained.

Null Hypothesis 68

Null Hypothesis 68: There was no significant difference between the combined achievers and nonachievers on the trait qualitative code esthetic, Q(CES).

The analysis of variance produced an F-value of .028. This value was not sufficiently large to reject the null hypothesis.

Null Hypothesis 69

Null Hypothesis 69: There was no significant difference between the combined achievers and nonachievers on the trait
qualitative code ethic, Q(CET).

The results of the analysis of variance for this variable revealed a nonsignificant F-value of .177. As a result, Null Hypothesis 69 was retained.

Null Hypothesis 70

Null Hypothesis 70: There was no significant difference between the combined achievers and nonachievers on the trait qualitative code histronics, Q(CH).

An F-value of .322 was calculated. The F-value was nonsignificant and therefore the null hypothesis was retained.

Null Hypothesis 71

Null Hypothesis 71: There was no significant difference between the combined achievers and nonachievers on the trait qualitative code kinesics, Q(CK).

Null Hypothesis 71 was not rejected due to a nonsignificant F-value of .008 at the .05 level.

Null Hypothesis 72

Null Hypothesis 72: There was no significant difference between the combined achievers and nonachievers on the trait qualitative code kinesthetics, Q(CKH).

An F-value of .058 was calculated and determined as nonsignificant. The null hypothesis was retained.
Null Hypothesis 73

Null Hypothesis 73: There was no significant difference between the combined achievers and nonachievers on the trait qualitative code proxemics, Q(CP).

An F-value of 1.682 was not sufficient to reject the null hypothesis at the .05 level.

Null Hypothesis 74

Null Hypothesis 74: There was no significant difference between the combined achievers and nonachievers on the trait qualitative code synnoetics, Q(CS).

A nonsignificant F-value of .454 was calculated. Null Hypothesis 74 was retained.

Null Hypothesis 75

Null Hypothesis 75: There was no significant difference between the combined achievers and nonachievers on the trait qualitative code transactional, Q(CT).

An F-value of .109 was calculated on an analysis of variance. The null hypothesis was retained.

Null Hypothesis 76

Null Hypothesis 76: There was no significant difference between the combined achievers and nonachievers on the trait "individuality", I.

The analysis of variance produced an F-value of 5.755.
This value was sufficiently large to reject the null hypothesis and accept the alternative hypothesis.

The combined management and beef achievers scored significantly higher on the trait "individuality" than the combined management and beef nonachievers.

Null Hypothesis 77

Null Hypothesis 77: There was no significant difference between the combined achievers and nonachievers on the trait "associates", A.

The results of the analysis of variance for this variable revealed a significant F-value of 3.958. As a result, Null Hypothesis 77 was rejected and the alternative hypothesis was accepted.

The combined achievers scored significantly lower on the trait "associates" than the combined nonachievers.

Null Hypothesis 78

Null Hypothesis 78: There was no significant difference between the combined achievers and nonachievers on the trait "family", F.

An F-value of 1.160 was calculated and determined as non-significant. Null Hypothesis 78 was not rejected.
Null Hypothesis 79

Null Hypothesis 79: There was no significant difference between the combined achievers and nonachievers on the trait "magnitude", M.

An F-value of .000 was nonsignificant and the null hypothesis was retained.

Null Hypothesis 80

Null Hypothesis 80: There was no significant difference between the combined achievers and nonachievers on the trait "difference", D.

A nonsignificant F-value of .310 was calculated. The null hypothesis was retained.

Null Hypothesis 81

Null Hypothesis 81: There was no significant difference between the combined achievers and nonachievers on reading level, as measured by the "Style Test".

An F-value of .510 was calculated on an analysis of variance and determined as nonsignificant. Null Hypothesis 81 was retained.

Null Hypothesis 82

Null Hypothesis 82: There was no significant difference between the combined achievers and nonachievers on the trait "appraisal", L.
The analysis of variance produced an F-value of .094. This value was not sufficiently large to reject the null hypothesis at the .05 level.

**Null Hypothesis 83**

Null Hypothesis 83: There was no significant difference between the combined achievers and nonachievers on the deductive inferential process, (K).

An F-value of 2.653 was calculated. The F-value was nonsignificant and therefore the null hypothesis was not rejected.

**Null Hypothesis 84**

Null Hypothesis 84: There was no significant difference between the combined achievers and nonachievers on the trait "relationship", R.

Null Hypothesis 84 was retained due to a nonsignificant F-value of .029 at the .05 level.

**Null Hypothesis 85**

Null Hypothesis 85: There was no significant difference between the combined achievers and nonachievers on the trait qualitative visual, Q(V).

The results of the analysis of variance for this variable revealed a nonsignificant F-value of .171. As a result, Null Hypothesis 85 was retained.
Null Hypothesis 86

Null Hypothesis 86: There was no significant difference between the combined achievers and nonachievers on the trait qualitative auditory, Q(A).

An F-value of .008 was calculated which was not sufficient to reject the null hypothesis at the .05 level.

Summary of results for Research Hypothesis III

An observational comparison of the style traits in which there was a significant difference between the management achievers and nonachievers, and between the beef achievers and nonachievers was made. There were no traits in which there was a significant difference for both groups. Further analysis through the use of 26 analyses of variance indicated there was a significant difference between the combined achievers and nonachiever on scores of two traits. The traits on which the differences appeared were "individuality", I, and "associates", A. Table 9 summarizes the results of the 26 null hypotheses. Figure 8 depicts the standard scores of the means for the combined achievers and nonachievers on the learning style traits.
Table 9. Summary of results testing learning style trait differences between combined achiever groups and combined nonachiever groups

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* $0.95 F_{1, 220} = 3.89$
Figure 8. Standard scores of means for combined achievers and nonachievers on learning style traits
CHAPTER V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this chapter was to summarize the problems which led to this study and present the research procedures undertaken. Discussion of the findings of the study were also presented and conclusions made. Recommendations for further study were given in the final section of this chapter.

Summary

There were three problems investigated in the study. The first problem was to determine if students could learn cognitive concepts and facts by playing two computer simulation games. The second problem was to identify the cognitive learning style associated with successful performance on content mastery tests over the two simulation games. The third problem of the study was to identify the learning style components associated with achievement using computer simulation games. These were determined by identifying common style traits of those who succeeded in two computer simulation games.

The subjects used for the study were 135 undergraduates at Iowa State University during the winter quarter, 1974. The subjects volunteered from two sections of Psychology 333
and one section of Industrial Education 490Z. A control group of 24 and an experimental group of 111 subjects were used.

During the eight weeks of the study, the experimental group played two computer simulation games, "The Management Game" and "The Beef Breeding Game". Each game was preceded and followed by a content mastery examination testing the cognitive knowledge presented in the game. Each content mastery examination was taken by both the experimental and the control groups. The experimental group also took a battery of tests developed by the Institute For Educational Sciences at Bloomfield Hills, Michigan. The tests were used to determine the individual cognitive learning style of each student.

To determine if learning had taken place as a result of playing the computer simulation games, t-tests were used to measure the differences in scores on the content mastery tests between the experimental and control groups. To identify the style traits associated with achievement on the two individual games, it was necessary to determine achiever and nonachievers. Using a chi-square test, 21 management achievers and 22 beef achievers were identified. One-way analyses of variance were used to identify significant differences in scores on each style trait between the achievers and nonachievers for each game. To identify those
traits common to achievement with both computer simulation games, an observational comparison was made between the traits identified as associated with the individual games. One-way analyses of variance were also calculated to test the differences between the combined achievers and non-achievers.

Conclusions

The first problem of the study was to determine if learning could take place by playing two computer simulation games. The results of the study indicated that there was a significant gain on the content mastery tests by those who played the simulation games over those who did not play. Based on these data it was concluded that the students did learn from playing the two computer simulation games.

The conclusion that students learned from playing the computer simulation games in no way implies that students do not learn from other instructional methodologies. Neither does the conclusion suggest that simulation games are either superior or inferior to other educational methodologies in effectively aiding students in acquiring cognitive knowledge. It does, however, add support to the hypothesis that students can learn cognitive facts and concepts with the use of computer simulation games.

The second problem of the study was to determine if any
cognitive learning style elements could be associated with successful and unsuccessful performance on the "Management Test" and the "Beef Breeding Test". The data indicated that the only trait in which there was a significant difference between the management achievers and management non-achievers was on the trait "associates".

The finding that the cultural determinant "associates" was the only cognitive style trait associated with achievement on "The Management Game" may be inconclusive. The content mastery test used to determine the degree of learning which took place and to identify those who were achievers and nonachievers, exhibited questionable reliability. The reliability of the pre-test for the total experimental group was .37 and for the post-test it was calculated as .49. The reliability was calculated at .59 using a separate reliability group prior to administration to the experimental group. This could indicate that the "true achievers" associated with the game may not have been included in the identified achievement group.

As a result of testing the differences in learning style traits between achievers and nonachievers associated with "The Beef Breeding Game", it was concluded that there were differences on three style traits. The beef achievers were higher than the beef nonachievers on the qualitative symbol Q(CP) associated with cultural code proxemics. This implied that
those who succeeded were able to more appropriately judge the social or physical distance between themselves and others around them. This process not only required an accurate assessment and knowledge of oneself but also required the ability to assess others rapidly and accurately as well.

The two remaining traits on which there were differences between beef achievers and nonachievers were located in the cultural determinants set of the "educational sciences". The beef achievers reflected a higher "individuality" influence than did the nonachievers. Tendencies toward the trait "individuality" indicated that the beef achievers relied on themselves in making decisions and solving problems.

The beef achievers were lower than the nonachievers in the "family" cultural determinant. Being independent by nature precluded a major dependence on others. For the beef achievers this was reflected in the lack of dependence shown toward the family rather than toward peers or associates.

The third problem of the study was to identify those traits associated with computer simulation gaming in general. It was concluded that the traits associated with this methodology were in the cultural determinants set used to obtain meaning from theoretical and quantitative symbols. A major portion of those students involved in the study had the theoretical ability to successfully achieve using the computer
simulation games. There were no significant differences in the abilities to interpret visual or auditory inputs to the nervous system. Neither were there differences in abilities to perceive sensory stimuli. There were no appreciable differences on cultural codes, feelings, or commitments between those who succeeded and those who did not succeed using this methodology. The only major determining factor associated with success on computer simulation games found in the study was a high degree of independence.

It was evident that the display of individual independence was necessary when considering the nature of the two games used in the study. Both games used were individualistic in nature rather than group oriented. Each player had to make decisions regarding the company or beef herd he managed. The games required that an individual analyze a situation, determine a strategy, and make judgments all on limited background and knowledge. By definition, simulation games require competition, either intrinsic or extrinsic in nature, and this characteristic was exhibited in the style trait "individuality".

Summary

The following conclusions were drawn from this study:

1. Individuals can learn cognitive concepts and facts using computer simulation games.
2. Individual cognitive learning style traits can be associated with achievement on specific computer simulation games.

3. Those who successfully achieve using computer simulation games demonstrate higher degrees of individuality over those who do not achieve using this educational methodology.

Educators need to be aware of differences within individuals and the affect these differences have on ways in which students seek meaning from their surroundings. Individual differences must be realized and various educational methodologies be available to students to meet instructional objectives. Students should be allowed to select alternative instructional techniques enabling them to capitalize on their unique skills and abilities. In order to develop such educational alternatives, a full understanding of learning style and how it interacts with individual methodologies is paramount.

Recommendations for Further Study

As a result of the study, the following recommendations are made:

1. Continued applied research is needed to fully determine the learning style associated with games, simulation games, and computer simulation games.
Additional games, beyond those used in this study, should be employed.

2. Additional studies need to be conducted using larger, randomly selected, samples.

3. Research on learning style, associated with computer simulation gaming, needs to be conducted at the elementary and secondary educational levels and on a sample with diverse cognitive styles.

4. Studies of the cognitive style associated with success on synergized group simulation games over an extended time span are needed.

5. There is a need to investigate the interactive affect of the variables in learning style on performance using computer simulation games.

6. Cognitive learning styles associated with computer simulation games need to be investigated using various learning style instruments.

7. There is a need to study the influence of simulation games on the affective domain of learning.

8. Research is needed to determine the affect of the administrator's style on the outcomes of simulation games.
LIST OF REFERENCES


ACKNOWLEDGMENTS

The writer would like to express his appreciation to Mr. James Hoekstra for his relentless assistance in analyzing, organizing, and developing the data handling procedure for the computer simulation games. Special gratitude is expressed to Dr. Robert Gelina for his guidance, insight, and criticism in the preparation of this document.

Appreciation is expressed to the members of the writer's graduate committee: Dr. William Wolansky, for his support in serving as major adviser; Drs. Arthur Kleinschmidt, Anton Netusil, and Dwight Bensend, for their guidance throughout the graduate program; and Dr. Rex Thomas for his continued encouragement, concern, and expertise throughout the course of this research study and the graduate program.
APPENDIX A: DEMOGRAPHIC TABLES
Table A-1. Description of sample by age

<table>
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<td>%</td>
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\(^a\)Error due to rounding

Table A-2. Description of sample by classification

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\(^a\)Error due to rounding
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<td><strong>24 100.2</strong></td>
</tr>
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\(^a\) Error due to rounding.
Table A-4. Description of sample by state

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<tr>
<td></td>
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<td>Illinois</td>
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<td>Iowa</td>
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Table A-5. Description of sample by their parents' home location

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<td></td>
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Table A-6. Description of sample by home town population

<table>
<thead>
<tr>
<th>Population Group</th>
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<th>Experimental Group %</th>
<th>Control Group n</th>
<th>Control Group %</th>
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<tr>
<td>100,000 and over</td>
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<td>3</td>
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<td>50,000 - 100,000</td>
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<td>8.3</td>
</tr>
<tr>
<td>25,000 - 50,000</td>
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<td>2</td>
<td>8.3</td>
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<tr>
<td>10,000 - 25,000</td>
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<td>4</td>
<td>16.7</td>
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<tr>
<td>5,000 - 10,000</td>
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<td>9.0</td>
<td>2</td>
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</tr>
<tr>
<td>1,000 - 5,000</td>
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<td>8</td>
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<tr>
<td>0 - 1,000</td>
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<td>3</td>
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</tr>
<tr>
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<td><strong>111</strong></td>
<td><strong>99.9</strong></td>
<td><strong>24</strong></td>
<td><strong>99.9</strong></td>
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*Error due to rounding*

Table A-7. Description of sample by ACT scores

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<th>Control Group n</th>
<th>Control Group %</th>
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<td>0.0</td>
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<td><strong>12.5</strong></td>
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\[ \bar{X} \quad 24.49 \quad 23.43 \]

\[ s \quad 3.54 \quad 3.62 \]
Table A-8. Description of sample by high school rank in percentile

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<td>%</td>
<td>n</td>
<td>%</td>
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<td>10.8</td>
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\(^a\)Error due to rounding
APPENDIX B: ANALYSES OF VARIANCE
TABLES OF DIFFERENCES BETWEEN MANAGEMENT ACHIEVERS AND NONACHIEVERS
### Table B-1. Analysis of variance of differences in $T(VL)$ between management achievers and nonachievers

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<tr>
<th>Source of Variation</th>
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<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
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<td>11.04</td>
<td>.228</td>
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</tr>
<tr>
<td>Total</td>
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<tr>
<th>Management achievers</th>
<th>$\bar{X}$</th>
<th>$S$</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>40.52</td>
<td>6.419</td>
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<tr>
<td>Management nonachievers</td>
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### Table B-2. Analysis of variance of differences in $T(AL)$ between management achievers and nonachievers

<table>
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<th>F</th>
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<table>
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<th>$S$</th>
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</thead>
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<tr>
<td></td>
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### Table B-3. Analysis of variance of differences in $T(VQ)$ between management achievers and nonachievers

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<th>Mean Square</th>
<th>F</th>
</tr>
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<td>8.33</td>
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<th>Management achievers</th>
<th>$\bar{X}$</th>
<th>$S$</th>
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<tr>
<td></td>
<td>32.67</td>
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Table B-4. Analysis of variance of differences in $T(VL)_{2}$
between management achievers and nonachievers

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<tbody>
<tr>
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<td>3909.96</td>
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<td>Management nonachievers</td>
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Table B-5. Analysis of variance of differences in $T(AQ)$
between management achievers and nonachievers

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<tr>
<td>Management nonachievers</td>
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Table B-6. Analysis of variance of differences in $T(VL)_{3}$
between management achievers and nonachievers

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<td>6.73</td>
<td>6.73</td>
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<td>Management nonachievers</td>
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Table B-7. Analysis of variance of differences in \(Q(CEM)\) between management achievers and nonachievers

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<td>.05</td>
<td>.012</td>
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<tr>
<td>Error</td>
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<td>Management achievers</td>
<td>20.86</td>
<td>1.320</td>
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<td>Management nonachievers</td>
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Table B-8. Analysis of variance of differences in \(Q(CES)\) between management achievers and nonachievers

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<td>.63</td>
<td>.033</td>
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<td>19.07</td>
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<td>Management achievers</td>
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<td>Management nonachievers</td>
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Table B-9. Analysis of variance of differences in \(Q(CET)\) between management achievers and nonachievers

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<td>.16</td>
<td>.16</td>
<td>.031</td>
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<tr>
<td>Error</td>
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<td>5.35</td>
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<td>Total</td>
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<td>583.86</td>
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<td>Management achievers</td>
<td>18.81</td>
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Table B-10. Analysis of variance of differences in $Q(CH)$ between management achievers and nonachievers

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<td>7.39</td>
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<td>13.86</td>
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<tr>
<td>Management nonachievers</td>
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Table B-11. Analysis of variance of differences in $Q(CK)$ between management achievers and nonachievers

<table>
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<td>.14</td>
<td>.014</td>
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<td>Management achievers</td>
<td>16.48</td>
<td>3.126</td>
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Table B-12. Analysis of variance of differences in $Q(CKH)$ between management achievers and nonachievers

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<th>F</th>
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<td>1.45</td>
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<td>3.015</td>
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<tr>
<td>Management nonachievers</td>
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Table B-13. Analysis of variance of differences in \( Q(CP) \) between management achievers and nonachievers

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<td>2.33</td>
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<td>1107.00</td>
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<table>
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Table B-14. Analysis of variance of differences in \( Q(CS) \) between management achievers and nonachievers

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<td>12.98</td>
<td>12.98</td>
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<tr>
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<td>110</td>
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<td></td>
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<thead>
<tr>
<th></th>
<th>( \bar{X} )</th>
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<tbody>
<tr>
<td>Management achievers</td>
<td>18.57</td>
<td>2.321</td>
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<tr>
<td>Management nonachievers</td>
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Table B-15. Analysis of variance of differences in \( Q(CT) \) between management achievers and nonachievers

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<th>F</th>
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<td>6.43</td>
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<td>109</td>
<td>911.15</td>
<td>8.36</td>
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</tr>
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<td>Management achievers</td>
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<td>Management nonachievers</td>
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Table B-16. Analysis of variance of differences in I between management achievers and nonachievers

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<th>F</th>
</tr>
</thead>
<tbody>
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<td>11.78</td>
<td>1.059</td>
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<td>1212.08</td>
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<td>Total</td>
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</tr>
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<tr>
<td>Management achievers</td>
<td>24.48</td>
<td>3.960</td>
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<tr>
<td>Management nonachievers</td>
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Table B-17. Analysis of variance of differences in A between management achievers and nonachievers

<table>
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<th>F</th>
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<td>31.80</td>
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<td>Total</td>
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<tr>
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<td>Management nonachievers</td>
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<td>2.364</td>
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</table>

* .95 F1, 109 = 3.93

Table B-18. Analysis of variance of differences in F between management achievers and nonachievers

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<th>F</th>
</tr>
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<td>8.08</td>
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<td>Total</td>
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<td>885.93</td>
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<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management achievers</td>
<td>20.19</td>
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<tr>
<td>Management nonachievers</td>
<td>19.67</td>
<td>2.856</td>
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Table B-19. Analysis of variance of differences in M between management achievers and nonachievers

<table>
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<th>F</th>
</tr>
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<td>15.00</td>
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<td>43.42</td>
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<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>31.90</td>
<td>6.309</td>
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<tr>
<td>Management nonachievers</td>
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<td>6.626</td>
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Table B-20. Analysis of variance of differences in D between management achievers and nonachievers

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<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
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<td>18.95</td>
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</tr>
<tr>
<td>Error</td>
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<td>5375.88</td>
<td>49.32</td>
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<td>Total</td>
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<td>5394.83</td>
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</table>

<table>
<thead>
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<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>29.19</td>
<td>5.877</td>
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<tr>
<td>Management nonachievers</td>
<td>30.24</td>
<td>7.188</td>
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Table B-21. Analysis of variance of differences in R between management achievers and nonachievers

<table>
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<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
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<td>1.881</td>
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<td>Error</td>
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<td>6204.28</td>
<td>56.92</td>
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<td>Total</td>
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<td>6311.28</td>
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<table>
<thead>
<tr>
<th>Management achievers</th>
<th>X</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>31.62</td>
<td>6.214</td>
</tr>
<tr>
<td>Management nonachievers</td>
<td>29.11</td>
<td>7.741</td>
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</tbody>
</table>
Table B-22. Analysis of variance of differences in L between management achievers and nonachievers

<table>
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<th>F</th>
</tr>
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<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>43.94</td>
<td>43.94</td>
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<td>8327.60</td>
<td>76.40</td>
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<td>Total</td>
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<td>8371.54</td>
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<td></td>
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<table>
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<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.24</td>
<td>6.996</td>
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<td>9.006</td>
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Table B-23. Analysis of variance of differences in (K) between management achievers and nonachievers

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<th>Mean Square</th>
<th>F</th>
</tr>
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<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>.36</td>
<td>.36</td>
<td>.197</td>
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<tr>
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<td>109</td>
<td>201.10</td>
<td>1.84</td>
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<td>201.46</td>
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<table>
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</tr>
</thead>
<tbody>
<tr>
<td>1.81</td>
<td>.906</td>
</tr>
<tr>
<td>1.96</td>
<td>1.429</td>
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Table B-24. Analysis of variance of differences in reading level between management achievers and nonachievers

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<th>Mean Square</th>
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</tr>
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<tr>
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<td>1</td>
<td>2.36</td>
<td>2.36</td>
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</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>466.08</td>
<td>4.28</td>
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<td>468.44</td>
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<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>10.20</td>
<td>2.055</td>
</tr>
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<td>9.83</td>
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</table>
Table B-25. Analysis of variance of differences in $Q(V)$ between management achievers and nonachievers

<table>
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<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
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<tr>
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<td>35.88</td>
<td>35.88</td>
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<td>109</td>
<td>3840.07</td>
<td>35.23</td>
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<td>3875.95</td>
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<table>
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<th>$S$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management achievers</td>
<td>28.90</td>
<td>5.371</td>
</tr>
<tr>
<td>Management nonachievers</td>
<td>30.36</td>
<td>5.995</td>
</tr>
</tbody>
</table>

Table B-26. Analysis of variance of differences in $Q(A)$ between management achievers and nonachievers

<table>
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<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
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<td>.09</td>
<td>.09</td>
<td>.002</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>5501.50</td>
<td>50.47</td>
<td></td>
</tr>
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<td>Total</td>
<td>110</td>
<td>5501.59</td>
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<table>
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<th>$S$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management achievers</td>
<td>13.90</td>
<td>6.531</td>
</tr>
<tr>
<td>Management nonachievers</td>
<td>13.98</td>
<td>7.154</td>
</tr>
</tbody>
</table>
APPENDIX C: ANALYSES OF VARIANCE

TABLES OF DIFFERENCES BETWEEN BEEF

ACHIEVERS AND NONACHIEVERS
### Table C-1. Analysis of variance of differences in $T(VL)_{1}$ between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
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<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
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<td>3.44</td>
<td>3.44</td>
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</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>5285.41</td>
<td>48.49</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>5288.85</td>
<td></td>
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<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Beef achievers</td>
<td>40.27</td>
<td>5.634</td>
</tr>
<tr>
<td>Beef nonachievers</td>
<td>39.83</td>
<td>7.179</td>
</tr>
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### Table C-2. Analysis of variance of differences in $T(AL)$ between beef achievers and nonachievers

<table>
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<th>F</th>
</tr>
</thead>
<tbody>
<tr>
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<td>5.36</td>
<td>2.961</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>197.18</td>
<td>1.81</td>
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</tr>
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<td>Total</td>
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<td>202.54</td>
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<table>
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</tr>
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<tbody>
<tr>
<td>Beef achievers</td>
<td>5.95</td>
<td>1.331</td>
</tr>
<tr>
<td>Beef nonachievers</td>
<td>6.51</td>
<td>1.333</td>
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### Table C-3. Analysis of variance of differences in $T(VQ)$ between beef achievers and nonachievers

<table>
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<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>50.42</td>
<td>50.42</td>
<td>2.417</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>2273.74</td>
<td>20.86</td>
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<td>Total</td>
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<table>
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<tr>
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<th>$\bar{X}$</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef achievers</td>
<td>33.45</td>
<td>3.870</td>
</tr>
<tr>
<td>Beef nonachievers</td>
<td>31.76</td>
<td>4.674</td>
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Table C-4. Analysis of variance of differences in $T(VL)_2$ between beef achievers and nonachievers

<table>
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<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>17.08</td>
<td>17.08</td>
<td>.478</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>3892.59</td>
<td>35.71</td>
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<td>3909.67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th></th>
<th>$\bar{X}$</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef achievers</td>
<td>23.41</td>
<td>5.867</td>
</tr>
<tr>
<td>Beef nonachievers</td>
<td>24.39</td>
<td>5.935</td>
</tr>
</tbody>
</table>

Table C-5. Analysis of variance of differences in $T(AQ)$ between beef achievers and nonachievers

<table>
<thead>
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<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Error</td>
<td>109</td>
<td>126.00</td>
<td>1.56</td>
<td></td>
</tr>
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<td>Total</td>
<td>110</td>
<td>127.00</td>
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<table>
<thead>
<tr>
<th></th>
<th>$\bar{X}$</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef achievers</td>
<td>8.82</td>
<td>1.230</td>
</tr>
<tr>
<td>Beef nonachievers</td>
<td>9.06</td>
<td>1.021</td>
</tr>
</tbody>
</table>

Table C-6. Analysis of variance of differences in $T(VL)_3$ between beef achievers and nonachievers

<table>
<thead>
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<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
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<td>37.45</td>
<td>37.45</td>
<td>1.025</td>
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<td>109</td>
<td>3983.95</td>
<td>36.55</td>
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<tr>
<td>Total</td>
<td>110</td>
<td>4021.40</td>
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<table>
<thead>
<tr>
<th></th>
<th>$\bar{X}$</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef achievers</td>
<td>34.27</td>
<td>6.743</td>
</tr>
<tr>
<td>Beef nonachievers</td>
<td>35.73</td>
<td>5.790</td>
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</tbody>
</table>
Table C-7. Analysis of variance of differences in $Q(CEM)$ between beef achievers and nonachievers

<table>
<thead>
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<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
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<td>1.32</td>
<td>1.32</td>
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</tr>
<tr>
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<td>109</td>
<td>440.58</td>
<td>4.04</td>
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<tr>
<td>Total</td>
<td>110</td>
<td>441.90</td>
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</tr>
</tbody>
</table>

$\bar{X}$  $S$

Beef achievers  20.68  2.343
Beef nonachievers  20.96  1.896

Table C-8. Analysis of variance of differences in $Q(CES)$ between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>.06</td>
<td>.06</td>
<td>.003</td>
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<td>Error</td>
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<td>2079.72</td>
<td>19.08</td>
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<td>Total</td>
<td>110</td>
<td>2079.78</td>
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</tbody>
</table>

$\bar{X}$  $S$

Beef achievers  15.73  4.002
Beef nonachievers  15.79  4.405

Table C-9. Analysis of variance of differences in $Q(CET)$ between beef achievers and nonachievers

<table>
<thead>
<tr>
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<th>d.f.</th>
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<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
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<td>.88</td>
<td>.165</td>
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<tr>
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<td>583.04</td>
<td>5.35</td>
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<td>Total</td>
<td>110</td>
<td>583.92</td>
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</tbody>
</table>

$\bar{X}$  $S$

Beef achievers  18.91  2.466
Beef nonachievers  18.68  2.247
Table C-10. Analysis of variance of differences in Q(CH) between beef achievers and nonachievers

<table>
<thead>
<tr>
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<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
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<tr>
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<td>31.66</td>
<td>31.66</td>
<td>2.321</td>
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<td>Error</td>
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<td>1486.76</td>
<td>13.64</td>
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<td>1518.42</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>( \bar{X} )</th>
<th>( S )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef achievers</td>
<td>13.23</td>
<td>2.762</td>
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<tr>
<td>Beef nonachievers</td>
<td>11.89</td>
<td>3.850</td>
</tr>
</tbody>
</table>

Table C-11. Analysis of variance of differences in Q(CK) between beef achievers and nonachievers

<table>
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<th>Source of Variation</th>
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<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
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<tr>
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<td>.00</td>
<td>.000</td>
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<tr>
<td>Error</td>
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<td>9.85</td>
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<td>1073.43</td>
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</tr>
</tbody>
</table>

<table>
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<th>( S )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef achievers</td>
<td>16.54</td>
<td>2.742</td>
</tr>
<tr>
<td>Beef nonachievers</td>
<td>16.55</td>
<td>3.194</td>
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</tbody>
</table>

Table C-12. Analysis of variance of differences in Q(CKH) between beef achievers and nonachievers

<table>
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<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>5.86</td>
<td>5.86</td>
<td>.410</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>1559.79</td>
<td>14.31</td>
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</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>1565.65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>( \bar{X} )</th>
<th>( S )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef achievers</td>
<td>18.32</td>
<td>3.211</td>
</tr>
<tr>
<td>Beef nonachievers</td>
<td>17.74</td>
<td>3.870</td>
</tr>
</tbody>
</table>
Table C-13. Analysis of variance of differences in Q(CP) between beef achievers and nonachievers

<table>
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<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
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<td>52.56</td>
<td>52.56</td>
<td>5.424*</td>
</tr>
<tr>
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<td>109</td>
<td>1056.43</td>
<td>9.69</td>
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</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>1108.99</td>
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<td></td>
</tr>
</tbody>
</table>

\[ \bar{X} \quad S \]

Beef achievers 18.64 2.101
Beef nonachievers 16.91 3.283

* .95^F1, 109 = 3.93

Table C-14. Analysis of variance of differences in Q(CS) between beef achievers and nonachievers

<table>
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<th>F</th>
</tr>
</thead>
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<tr>
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<td>.84</td>
<td>.84</td>
<td>.109</td>
</tr>
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<tr>
<td>Total</td>
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<td>838.40</td>
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<td></td>
</tr>
</tbody>
</table>

\[ \bar{X} \quad S \]

Beef achievers 19.45 2.189
Beef nonachievers 19.24 2.868

Table C-15. Analysis of variance of differences in Q(CT) between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>14.68</td>
<td>14.68</td>
<td>1.772</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>902.85</td>
<td>8.28</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>917.53</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \bar{X} \quad S \]

Beef achievers 17.18 2.823
Beef nonachievers 16.27 2.859
Table C-16. Analysis of variance of differences in I between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>59.36</td>
<td>59.36</td>
<td>5.558*</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>1164.12</td>
<td>10.68</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>1223.48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \bar{X} \quad S \]

Beef achievers  
25.27  
2.700

Beef nonachievers  
23.44  
3.359

\[ .95_{1, 109}^F = 3.93 \]

Table C-17. Analysis of variance of differences in A between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>1.85</td>
<td>1.85</td>
<td>.295</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>683.54</td>
<td>6.27</td>
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</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>685.39</td>
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<td></td>
</tr>
</tbody>
</table>

\[ \bar{X} \quad S \]

Beef achievers  
16.18  
1.800

Beef nonachievers  
16.51  
2.623

Table C-18. Analysis of variance of differences in F between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>40.86</td>
<td>40.86</td>
<td>5.270*</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>845.07</td>
<td>7.75</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>885.93</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \bar{X} \quad S \]

Beef achievers  
18.55  
2.536

Beef nonachievers  
20.07  
2.812

\[ .95_{1, 109}^F = 3.93 \]
Table C-19. Analysis of variance of differences in M between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>13.04</td>
<td>13.04</td>
<td>.297</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>4788.50</td>
<td>43.93</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>4801.54</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\bar{X} \quad S
\]

Beef achievers
Beef nonachievers

30.45 \quad 5.805
31.31 \quad 6.743

Table C-20. Analysis of variance of differences in D between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>1.41</td>
<td>1.41</td>
<td>.029</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>5393.32</td>
<td>49.48</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>5394.73</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\bar{X} \quad S
\]

Beef achievers
Beef nonachievers

29.82 \quad 5.357
30.10 \quad 7.315

Table C-21. Analysis of variance of differences in R between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>6.68</td>
<td>6.68</td>
<td>1.398</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>6304.56</td>
<td>57.84</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>6311.24</td>
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<td></td>
</tr>
</tbody>
</table>

\[
\bar{X} \quad S
\]

Beef achievers
Beef nonachievers

29.09 \quad 6.775
29.71 \quad 7.713
Table C-22. Analysis of variance of differences in L between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>105.40</td>
<td>105.40</td>
<td>1.389</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>8266.56</td>
<td>75.84</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>8371.96</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef achievers</td>
<td>40.50</td>
<td>8.139</td>
</tr>
<tr>
<td>Beef nonachievers</td>
<td>38.06</td>
<td>8.747</td>
</tr>
</tbody>
</table>

Table C-23. Analysis of variance of differences in (K) between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>6.15</td>
<td>6.15</td>
<td>3.432</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>195.33</td>
<td>1.79</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>201.48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef achievers</td>
<td>1.45</td>
<td>1.233</td>
</tr>
<tr>
<td>Beef nonachievers</td>
<td>2.04</td>
<td>1.348</td>
</tr>
</tbody>
</table>

Table C-24. Analysis of variance of differences in reading level between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>3.97</td>
<td>3.97</td>
<td>.931</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>464.45</td>
<td>4.26</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>468.42</td>
<td></td>
<td></td>
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<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef achievers</td>
<td>9.52</td>
<td>2.012</td>
</tr>
<tr>
<td>Beef nonachievers</td>
<td>9.99</td>
<td>2.054</td>
</tr>
</tbody>
</table>
Table C-25. Analysis of variance of differences in $Q(V)$ between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>87.22</td>
<td>87.22</td>
<td>2.509</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>3788.84</td>
<td>34.76</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>3876.06</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef achievers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef nonachievers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table C-26. Analysis of variance of differences in $Q(A)$ between beef achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>.18</td>
<td>.18</td>
<td>.004</td>
</tr>
<tr>
<td>Error</td>
<td>109</td>
<td>5501.50</td>
<td>50.47</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>5501.68</td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef achievers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef nonachievers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

X | S
---|---
Beef achievers | 31.86 | 4.224
Beef nonachievers | 29.64 | 6.178
Table D-1. Analysis of variance of differences in $T(VL)$ between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>13.25</td>
<td>13.25</td>
<td>.276</td>
</tr>
<tr>
<td>Error</td>
<td>220</td>
<td>10564.40</td>
<td>48.02</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>10577.65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Combined achievers 40.42 6.032
Combined nonachievers 39.80 7.090

Table D-2. Analysis of variance of differences in $T(AL)$ between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>4.18</td>
<td>4.18</td>
<td>2.295</td>
</tr>
<tr>
<td>Error</td>
<td>220</td>
<td>400.84</td>
<td>1.82</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>405.02</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Combined achievers 6.12 1.333
Combined nonachievers 6.46 1.346

Table D-3. Analysis of variance of differences in $T(VQ)$ between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>50.27</td>
<td>50.27</td>
<td>2.405</td>
</tr>
<tr>
<td>Error</td>
<td>220</td>
<td>.4598.00</td>
<td>20.90</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>4648.27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Combined achievers 33.07 4.342
Combined nonachievers 31.87 4.599
Table D-4. Analysis of variance of differences in $T(VL)$ between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>.01</td>
<td>.01</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>220</td>
<td>7818.80</td>
<td>35.54</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>7818.81</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined achievers</td>
<td>24.23</td>
<td>5.980</td>
</tr>
<tr>
<td>Combined nonachievers</td>
<td>24.19</td>
<td>5.924</td>
</tr>
</tbody>
</table>

Table D-5. Analysis of variance of differences in $T(AQ)$ between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>2.03</td>
<td>2.03</td>
<td>1.774</td>
</tr>
<tr>
<td>Error</td>
<td>220</td>
<td>251.90</td>
<td>1.14</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>253.93</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined achievers</td>
<td>8.81</td>
<td>1.126</td>
</tr>
<tr>
<td>Combined nonachievers</td>
<td>9.06</td>
<td>1.050</td>
</tr>
</tbody>
</table>

Table D-6. Analysis of variance of differences in $T(VL)$ between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>6.43</td>
<td>6.43</td>
<td>.176</td>
</tr>
<tr>
<td>Error</td>
<td>220</td>
<td>8036.60</td>
<td>36.53</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>8043.03</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined achievers</td>
<td>35.09</td>
<td>5.438</td>
</tr>
<tr>
<td>Combined nonachievers</td>
<td>35.53</td>
<td>6.147</td>
</tr>
</tbody>
</table>
Table D-7. Analysis of variance of differences in \( Q(CEM) \) between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>.95</td>
<td>.95</td>
<td>.236</td>
</tr>
<tr>
<td>Error</td>
<td>220</td>
<td>882.86</td>
<td>4.01</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>883.81</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \bar{X} \]  \( S \)

| Combined achievers  | 20.77 | 1.915 |
| Combined nonachievers | 20.93 | 2.013 |

Table D-8. Analysis of variance of differences in \( Q(CES) \) between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>.54</td>
<td>.54</td>
<td>.028</td>
</tr>
<tr>
<td>Error</td>
<td>220</td>
<td>4158.00</td>
<td>18.90</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>4158.54</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \bar{X} \]  \( S \)

| Combined achievers  | 15.67 | 3.777 |
| Combined nonachievers | 15.80 | 4.450 |

Table D-9. Analysis of variance of differences in \( Q(CET) \) between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>.94</td>
<td>.94</td>
<td>.177</td>
</tr>
<tr>
<td>Error</td>
<td>220</td>
<td>1166.88</td>
<td>5.30</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>1167.82</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \bar{X} \]  \( S \)

| Combined achievers  | 18.86 | 2.184 |
| Combined nonachievers | 18.70 | 2.318 |
Table D-10. Analysis of variance of differences in Q(CH) between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>4.44</td>
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<td>Error</td>
<td>220</td>
<td>3031.60</td>
<td>13.78</td>
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<tr>
<td>Total</td>
<td>221</td>
<td>3036.04</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\bar{X} \quad S
\]

Combined achievers 12.44 3.098
Combined nonachievers 12.08 3.826

Table D-11. Analysis of variance of differences in Q(CK) between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
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<td>.07</td>
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<td>220</td>
<td>2146.98</td>
<td>9.17</td>
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<td>Total</td>
<td>221</td>
<td>2147.05</td>
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<td></td>
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</tbody>
</table>

\[
\bar{X} \quad S
\]

Combined achievers 16.51 2.936
Combined nonachievers 16.56 3.150

Table D-12. Analysis of variance of differences in Q(CKH) between combined achievers and nonachievers

<table>
<thead>
<tr>
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<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
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<tr>
<td>Between groups</td>
<td>1</td>
<td>.82</td>
<td>.82</td>
<td>.058</td>
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<tr>
<td>Error</td>
<td>220</td>
<td>3130.60</td>
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<td>Total</td>
<td>221</td>
<td>3131.42</td>
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</table>

\[
\bar{X} \quad S
\]

Combined achievers 17.98 3.136
Combined nonachievers 17.83 3.889
Table D-13. Analysis of variance of differences in $Q(CP)$ between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
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<td>16.82</td>
<td>16.82</td>
<td>1.682</td>
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<tr>
<td>Error</td>
<td>220</td>
<td>2201.00</td>
<td>10.00</td>
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</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>2217.82</td>
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<table>
<thead>
<tr>
<th>Combined achievers</th>
<th>Combined nonachievers</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bar{X}$</td>
<td>17.81</td>
</tr>
<tr>
<td>$S$</td>
<td>2.983</td>
</tr>
<tr>
<td>17.12</td>
<td>3.187</td>
</tr>
</tbody>
</table>

Table D-14. Analysis of variance of differences in $Q(CS)$ between combined achievers and nonachievers

<table>
<thead>
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<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1</td>
<td>3.46</td>
<td>3.46</td>
<td>.454</td>
</tr>
<tr>
<td>Error</td>
<td>220</td>
<td>1673.32</td>
<td>7.61</td>
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<td>Total</td>
<td>221</td>
<td>1676.78</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Combined achievers</th>
<th>Combined nonachievers</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bar{X}$</td>
<td>19.02</td>
</tr>
<tr>
<td>$S$</td>
<td>2.298</td>
</tr>
<tr>
<td>19.34</td>
<td>2.842</td>
</tr>
</tbody>
</table>

Table D-15. Analysis of variance of differences in $Q(CT)$ between combined achievers and nonachievers

<table>
<thead>
<tr>
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<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>.91</td>
<td>.91</td>
<td>.109</td>
</tr>
<tr>
<td>Error</td>
<td>220</td>
<td>1834.41</td>
<td>8.34</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>1835.05</td>
<td></td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Combined achievers</th>
<th>Combined nonachievers</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bar{X}$</td>
<td>16.58</td>
</tr>
<tr>
<td>$S$</td>
<td>2.998</td>
</tr>
<tr>
<td>16.42</td>
<td>2.844</td>
</tr>
</tbody>
</table>
### Table D-16. Analysis of variance of differences in I between combined achievers and nonachievers

<table>
<thead>
<tr>
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<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>62.39</td>
<td>62.39</td>
<td>5.755*</td>
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<tr>
<td>Error</td>
<td>220</td>
<td>2384.80</td>
<td>10.84</td>
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</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>2447.19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\bar{X}, \quad S
\]

Combined achievers : 24.88, 3.398
Combined nonachievers : 23.54, 2.248

\[^{*}.95^{F_1}, 220 = 3.89\]

### Table D-17. Analysis of variance of differences in A between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>24.23</td>
<td>24.23</td>
<td>3.958*</td>
</tr>
<tr>
<td>Error</td>
<td>220</td>
<td>1346.62</td>
<td>6.12</td>
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<td>Total</td>
<td>221</td>
<td>1370.85</td>
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<td></td>
</tr>
</tbody>
</table>

\[
\bar{X}, \quad S
\]

Combined achievers : 15.77, 2.311
Combined nonachievers : 16.60, 2.498

\[^{*}.95^{F_1}, 220 = 3.89\]

### Table D-18. Analysis of variance of differences in F between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>9.29</td>
<td>9.29</td>
<td>1.160</td>
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<tr>
<td>Error</td>
<td>220</td>
<td>1762.64</td>
<td>8.01</td>
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<tr>
<td>Total</td>
<td>221</td>
<td>1771.93</td>
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<td></td>
</tr>
</tbody>
</table>

\[
\bar{X}, \quad S
\]

Combined achievers : 19.35, 2.819
Combined nonachievers : 19.87, 2.817
Table D-19. Analysis of variance of differences in M between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
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<tr>
<td>Between groups</td>
<td>1</td>
<td>.01</td>
<td>.01</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>220</td>
<td>9603.00</td>
<td>43.65</td>
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</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>9603.01</td>
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</tr>
</tbody>
</table>

\[
\bar{X} \quad S
\]

Combined achievers 31.16 6.100
Combined nonachievers 31.14 6.687

Table D-20. Analysis of variance of differences in D between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>15.19</td>
<td>15.19</td>
<td>.310</td>
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<td>220</td>
<td>10773.40</td>
<td>48.97</td>
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<td>Total</td>
<td>221</td>
<td>10778.59</td>
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</tbody>
</table>

\[
\bar{X} \quad S
\]

Combined achievers 29.51 5.625
Combined nonachievers 30.17 7.252

Table D-21. Analysis of variance of differences in R between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>29.18</td>
<td>29.18</td>
<td>.510</td>
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<td>Error</td>
<td>220</td>
<td>12592.80</td>
<td>57.24</td>
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<tr>
<td>Total</td>
<td>221</td>
<td>12521.98</td>
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</tbody>
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\[
\bar{X} \quad S
\]

Combined achievers 30.33 6.629
Combined nonachievers 29.41 7.733
Table D-22. Analysis of variance of differences in \( L \) between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
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<td>7.12</td>
<td>7.12</td>
<td>.094</td>
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<td>Error</td>
<td>220</td>
<td>16735.40</td>
<td>76.07</td>
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<tr>
<td>Total</td>
<td>221</td>
<td>16742.52</td>
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<td></td>
</tr>
</tbody>
</table>

\[ \overline{X} \quad S \]

\[ \text{Combined achievers} \quad 38.91 \quad 7.775 \]
\[ \text{Combined nonachievers} \quad 38.45 \quad 8.887 \]

Table D-23. Analysis of variance of differences in \((K)\) between combined achievers and nonachievers

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f.</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
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<tbody>
<tr>
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<td>4.80</td>
<td>4.80</td>
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<td>220</td>
<td>397.98</td>
<td>1.81</td>
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<tr>
<td>Total</td>
<td>221</td>
<td>402.78</td>
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</table>

\[ \overline{X} \quad S \]

\[ \text{Combined achievers} \quad 1.63 \quad 1.100 \]
\[ \text{Combined nonachievers} \quad 2.00 \quad 1.390 \]

Table D-24. Analysis of variance of differences in reading level between combined achievers and non­-achievers

<table>
<thead>
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<th>Source of Variation</th>
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<th>Mean Square</th>
<th>F</th>
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<tbody>
<tr>
<td>Between groups</td>
<td>1</td>
<td>12.25</td>
<td>12.25</td>
<td>.029</td>
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<tr>
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<td>220</td>
<td>93670.00</td>
<td>425.80</td>
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<tr>
<td>Total</td>
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\[ \overline{X} \quad S \]

\[ \text{Combined achievers} \quad 9.85 \quad 2.06 \]
\[ \text{Combined nonachievers} \quad 9.91 \quad 2.05 \]
Table D-25. Analysis of variance of differences in Q(V) between combined achievers and nonachievers

<table>
<thead>
<tr>
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<th>Mean Square</th>
<th>F</th>
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<tr>
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<td>6.04</td>
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<td>7746.20</td>
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<td></td>
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<tr>
<td>Combined achievers</td>
<td>30.42</td>
<td>5.04</td>
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</tr>
<tr>
<td>Combined nonachievers</td>
<td>30.00</td>
<td>6.10</td>
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Table D-26. Analysis of variance of differences in Q(A) between combined achievers and nonachievers

<table>
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<th>Mean Square</th>
<th>F</th>
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</thead>
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<td>.01</td>
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<td>Error</td>
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<td>11004.40</td>
<td>50.02</td>
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<td>Total</td>
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<td>11004.41</td>
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<table>
<thead>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined achievers</td>
<td>13.98</td>
<td>7.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined nonachievers</td>
<td>13.96</td>
<td>7.00</td>
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APPENDIX E: "THE MANAGEMENT GAME" HANDOUT
THE MANAGEMENT GAME

THE MANAGEMENT GAME is modeled after the business strategy game constructed by Richard Bellman, Franco Ricciordi and others, for the American Management Association. Since the game's origin, a number of innovations have been added by IBM and the staff at Iowa State University and others.

The operation of five firms manufacturing similar low profit products in a highly competitive industry is simulated. The object of the game is to try and maximize profits over the time of game play.

The rules for participating in the exercise are relatively simple: five individuals are each given a firm to operate. This is an industry in which all firms produce a product which is an imperfect substitute for the other. The individuals make decisions for the firms which they control, by choosing output levels, price, advertising expenditures, etc. The decisions chosen by all five firms are fed into a computer processing system, which translates these decisions into results for each person. The results, in the form of financial position, as well as certain other data, are transmitted to the individuals, which then repeat the decision making process. This continues for 9 fiscal quarters, or a little over two simulated years.

In order to participate in this game, it is not required that you have familiarity with the mathematical model. The peculiarities of the game will be easily understood after one or two periods of participation. You should approach the decision problems posed by the game in the same manner in which you approach business problems of everyday life. Choose an objective, a strategy to obtain that objective, and be flexible enough to reverse yourself if it appears that you are heading for trouble.
The basic decision problem involved in this game is that of deciding on courses of action with only a vague knowledge of the outcome of such actions. The results of decisions made for your firm depend not only on these decisions alone, but also on decisions being made by your competitors, about which you can only speculate. Thus, an "unwise" decision might occur because of an opponent's unpredictable action, rather than the unreasonableness of the decision itself. For example, a cut in price will increase your share of the market — but only if your competitors are not cutting prices at the same time.

At the beginning of the exercise, each of you are presented with a statement which includes the following information:

1. The annual statements of all companies.

2. The financial position of the company that you control, showing the amount of cash, the number of units held in inventory, the value of each unit and the total value of inventory, the gross value of plant and equipment, the depreciation reserve, the capacity of plant and equipment, the value of each unit of capacity, the net value of plant and equipment, the amount of loans outstanding, and the total assets less liabilities.

3. The results of operation for the previous period of the company you control, showing number of units sold, price charged per unit, total revenue, cost of goods sold, marketing expenditures, research expenditures, market research expenditures, inventory carrying costs, interest costs for the previous period, income before taxes, taxes and profit after taxes, dividends paid, and profit retained in business.

4. A decision worksheet showing a summary of funds available for the next quarter (cash plus depreciation plus line of credit available less loans outstanding), together with a form for entering planned expenditures.

5. Market information listing the prices charged by all companies in the previous period, the stock price of each company, the total industry market (in units) in the previous period, the share of market for the company the team controls, the potential sales in the previous quarter for the company,
and dividends paid by each company in the previous quarter.

6. Operating and decision information showing alternatives available to the firm for the next period.

The above represents all the information which is available to each individual at the beginning of the game. This may seem like a great deal of information and a bit confusing at this point, however, it makes a great deal more sense as you look over the computer printouts. All five participants are starting with identical data and with identical decision alternatives. On the basis of the above information, each person makes his decisions for the next period. These decisions are used by the computer to determine the results for each company for the first period of play. By analyzing these results new decisions are then made by each player. The process continues to the end of the game.

Each individual has direct control over eight "decision variables" -- price, marketing expenditures, research and development expenditures, investment in additional plant and equipment, discard of plant, expenditures on market research, production, and dividends. The values of all other variables in the game are determined by the model, using the decisions chosen by each firm.

There are certain restrictions imposed upon the set of available decisions:

1. The total expenditures of each firm must not exceed the funds available. To the extent that expenditures exceed cash plus depreciation, the firm must borrow on its line of credit.

2. For each of the decision variables, the firm must choose a value for the variable from a set of available values which is listed on the statement for the firm; dividends, however may be set at any value.

Within these restrictions, you may choose any strategy which you feel is desirable.
GENERAL QUALITATIVE RULES UNDERLYING THE GAME

There are many many general relationships which affect business and industry. Some of these relationships as portrayed by the simulation game follow:

1. Industry demand increases:
   a. When the average price of the products of all firms declines;
   b. When the total amount spent by the industry on marketing or on research and development increases;
   c. Over a period of time, there is a gradual increase in demand for the industry's product which continues regardless of what the firms do.

In addition to this, however, there are unpredictable changes in demand from period to period over which the firms have no control. In the same manner the results obtained by expenditures for research and development will tend to increase industry demand. However this depends not only on the level of such expenditures, but also on random elements, which reflect the basically unpredictable nature of research undertakings.

2. The individual firm's share of the market increases:
   a. When the price charged by the firm, relative to the prices charged by other firms, declines.
   b. When the expenditures for marketing by the firm, relative to the expenditures for marketing by other firms, increases.
   c. When the expenditures for research and development by the firm relative to the expenditures for research and development by other firms, increases.

As with industry demand, there is an unpredictable element in research and development. A small expenditure might result in a large increase in share of the market if the research is successful, and a large expenditure might result in an actual decline in market share if the research is unsuccessful (e.g., the development of an idea which actually reduces the
"attractiveness" of the firm's product). Share of the market also depends upon the ability of the firm to supply its product. If production and inventories available are not sufficient to supply the potential demand for the firm's product, the firm is penalized in succeeding quarters through the loss of customers that the firm was unable to supply.

3. The costs of the firm include production costs, marketing costs, research and development costs, market research costs, inventory carrying costs, and interest costs. The last five above are assigned to the quarter in which they are incurred. Cost of goods sold, on the other hand, is determined by using the FIFO method of inventory valuation. Since goods are costed out of inventory on the basis of "first in, first out", production costs incurred in one quarter might influence cost of goods sold in succeeding quarters.

Individuals have direct control over their company's level of marketing, research and development, market research costs, and may set these at any level they wish, consistent with the restrictions mentioned above. Inventory carrying costs are determined by the number of units the firm has in inventory at the beginning of the period, the firm being charged 20 cents per unit of inventory. Interest costs are determined by the amount of borrowing, the interest rate being 1% per quarter.

Production costs are influenced by a number of factors:

a. There are certain fixed costs involved in production, so that increasing output tends to decrease per unit cost.

b. After 90% of capacity is reached, certain inefficiencies occur which work to increase per unit costs.

c. Changes in the level of production from one period to another (either up or down) involve costs for the firm.

d. As the capacity of the firm is increased, this tends to decrease per unit costs.

e. Expenditures for research and development also tend to reduce per unit costs.

4. Information which is freely available to the firm includes the total industry demand for the previous period, the prices charged by all firms in the industry, the firm's share of the market, the demand for its product, the market price of stock for all companies, the amount of dividends paid by all companies, and every fourth period, the financial position of all companies in the industry. Information which the firm may buy, through the expenditure of market research funds, includes:
a. Competitor's share of market.
b. Total industry expenditures on marketing.
c. Relative attractiveness of products.

The decisions chosen by your firm are indicated by circling the appropriate decision alternatives in each column of the operating and decision information form. You must circle one of the alternatives listed in each column. The first three columns of the form (unit cost, units of production, cost of production) are interrelated. Circling any entry in one of these three columns automatically results in the choice of the other two entries along the same row. All other columns are independent of one another; any entries may be circled, as long as total expenditures for all items circled do not exceed total funds available. On the decision worksheet for your firm, there is a table you may use to insert the expenditures chosen to check against funds available to insure that this restriction is not violated.

From quarter to quarter, the set of available decision alternatives will change as a result of past decisions of the firm. This is not true of the columns headed "additional plant investment", "discard of plant" and "market research information", which will remain the same throughout the game. The first three columns, initially presenting production alternatives ranging from 76% to 100% of capacity, will change as cash holdings change. Price, marketing expenditures, and research and development expenditures alternatives for each quarter will list alternatives distributed on either side of the decision choice for the previous quarter. For these three last named variables, drastic changes from quarter to quarter will not be possible. To achieve your objective, you must make longer range plans involving gradual increases or decreases in the levels chosen.
OPERATING DETAIL REFERENCE TABLE

Page 8: ANNUAL STATEMENT (Exhibit A Attached)
11 CASH AVAILABLE
10 DECISION WORKSHEET (Exhibit C Attached)
13 ECONOMIC RELATIONSHIPS
16 EXHIBIT A (annual statements - all companies)
17 EXHIBIT B (quarterly reports)
18 EXHIBIT C (decision worksheet)
19 EXHIBIT D (operating and decision information)
10 EXPENDITURES (for current quarter)
 8 FINANCIAL POSITION (as of the beginning of the current quarter)
10 FUNDS AVAILABLE (as of the beginning of the current quarter)
11 INCREASE OR DECREASE OF LOANS
14 LINE OF CREDIT
11 MARKET INFORMATION (for the previous quarter)
12 OPERATING AND DECISION INFORMATION FOR THE NEXT QUARTER
   (Exhibit D Attached)
13 PRODUCT UNIT COSTS
 8 QUARTERLY REPORT (Exhibit B Attached)
 9 RESULTS OF OPERATION (for the previous quarter)
14 SHARE OF THE MARKET FOR THE FIRM
14 STOCK PRICE
10 TOTAL EXPENDITURES
10 TOTAL FUNDS AVAILABLE
13 TOTAL MARKET
EXPLANATION OF RULES, RELATIONSHIPS AND KEY POINTS FOR DECISION MAKING

This section will explain, in detail, the data your firm will receive in order to operate. The important economic relationships, which must be considered in making your decisions for each quarter of business operation, will also be explained. As you study each page make notes of any questions so that we can discuss them.

A. ANNUAL STATEMENT (EXHIBIT A ATTACHED)

The annual statement for each firm is published at the end of each four quarter period (1 year) and made available to the other firms in the game. In addition to summarizing the balance sheet position of each firm, the annual statement also shows profits earned over the previous four quarters. All five firms begin the game with identical annual statements.

I. FINANCIAL POSITION:

CASH - the amount on hand.

INVENTORY - units on hand multiplied by PRODUCTION UNIT COST - previous quarter.

NET PLANT INVESTMENT - value of GROSS PLANT minus DEPRECIATION RESERVE.

LESS LOANS OUTSTANDING - amount the firm owes.

TOTAL NET ASSETS - CASH plus INVENTORY plus NET PLANT INVESTMENT minus LOAN OUTSTANDING.

II. RESULTS OF OPERATION

PROFIT AFTER TAXES - amount earned the previous year after TAXES.

B. QUARTERLY REPORT (EXHIBIT B ATTACHED)

You will receive an operating statement for your firm each quarter.

I. FINANCIAL POSITION (as of the beginning of the current quarter)

The figures shown under CHANGE are the changes in your firm's assets and liabilities as a result of operations and decisions made the previous quarter. All figures are plus unless followed by a minus sign.

ASSETS:

CASH - the amount on hand
INVENTORY - units on hand times PRODUCTION UNIT COST
   previous quarter ("first in, first out" valuation)

GROSS PLANT - total value of plant and equipment before
   DEPRECIATION RESERVE.

LESS DEPRECIATION RESERVE - the amount reserved to date.

NET PLANT - GROSS PLANT minus DEPRECIATION RESERVE. The figure
   for NET PLANT is equal to the number of units of
capacity times $5.00. One unit of capacity produces
   one unit of output.

LIABILITIES:

LOANS OUTSTANDING - amount the firm owes on loans previously
   contracted.

ASSETS LESS LIABILITIES:

CASH plus INVENTORY plus NET PLANT less LOANS OUTSTANDING.

II. RESULTS OF OPERATION (for the previous quarter)

SALES - total units sold previous quarter multiplied by PRICE
   previous quarter.

COSTS

COST OF GOODS SOLD - total COST OF PRODUCTION (includes depre-
ciation) previous quarter adjusted by net
dollar change in INVENTORY.

MARKETING - the amount you chose to spend previous quarter.

RESEARCH AND DEVELOPMENT - the amount you chose to spend previous
   quarter.

INVENTORY CARRYING COST - $0.20 per unit held in inventory at the
   beginning of the previous quarter.

INTEREST COST - 1% per quarter on loans outstanding.

MARKET RESEARCH - the amount your firm paid previous quarter.

TOTAL COSTS - sum of items above.

PROFIT

INCOME BEFORE TAXES - SALES INCOME minus TOTAL COSTS.

TAXES - 50% of INCOME BEFORE TAXES.

PROFIT AFTER TAXES - INCOME BEFORE TAXES minus TAXES.

DIVIDENDS PAID - amount your firm paid previous quarter.

PROFIT RETAINED IN BUSINESS - PROFIT AFTER TAXES minus DIVIDENDS.
C. DECISION WORKSHEET (EXHIBIT C ATTACHED)

I. FUNDS AVAILABLE (as of the beginning of the current quarter.

CASH - amount on hand. This is the figure shown for your firm on STATEMENT OF ASSETS.

DEPRECIATION - This figure will be determined and printed by the computer. It represents depreciation expense for this quarter and is equal to 2% of the firm's net plant as shown on STATEMENT OF ASSETS.

CASH AVAILABLE - CASH plus DEPRECIATION. Depreciation was included in the COST OF PRODUCTION even though it does not involve a cash outlay. This is balanced by adding the amount of DEPRECIATION to CASH, and calling the resulting sum CASH AVAILABLE.

LINE OF CREDIT AVAILABLE - the maximum total indebtedness permitted to the firm.

LESS LOANS OUTSTANDING - amount outstanding as of this data as shown on quarterly financial position report.

AVAILABLE FOR LOAN INCREASE - equals LINE OF CREDIT AVAILABLE minus LESS LOANS OUTSTANDING. If positive, the maximum amount by which loans outstanding may be increased; if negative, the minimum amount by which loans outstanding must be decreased.

TOTAL FUNDS AVAILABLE - sum of CASH AVAILABLE and AVAILABLE FOR LOAN INCREASE. The figure represents the maximum expenditures possible this period.

II. EXPENDITURES (for current quarter)

Enter the figures your firm has chosen as decisions for this period. You will make these decisions on the OPERATION AND DECISION INFORMATION FOR NEXT PERIOD sheet (Exhibit D). They must be correctly transferred and added and the total placed under TOTAL EXPENDITURES.

The items are:

a. COST OF PRODUCTION.

b. RESEARCH AND DEVELOPMENT.

c. MARKETING

d. ADDITIONAL PLANT INVESTMENT

e. MARKET RESEARCH

f. INVENTORY CARRYING COST - This figure is equal to $0.20 per unit held in inventory at the beginning of this period and will be printed by the computer.
g. ESTIMATED INTEREST COST - This figure is to be estimated by each company, at an interest rate of 1% per quarter.

h. DIVIDENDS
TOTAL EXPENDITURES - Sum of items (a) - (h) above.
TOTAL EXPENDITURES includes DEPRECIATION which is not a cash outlay but is included in COST OF PRODUCTION.

III. INCREASE OR DECREASE IN LOANS - For any firm the TOTAL EXPENDITURES may exceed CASH AVAILABLE only by the amount that LINE OF CREDIT AVAILABLE exceeds LOANS OUTSTANDING.

Therefore:
1. If the figure printed for AVAILABLE FOR LOAN INCREASE is positive; compare proposed TOTAL EXPENDITURES WITH CASH AVAILABLE:
   a. If the proposed TOTAL EXPENDITURES is smaller than CASH AVAILABLE - you may pay back on LOANS OUTSTANDING up to this difference. Make sure that you don't pay back more than you owe.
   b. If the proposed TOTAL EXPENDITURES is greater than CASH AVAILABLE - you may either borrow to cover this deficit up to the amount shown under AVAILABLE FOR LOAN INCREASE or reduce the proposed TOTAL EXPENDITURES. If the amount AVAILABLE FOR LOAN INCREASE does not cover the difference, then you must reduce the proposed TOTAL EXPENDITURES until it will.

2. If the printed figures for AVAILABLE FOR LOAN INCREASE is negative;
   Then you must pay back at least this amount and indicate this under INCREASE OR DECREASE IN LOAN. (The amount being repaid plus TOTAL EXPENDITURES must not exceed the CASH AVAILABLE.)

   When increasing loan, use plus figure (+$0,000)
   When decreasing loan, use minus figure (-$0,000)

IV. MARKET INFORMATION (for the previous quarter)
1. STOCK PRICE - Quotation of each firm's stock on the market. Your firm will receive each firm's stock price each quarter. There are 100,000 shares of stock outstanding for each firm at all times.

2. DIVIDENDS - amount each firm chose to pay the previous quarter. Your firm will receive this figure for each firm each quarter.
3. UNIT PRODUCT PRICE - price charged by each firm the previous quarter. Your firm will receive each firm's price each quarter.

4. QUALITY OF PRODUCT - relative effectiveness of each firm's RESEARCH AND DEVELOPMENT expenditures. Your firm may buy MARKET RESEARCH INFO code Q (Exhibit D) which will indicate relative quality for each firm on a 1, 2, 3 scale basis. (1 is the highest and 3 the lowest relative quality.)

5. SHARE OF MARKET - the number of units sold by your firm during the previous quarter as a percentage of the number of units sold by all firms during the same period. Your firm's SHARE OF MARKET will be printed each quarter. If your firm purchases MARKET RESEARCH INFO code S (Exhibit D), then SHARE OF MARKET for all other firms will be printed as well.

6. TOTAL MARKET - the sales in units of all firms in the industry for the previous quarter.

7. POTENTIAL SALES - OUR COMPANY - the number of units your firm sold or could have sold the previous quarter. Actual sales equal potential sales unless your firm ran out of inventory. You will receive this figure for your firm each quarter. If your firm runs out of inventory it will be penalized by losing customers for the next four quarter.

8. TOTAL INDUSTRY MARKETING EXPENDITURE - the aggregate amount spent for MARKETING by all firms during the previous quarter. You may purchase this information as MARKET RESEARCH INFO code M (Exhibit D).

D. OPERATING AND DECISION INFORMATION FOR THE NEXT QUARTER (EXHIBIT D ATTACHED)

You must circle one alternative in every column and also enter the figures for DIVIDENDS and INCREASE OR DECREASE IN LOANS.

1. PRODUCTION UNIT COST, UNITS OF PRODUCTION, COST OF PRODUCTION - you must circle the same horizontal row in all three columns. Your range of alternatives available depends upon the cash position of your firm at the beginning of the quarter.

2. RESEARCH AND DEVELOPMENT - for each quarter the range of alternatives will be $30,000 in $5,000 increments around your firm's decision choice the previous quarter.

3. MARKETING - for each quarter the range of alternatives will be $60,000 in $10,000 increments around your firm's decision choice the previous quarter.
4. ADDITIONAL PLANT INVESTMENT - the choices of alternatives will be the same each quarter. The figures shown are in dollars at $5.00 per unit of capacity. For example the middle figure shown is $120,000 or 24,000 units of plant capacity at $5.00 per unit. This figure represents gross investment. Because your plant is depreciating it takes at least $100,000 each quarter to avoid reduction in capacity.

5. DISCARD OF PLANT - the range of alternatives will be the same each quarter. The figures given are in dollars at $5.00 per unit of capacity. A decision to discard plant causes capacity to fall and reduce assets. No scrap value is obtained for discarded plant.

6. PRICE - for each quarter the range of alternatives will be plus and minus $0.30 in $0.05 increments around your firm's decision choice the previous quarter.

7. MARKET RESEARCH INFORMATION - your firm may purchase certain market information in any combination. If you prefer not to buy any market research information, circle alternative $0,000.

8. DIVIDENDS - enter the figure your firm chose as shown on the worksheet. Exhibit C.

9. INCREASE OR DECREASE IN LOANS - enter figure your firm calculated as shown on the worksheet. Exhibit C.

E. ECONOMIC RELATIONSHIPS

I. PRODUCT UNIT COSTS

Your firm's unit costs depend on your capacity, level of production, production variations between quarters, and expenditures on research and development during the preceding four quarters. The effect of the variables on unit costs is as follows:

- Increased expenditures on research and development lower unit costs, with major impact occurring three to four quarters following such expenditures.

- Output variations from quarter to quarter increase unit costs.

- The most efficient level of utilization of the plant is at approximately 95% of capacity. Higher and lower levels of output increase unit costs.

- Under efficient plant utilization, high capacity, with appropriate higher production, lowers unit costs.

II. TOTAL MARKET (potential unit sales for the industry as a whole)

The size of the total market depends upon a long term growth trend, the phase of the business cycle, industry expenditures on research and development and marketing in the current and three preceding quarters, and on the average price per unit charged by the industry. The effect of these variables on the size of the total market is a follows:
- Due to population and income growth, the total market will show a moderate rate of growth over time.

- Increased expenditures by the industry on research and development increase the total market. The major impact of research and development expenditures occurs 3 to 4 quarters following a firm's expenditures.

- Increased expenditures by the industry on marketing increases the total market, with the major impact of such expenditures occurring in the current quarter and with decreasing impact over the next three quarters.

- A lower average price charged by the industry results in an immediate increase in the total market.

III. SHARE OF THE MARKET FOR THE FIRM

The share of the market for the firm depends upon the amount spent by the firm on research and development and marketing in the current and three preceding quarters, relative to amounts spent by other firms. It also depends on the price charged in the current quarters by the firm relative to prices charged by other firms and the ability of the firm to supply its potential customers.

IV. LINE OF CREDIT

The line of credit consists of two "parts"; one based on the firm's inventories or past profits (whichever is more favorable to the firm), and the other based on the market quotation of the stock.

- An increase in the stock price above $60 will increase the firm's borrowing potential. An increase in profits will increase a firm's borrowing potential, unless inventories form a more favorable basis for credit purposes. Major impact of increased profit occurs in the first and second quarters after these profit increases. Inventories may be regarded as collateral. Their valuation as collateral drops if the market is gutted with inventories in relation to industry sales.

V. STOCK PRICE

The market price of the firm's stock depends upon the firm's profits in the four preceding quarters, the dividends paid in the four preceding quarters, the total net assets of the firm, the value of inventories held by the firm, the capacity of the firm, and the phase of the business cycle.

The effect of these variables on the market price of the firm's stock is as follows:

- An increase in profits increases the stock price, with major impact occurring in the first and second quarters immediately following each increase.
- An increase in dividends increases the stock price, with major impact occurring in the first and second quarters immediately following such increase.

- An increase in the total net assets of the firm increases the stock price.

- An increase in the value of inventories held by the firm decreases the stock price.

- An increase in the capacity of the firm increases the stock price.

- An improvement in general business conditions increases the stock price. Often the stock price leads movements of the business cycle.
### Financial Position

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### Results of Operation

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### Results of Operation

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DECISION WORKSHEET

COMPANY 5 - QUARTER 6

Funds Available

Cash
Depreciation

Cash Available:

Line of Credit Available
Less Loans Outstanding
Available for Loan Increase

Total Funds Available

Expenditures

Cost of Production
Research and Development
Marketing
Additional Plant Investment
Market Research
Dividends
Estimated Interest Cost 1.0 per Quarter
Inventory Carrying Cost $.20 per Unit

Total Expenditures

Increase or Decrease in Loans

Market Information

Company 1    Company 2    Company 3    Company 4    Company 5

Stock Price    62.39    64.95    55.81    60.65    59.70
Dividends    70000    40000    25000    25000    30000
Unit Product Price    4.95    4.95    5.00    4.90    4.85
Quality of Product
Share of Market    0.186

Total Market
Potential Sales - Our Company
Total Industry Marketing Expenditure

Quality Code    1 - Excellent    2 - Good    3 - Fair
### OPERATING AND DECISION INFORMATION

- Record decisions for next period by circling the desired values.

#### COMPANY 5 - QUARTER 6

- **Production**
  - Unit Cost
  - Number of Units
  - Cost of Production
  - Cost of Development
  - Plant Investment
  - Plant OF Plant
  - Price
  - Market Research Information

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### DIVIDENDS

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### INCREASE OR DECREASE IN LOANS

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**RICHARD NEUMANN**

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**292-5009**

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**3333 5555**

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- **Code**

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**19**
APPENDIX F: TYPICAL COMPUTER PRINTOUT
FROM "THE MANAGEMENT GAME"
### Financial Position

<table>
<thead>
<tr>
<th>Company</th>
<th>Cash</th>
<th>Inventory</th>
<th>Net Plant Investment</th>
<th>Less Loans Outstanding</th>
<th>Total NFT Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4424999</td>
<td>675000</td>
<td>5050000</td>
<td>0</td>
<td>10149999</td>
</tr>
<tr>
<td>2</td>
<td>4424999</td>
<td>675000</td>
<td>5050000</td>
<td>0</td>
<td>10149999</td>
</tr>
<tr>
<td>3</td>
<td>4424999</td>
<td>675000</td>
<td>5050000</td>
<td>0</td>
<td>10149999</td>
</tr>
<tr>
<td>4</td>
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<td>675000</td>
<td>5050000</td>
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<td>675000</td>
<td>5050000</td>
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</tbody>
</table>

### Results of Operation

| Profit After Taxes | 239999 | 239999 | 239999 | 239999 | 239999 |
### Financial Position

<table>
<thead>
<tr>
<th>Assets</th>
<th>Total</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>4615174</td>
<td>-128495</td>
</tr>
<tr>
<td>Inventory</td>
<td>7601000</td>
<td>90000</td>
</tr>
<tr>
<td>Gress plant</td>
<td>2701986</td>
<td>98143</td>
</tr>
<tr>
<td>Less depreciation</td>
<td>4099013</td>
<td>-8143</td>
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<tr>
<td>Net plant</td>
<td>10257974</td>
<td>-27800</td>
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<tr>
<td>Liabilities</td>
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### Results of Operation

<table>
<thead>
<tr>
<th>Sales</th>
<th>4085672</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs</td>
<td>4081434</td>
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</tbody>
</table>

#### Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Cost of goods sold</td>
<td>3833091</td>
</tr>
<tr>
<td>Marketing</td>
<td>140000</td>
</tr>
<tr>
<td>Research and development</td>
<td>80000</td>
</tr>
<tr>
<td>Market research</td>
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<tr>
<td>Inventory carrying cost</td>
<td>28343</td>
</tr>
<tr>
<td>Interest cost</td>
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</tbody>
</table>

#### Profit

<table>
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<tr>
<th>Description</th>
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<tbody>
<tr>
<td>Income before taxes</td>
<td>4238</td>
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<tr>
<td>Taxes</td>
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<tr>
<td>Profit after taxes</td>
<td>2119</td>
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<tr>
<td>Dividends paid</td>
<td>30000</td>
</tr>
<tr>
<td>Profit retained in business</td>
<td>-27881</td>
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</tbody>
</table>
*** *** *** DECISION WORKSHEET *** *** ***
COMPANY 5 - QUARTER 6

FUNDS AVAILABLE

| Description                      | Amount  
|----------------------------------|---------
| CASH                             | 4615174
| DEPRECIATION                     | 40143   
| CASH AVAILABLE                   | 4713317
| LINE OF CREDIT AVAILABLE         | 646881  
| LESS LOANS OUTSTANDING           | 0       
| AVAILABLE FOR LOAN INCREASE      | 646881  
| TOTAL FUNDS AVAILABLE            | 5360198

EXPENDITURES

| Description                                 | Amount  
|---------------------------------------------|---------
| COST OF PRODUCTION                          | N/A     
| RESEARCH AND DEVELOPMENT                    | N/A     
| MARKETING                                   | N/A     
| ADDITIONAL PLANT INVESTMENT                 | N/A     
| MARKET RESEARCH                             | N/A     
| DIVIDENDS                                   | N/A     
| ESTIMATED INTEREST COST                     | 1.0     
| INVENTORY CARRYING COST                     | $.20    
| TOTAL EXPENDITURES                          | N/A     

INCREASE OR DECREASE IN LOANS

| Description                      | Amount  
|----------------------------------|---------
| TOTAL MARKET                     | 4518947
| POTENTIAL SALES - OUR COMPANY    | 842406  
| TOTAL INDUSTRY MARKETING EXPENDITURE | N/A     

MARKET INFORMATION

| Description                      | Amount  
|----------------------------------|---------
| COMPANY 1                        |         
| COMPANY 2                        |         
| COMPANY 3                        |         
| COMPANY 4                        |         
| COMPANY 5                        |         
| STOCK PRICE                      |         
| DIVIDENDS                        |         
| UNIT PRODUCT PRICE               |         
| QUALITY OF PRODUCT               |         
| SHARE OF MARKET                  |         

| Description                      | Amount  
|----------------------------------|---------
| TOTAL MARKET                     | 4518947
| POTENTIAL SALES - OUR COMPANY    | 842406  
| TOTAL INDUSTRY MARKETING EXPENDITURE | N/A     
| QUALITY CODE                     | 1-EXCELLENT  2-GOOD  3-FAIR

QUALITY CODE 1-EXCELLENT  2-GOOD  3-FAIR
### OPERATING AND DECISION INFORMATION

- RECORD DECISIONS FOR NEXT PERIOD BY CIRCLING THE DESIRED VALUES -

**COMPANY 5 - QUARTER 6**

--- PRODUCTION ---

<table>
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<th>UNIT COST</th>
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<th>COST OF PRODUCTION</th>
<th>RESEARCH AND DEVELOPMENT</th>
<th>MARKETING</th>
<th>ADDITIONAL DISCARD</th>
<th>PRICE</th>
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DIVIDENDS

---

INCREASE OR DECREASE IN LOANS

---

### MARKET RESEARCH INFORMATION CODES

- S - COMPETITOR'S SHARE OF MARKET
- P - TOTAL INDUSTRY MARKETING EXPENDITURE
- C - RELATIVE QUALITY OF PRODUCT

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<td>441 PAMMEL</td>
<td>5555</td>
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<td>244</td>
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207
APPENDIX G: TYPICAL COMPUTER PRINTOUT
FROM "THE BEEF BREEDING GAME"
APHA

APHA

SIMULATED PRODUCTION RECORDS

HERO
36C
CALF CROP
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2,77| 113
2.671 109
2.28 S3

SI9 116

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3.14, iza

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FEEDlOl

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101
102
10%
10»

SEIECTION WORK SHEET

CALF CROP SUMMARY

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2.83 116

88 ; -10

s 0

2.31 S4
2.84 115
2.63 1C7
2.59 105

2.46

781i 93
8641 103

12

840

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bt*d br bull and
lilt njmb(r ol <0»t «rhot* Col'Si •>« lo LP >10^
>olicio*d
VConlinu» cow» lo »#o«d column
ID


### APHA SIMULATED PRODUCTION RECORDS

#### HERD 38C CALF SUMMARY

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#### ESTIMATED BREEDING VALUE FOR YEARLING WEIGHT

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<th>PEDIGEE</th>
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</tr>
</tbody>
</table>

### APHA SELECTION WORKSHEET

#### RETURN FORM

<table>
<thead>
<tr>
<th>PEDIGEE</th>
<th>HEARING</th>
<th>PEDIGEE</th>
<th>HEARING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
## APHA Simulated Production Records

### Sire Summary

<table>
<thead>
<tr>
<th>PEDIGREE</th>
<th>MEANING</th>
<th>FEEDLOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>102</td>
</tr>
<tr>
<td>2</td>
<td>454</td>
<td>102</td>
</tr>
<tr>
<td>3</td>
<td>436</td>
<td>96</td>
</tr>
<tr>
<td>4</td>
<td>453</td>
<td>101</td>
</tr>
<tr>
<td>5</td>
<td>491</td>
<td>96</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROGENY</th>
<th>828</th>
<th>99</th>
<th>11</th>
<th>11</th>
<th>836</th>
<th>100</th>
<th>10</th>
<th>10</th>
<th>828</th>
<th>99</th>
<th>11</th>
<th>11</th>
<th>836</th>
<th>100</th>
<th>10</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEED</td>
<td>2.31</td>
<td>56</td>
<td></td>
<td></td>
<td>2.40</td>
<td>46</td>
<td></td>
<td></td>
<td>2.41</td>
<td>46</td>
<td></td>
<td></td>
<td>2.65</td>
<td>163</td>
<td></td>
<td></td>
</tr>
<tr>
<td>YEARING</td>
<td>89</td>
<td>-116</td>
<td>0</td>
<td>0</td>
<td>89</td>
<td>99</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>89</td>
<td>99</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Estimated Breeding Value for Yearling Weight

- **Sire 1**: 0.80
- **Sire 2**: 0.79
- **Sire 3**: 0.79
- **Sire 4**: 0.79
- **Sire 5**: 0.79

## APHA Selection Work Sheet

### MATINGS FOR NEXT CALF CROP
APPENDIX H:  TEST FOR COGNITIVE STYLE TEST MAPPING
TEST FOR
COGNITIVE STYLE TEST MAPPING

Dr. Joseph E. Hill
Oakland Community College
Bloomfield Hills, Michigan

TIMED TESTING

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TEST FOR
COGNITIVE STYLE TEST MAPPING

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Oakland Community College
Bloomfield Hills, Michigan

TIMED TESTING

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TEST I

DIRECTIONS

ANSWERS ARE TO BE MARKED ON I.B.M. CARDS ONLY

Choose the pair of words that make the sentence true and sensible.

The first word of the pair you choose goes in the blank space at the beginning of the sentence; the second word of the pair goes in the blank at the end of the sentence.

When you have picked the pair to fill in the blanks, fill in the letter for that pair on the I.B.M. card.

Example X:

..... is to water as eat is to .....  

A. continue ..... drive  
B. foot ....... enemy  
C. drink ....... food  
D. girl ....... industry  
E. drink ....... enemy

ANSWER CARD:  
X  O  O  0  0  0  A  B  C  D  E  

The answer is C. The words drink and food complete the sentence in a true and sensible way.

Now look at the next example:

Example Y:  ..... is to night as breakfast is to .....  

A. supper ..... corner  
B. gentle ..... morning  
C. door ..... corner  
D. flow ..... enjoy  
E. supper ..... morning

ANSWER CARD:  
Y  O  O  0  0  0  A  B  C  D  E  

The answer is E. If your answer is incorrect, reread example X.

1. Turn the page  
2. You have 15 minutes for this test  
3. Stop at the bottom of page 4.
TEST I

1. is to cavalry as foot is to ______
A. horse.... travel
B. horse ... infantry
C. horse ... yard
D. cemetery ... yard
E. horse ..... armory

2. is to masculine as woman is to ______
A. man ..... madame
B. malicious ... feminine
C. malicious ... girl
D. man .... feminine
E. man ..... girl

3. is to verse as sculptor is to ______
A. poet ..... artist
B. poet ..... statue
C. music ..... statue
D. reverse ... statue
E. reverse ... artist

4. is to animal as rind is to ______
A. husk ..... melon
B. skin ..... nut
C. skin ..... melon
D. man ..... hard
E. husk ..... nut

5. is to tusk as deer is to ______
A. elephant ..... doe
B. ivory ..... doe
C. elephant ..... antler
D. ivory ..... antler
E. ivory ..... hunt

6. is to hang as guillotine is to ______
A. gallows ..... behead
B. criminal ..... behead
C. picture ..... capitulate
D. picture ..... behead
E. punish ..... citizen

7. is to pea as shell is to ______
A. green ..... nut
B. pod ..... crack
C. green ..... peel
D. green ..... crack
E. pod ..... nut

8. is to sentence as sentence is to ______
A. jail ..... phrase
B. word ..... paragraph
C. word ..... phrase
D. jail ..... paragraph
E. jail ..... fine

GO ON TO THE NEXT PAGE
9. is to childhood as adolescence is to
   A. infantry ..... adultery
   B. infancy ..... maturity
   C. infancy ..... intelligence
   D. infancy ..... adultery
   E. health ..... intelligence

10. is to dog as Guernsey is to
    A. terrier ..... cow
    B. bark ..... cow
    C. tail ..... cow
    D. tail ..... Jersey
    E. bark ..... Jersey

11. is to eagle as Pekinese is to
    A. sparrow ..... collie
    B. sparrow ..... Chinese
    C. flag ..... Chinese
    D. vulture ..... Chinese
    E. vulture ..... crow

12. is to foot as elbow is to
    A. toe ..... shoulder
    B. toe ..... hand
    C. knee ..... hand
    D. man ..... hand
    E. knee ..... shoulder

13. is to constitution as prologue is to
    A. preamble ..... play
    B. independence ..... epilogue
    C. independence ..... play
    D. law ..... epilogue
    E. amendment ..... epilogue

14. is to horse as bray is to
    A. neigh ..... donkey
    B. hoof ..... donkey
    C. saddle ..... wagon
    D. hoof ..... wagon
    E. hoof ..... pony

15. is to distance as pound is to
    A. far ..... ounce
    B. far ..... weight
    C. travel ..... ounce
    D. rod ..... ounce
    E. rod ..... weight

16. is to never as all is to
    A. seldom ..... whole
    B. seldom ..... every
    C. always ..... every
    D. seldom ..... none
    E. always ..... none

17. is to rain as levee is to
    A. water ..... departure
    B. water ..... rise
    C. water ..... wash
    D. umbrella ..... flood
    E. cloud ..... rise

GO ON TO THE NEXT PAGE
### TEST I

18. _____ is to pacifist as religion is to _____
   A. atlantis .... minister  
   B. object .... minister  
   C. atlantis .... sacred  
   D. war ....... atheist  
   E. conscience .... minister

19. _____ is to nut as hook is to _____
   A. bolt ..... eyehole  
   B. fruit ..... pitch  
   C. fruit ..... bend  
   D. bolt ..... bend  
   E. hazel ..... bend

20. _____ is to bird as shed is to _____
   A. fly ..... barn  
   B. fly ..... dog  
   C. fly ..... hay  
   D. moult ..... dog  
   E. migrate ..... barn

21. _____ is to England as lira is to _____
   A. pound ..... Italy  
   B. London .... money  
   C. London .... Mexico  
   D. London .... mandolin  
   E. London .... Italy

22. _____ is to prison as Louvre is to _____
   A. warden ..... paramour  
   B. warden ..... museum  
   C. warden ..... France  
   D. Bastille ..... museum  
   E. crime ..... artist

23. _____ is to opera as lyric is to _____
   A. baritone ..... music  
   B. baritone ..... poem  
   C. composer ..... music  
   D. composer ..... song  
   E. drama ..... song

24. _____ is to static as dynamic is to _____
   A. inert ..... active  
   B. radio ..... active  
   C. radio ..... speaker  
   D. inert ..... speaker  
   E. radio ..... motor

25. _____ is to diamond as circle is to _____
   A. gold ..... round  
   B. square ..... oval  
   C. shape ..... round  
   D. cube ..... round  
   E. square ..... round

STOP! You may check your work on this test if you have time.

DO NOT TURN THIS PAGE.

- 4 -
TEST III (3)

DIRECTIONS

This test consists of 20 numerical problems. Next to each problem there are five answers.

You are to pick out the correct answer and fill in its letter on the answer card. If you do not find a correct answer among the first four choices, fill in the "E" as your answer.

Choice E for every problem is "none of these" which means that a correct answer is not among the first four choices.

Only one answer should be marked for each problem.

Do your figuring on the scratch paper you have been given.

Reduce fractions to lowest terms. For example, if the choices are \( \frac{1}{2} \) and \( \frac{1}{4} \), \( \frac{1}{2} \) is correct.

The following are examples of problems in the test:

Example X

<table>
<thead>
<tr>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. 14</td>
</tr>
<tr>
<td>B. 25</td>
</tr>
<tr>
<td>C. 16</td>
</tr>
<tr>
<td>D. 59</td>
</tr>
<tr>
<td>E. None of these</td>
</tr>
</tbody>
</table>

ANSWER CARD

```
X 0 0 0 0
```

In Example X, 25 is the correct answer, so the letter B has been filled in.

Example Y

<table>
<thead>
<tr>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. 15</td>
</tr>
<tr>
<td>B. 26</td>
</tr>
<tr>
<td>C. 16</td>
</tr>
<tr>
<td>D. 8</td>
</tr>
<tr>
<td>E. None of these</td>
</tr>
</tbody>
</table>

ANSWER CARD

```
Y 0 0 0 0
```

In example Y, the correct answer has not been given, so the letter E has been filled in.
TEST III  (3)

<table>
<thead>
<tr>
<th></th>
<th>ANSWER</th>
<th></th>
<th></th>
<th>ANSWER</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5473</td>
<td>A. 2485</td>
<td>6</td>
<td>.04)4.036</td>
<td>A. 1.009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. 2486</td>
<td></td>
<td></td>
<td>B. 10.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. 2496</td>
<td></td>
<td></td>
<td>C. 10.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. 3486</td>
<td></td>
<td></td>
<td>D. 100.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E. None of these</td>
<td></td>
<td></td>
<td>E. None of these</td>
</tr>
<tr>
<td>2</td>
<td>2.04 x .75</td>
<td>A. 1.5300</td>
<td>7</td>
<td>1/8 =</td>
<td>A. 1/32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. 153.0</td>
<td></td>
<td></td>
<td>B. 1/8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. 1530</td>
<td></td>
<td></td>
<td>C. 1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. 15300</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>E. None of these</td>
<td></td>
<td></td>
<td>E. None of these</td>
</tr>
<tr>
<td>3</td>
<td>.025 x .025</td>
<td>A. .001375</td>
<td>8</td>
<td>3 x 10 =</td>
<td>A. 27/50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. .00625</td>
<td></td>
<td>.5 x 9</td>
<td>B. 1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. .625</td>
<td></td>
<td></td>
<td>C. 30/45</td>
</tr>
<tr>
<td></td>
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<td>D. 1.375</td>
<td></td>
<td></td>
<td>D. 2/3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E. None of these</td>
<td></td>
<td></td>
<td>E. None of these</td>
</tr>
<tr>
<td>4</td>
<td>46 49</td>
<td>A. 1 13/46</td>
<td>9</td>
<td>2 ft. 3 in.</td>
<td>A. 49 ft.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. 1 23/46</td>
<td></td>
<td>28 ft. 11 1/2 in.</td>
<td>B. 48 ft. 2 in.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. 1.5</td>
<td></td>
<td>17 ft. 5 in.</td>
<td>C. 47 ft. 24 in.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. 15</td>
<td></td>
<td>+ 4 1/2 in.</td>
<td>D. 48 ft.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E. None of these</td>
<td></td>
<td></td>
<td>E. None of these</td>
</tr>
<tr>
<td>5</td>
<td>3.6572</td>
<td>A. .02</td>
<td>10</td>
<td>√.09 =</td>
<td>A. .03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. .2</td>
<td></td>
<td></td>
<td>B. .3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. 2</td>
<td></td>
<td></td>
<td>C. 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. 20</td>
<td></td>
<td></td>
<td>D. 9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E. None of these</td>
<td></td>
<td></td>
<td>E. None of these</td>
</tr>
</tbody>
</table>

GO ON TO THE NEXT PAGE

- 6 -
TEST III (3)

11. \( \square = \frac{33\frac{1}{3}}{963} \) of 963
   A. 32.19
   B. 231
   C. 321
   D. 32100
   E. None of these

12. \( \square = \frac{4}{9} \) of 648
   A. 14.58
   B. 72
   C. 216
   D. 1458
   E. None of these

13. 15 = 75\% of \( \square \)
   A. .20
   B. 10.25
   C. 20
   D. 22.5
   E. None of these

14. 2.5 = \( \square \% \) of 2
   A. 5
   B. 8
   C. 80
   D. 125
   E. None of these

15. \( \frac{5}{9} = \square \) of 55
   A. 55
   B. 11
   C. 45
   D. 99
   E. None of these

16. \( \frac{3}{000729} \)
   A. .000243
   B. .009
   C. .027
   D. .09
   E. None of these

17. List price is $75.00. Discounts are 33\(\frac{1}{3}\)% and 2\%.
   Net Price is $\square$.
   A. 25
   B. 48.50
   C. 49.50
   D. 50
   E. None of these

18. What one number can replace B. \( \square \)?
   A. 6
   B. 12
   C. 35
   D. 36
   E. None of these

19. What one number can replace B. \( \square \)?
   A. 1\(\frac{1}{2}\)
   B. 4
   C. 64
   D. 100
   E. None of these

20. \( \frac{6(9 + 1) - 3}{7(4 + 2) - 6} \)
   A. 57
   B. 50
   C. 1\(\frac{7}{12}\)
   D. 36
   E. None of these

YOU MAY CHECK YOUR WORK. DO NOT TURN THE PAGE.
DIRECTIONS

There are eight selections in this part of the test. Read each selection through completely; then answer the questions.

When you have completed one selection, go immediately to the next.

Keep working until you have completed all the selections or until you are told to stop.

To answer a question, you may, if you wish, look back at the material you have read. But do not puzzle too long over any one question. After a reasonable effort, go on to the next question.

You will have 20 minutes to work this part of the test.

Wait for the signal to turn this page.
Morris had left Oxford University in 1856 to work at architecture. However, his profession kept him in Oxford town, and he and Rossetti, who was also there to do some work, soon came to know a young man who had arrived at Balliol College in January, 1856. He was a strange, almost imp-like person -- a small, girlish body topped with an enormous head which looked even larger than it was because of a great mop of reddish golden hair.

Yet the Pre-Raphaelite painter-poets were quickly drawn to Algernon Charles Swinburne. There was a kind of steely firmness in this elfin young man which commanded their respect, and there was a winning courtesy in his manner. Then too, it was apparent that he had read amazingly. He knew French literature like a native. He was almost as much at home with Italian, loved and wrote Greek, and seemed to have all English poetry at his tongue's end. Morris was soon reading him "The Haystack in the Floods" due to be printed the following year in his first book, and Rossetti called him "my little Northumbrian friend" and praised the verse that Swinburne showed him.

Swinburne came of a distinguished family. His father was an admiral and his mother was the daughter of an earl. Still, they were also haters of tyrants and believers in Liberty, especially Sir John Swinburne, Algernon's grandfather. The young poet had inherited this love of democracy and made a passion of it. Swinburne told a friend how he was driving once with his father and mother in the Champs Elysees in Paris, and passed the carriage of the French emperor, Napoleon III. He was infuriated because his father had bowed to the Emperor and raised his hat.

"And did you raise yours?" asked the friend.

"Not wishing to cut my hand off immediately on returning to the hotel," came the answer, partly in fun, but also serious, "I did not."

On the other hand, Swinburne was intensely proud of his noble blood. He considered his family one of the oldest and best in England and liked to think of his ancestors as brave and violent men. During his boyhood he seems to have urged his little body with resolute eagerness to attempt feats of skill and endurance. Near his father's home on the Isle of Wight he exulted in battles with the sea, and there on his grandfather's estate in Northumberland he
dashed wildly about on horseback. On the Isle of Wight there is a promontory, Culver Cliff, that drops sheer from its summit to the sea a thousand feet below. When he was eighteen, Swinburne went out one day without saying anything to his family and worked his way by crevice and rocky shelf up the perpendicular wall to the very crest of the height. It was a war between his light body and his fiery pride, and the pride was the victor.

Later, Swinburne tried to enlist in the cavalry, but was rejected. He regretted this for years. He was the only literary member of a family of fighters, and he seems to have felt that the least he could do by his clan was to seek some kind of active service. Later, he got comfort by feeling that he expressed the vehemence of the Swinburnes in his verse. He wrote once to a correspondent:

"I think you will allow that when this race (his family) chose at last to produce a poet, it would have been at least remarkable if he had been content to write nothing but hymns and idylls for clergymen and young ladies to read in chapels and drawing-rooms."

1. This is chiefly about:

   A. Morris
   B. The Pre-Raphaelites.
   C. Swinburne.
   D. Oxford University.
   E. Writing poetry.

2. One feat mentioned was:

   A. Leading a cavalry attack.
   B. Scaling a perpendicular cliff.
   C. Riding the rapids.
   D. Rescuing a girl from a flood.
   E. Battling rebel forces.

   Turn to the next page.
3. Swinburne's hair was what color?
   A. Reddish
   B. Brown
   C. Jet Black
   D. Brunette
   E. Snow white

4. The Pre-Raphaelites were spoken of as:
   A. Color-poets
   B. Musician-poets
   C. Painter-poets
   D. Neo-poets
   E. Italian-poets

5. The story about passing Napoleon's carriage was intended to show Swinburne's:
   A. Love of royalty.
   B. Passion for democracy.
   C. Hatred for his father.
   D. Tendency to exaggerate.
   E. Winning courtesy.

6. Swinburne compensated for his slight stature by:
   A. Writing poems.
   B. Leading radical causes.
   C. Performing acts requiring strength and courage.
   D. Becoming a linguist.
   E. Joining the ranks of the clergy.

7. Swinburne's character is revealed largely through what?
   A. His actions.
   B. His conversation.
   C. Comments of his friends.
   D. Description of his appearance.
   E. His poems.

8. Part of the action occurred in:
   A. Italy.
   B. London.
   C. Nice.
   D. Paris
   E. Cambridge. Turn to next page.
It now became evident that the city must be abandoned at once. There was some difference of opinion in respect to the hour of departure. The daytime, it was argued by some, would be preferable since it would enable them to see the nature and extent of their danger, and to provide against it. Darkness would be much more likely to embarrass their own movements than those of the enemy, who were familiar with the ground. A thousand impediments would occur in the night, which might prevent their acting in concert, or obeying the orders of the commander. But, on the other hand, it was urged that the night presented many obvious advantages in dealing with a foe who rarely carried his hostilities beyond the day. The late active operations of the Spaniards had thrown the Mexicans off their guard, and it was improbable they would anticipate so speedy a departure of their enemies. With celerity and caution, they might succeed therefore, in making their escape from the town, possibly over the causeway, before their retreat should be discovered; and, could they once get beyond that pass of peril, they felt but little apprehension for the rest of the journey.

The night was cloudy, and a drizzling rain, which fell without intermission, added to the obscurity. Steadily, and as noiselessly as possible, the Spaniards made their way along the main street, which had so lately resounded to the tumult of battle. All was now hushed in silence; they were only reminded of the past by the occasional presence of some solitary corpse, or a dark heap of the slain, which too plainly told where the strife had been hottest. As they passed along the lanes and alleys which opened into the great street, they easily fancied they discerned the shadowy forms of their foe lurking in ambush, ready to spring upon them. But it was only fancy; the city slept undisturbed even by the prolonged echoes of the tramp of the horses, and the hoarse rumbling of the artillery and baggage trains. At length, a lighter space beyond the dusky line of buildings showed the van of the army that it was emerging on the open causeway. They might well have congratulated themselves on having thus escaped the dangers of an assault in the city itself, and that a brief time would place them in comparative safety on the opposite shore.

Turn to the next page.
TEST IV (4)

9. What is the main topic of debate mentioned in the paragraph?

A. Whether to go by night or by day.
B. Whether or not to abandon the city.
C. Whether to depend on speed or on caution.
D. Whether or not to try the causeway.
E. Whether they should fight or flee.

10. What place was considered most dangerous to their retreat?

A. City gates.
B. The causeway.
C. The fort.
D. The Mexican guard house.
E. Enemy sentinel posts.

11. What objection was urged against a night retreat?

A. Difficulty in acting in concert.
B. It would look cowardly.
C. Difficulty of transporting baggage.
D. Artillery of little use.
E. Moon would reveal their movements.

12. Why would the Mexicans probably not expect a retreat?

A. They greatly feared the Spaniards.
B. Spanish reinforcements were approaching.
C. Bad weather conditions.
D. The Spaniards had been lately active.
E. The Spaniards had been quiet of late.
13. What kind of night was it?
   A. Freezing.
   B. Raining steadily.
   C. Hot and sultry.
   D. Calm and still
   E. Frosty, starlight.

14. What cause for congratulation did the soldiers have?
   A. A renowned leader.
   B. Good horses.
   C. They emerged from the city unmolested.
   D. Enemy sentinels were asleep.
   E. Artillery and baggage were saved.

15. What did the soldiers see in their imagination?
   A. Their homes in Spain
   B. Ghosts of the slain.
   C. Horses.
   D. Hidden enemies.
   E. Dark buildings.

16. What activity is described in the paragraph?
   A. A surprise attack.
   B. A spying party.
   C. Capture of a city.
   D. A night march.
   E. A midnight execution.

Turn to the next page.
The countries of the temperate zone are especially fit for the development of manufacturing industry; for the temperate zone is the region of intellectual and physical effort. If the countries of the torrid zone are little favored in reference to manufactures, they possess, on the other hand, the natural monopoly of many precious commodities which the inhabitants of the temperate climates greatly prize. A country of the torrid zone would make a very fatal mistake should it try to become a manufacturing country. Having received no invitation to that vocation from nature, it will progress more rapidly in riches and civilization if it continues to exchange its agricultural productions for the manufactured products of the temperate zone. It is true that tropical countries sink thus into dependence upon those of the temperate zone, but that dependence will not be without compensation if competition arises among the nations of temperate climes in their manufacturing industry, in their trade with former, and in their exercise of political power. This competition not only insures a full supply of manufactures at low prices, but will prevent any one nation from taking advantage of its superiority over the weaker nations of the torrid zone.

17. What compensation does the torrid zone have for its lack of manufacturing?

A. Articles greatly desired by the temperate zone.
B. Pleasure resorts.
C. A large commerce.
D. It is a region of intellectual and physical effort.
E. More political freedom.

18. What is the writer's attitude toward developing manufacturing in the torrid zone?

A. Nations of the temperate zone should encourage it.
B. Private concerns should supply capital for developing manufacturing.
C. Manufacturing in the torrid zone means dependence.
D. The torrid zone should remain an agricultural land.
E. Competition renders manufacturing there necessary.
19. What policy should a tropical country pursue in order to foster its development and civilization?

A. Build up its manufacturing.
B. Trade its farm products for manufactured wares.
C. Increase its number of ships.
D. Establish a stable form of government.
E. Foster intellectual and physical effort in its people.

20. Why is there so much manufacturing in the temperate zone?

A. Because of its trading with the torrid zone.
B. Because the torrid zone has a monopoly of many commodities.
C. Because its governments are superior to those in the tropics.
D. Because its people possess great industry.
E. Because of vast capital.

Peary's expedition arrived at the North Pole about noon, April 6, 1909. The test of being at the pole consisted of seeing the sun and stars going around the sky in horizontal circles. Peary made 32 observations which met this test.

Years after the discovery, a high ranking member of Peary's party said this about Henson:

"Henson was the most useful man of us all. He was the best man I've ever seen, then or in the thirty years since, in the handling of Eskimos. It was Henson who trained the Eskimos for all Peary's expeditions. And we all noticed that whenever Peary encountered a difficulty, Matt Henson was the man he sent for."

Financially, Henson did poorly out of the expedition. He was paid $25 a month and received a $150 bonus for the successful trip. In 1913, in halfhearted recognition of his feat, he was given a messenger's job at the New York Customs House. After 23 years he was able to retire on a pension of $1,020 a year. In 1945, he belatedly received a silver medal from Congress.
Years later at the Explorers Club dinner, however, when notables from all the world stopped to shake his hand, Matt Henson knew his record was tops.

21. Henson worked for a time as a:
   A. Messenger.
   B. Bookkeeper.
   C. Elevator operator.
   D. Salesman.
   E. Inspector.

22. What is the passage mainly about?
   A. The North Pole.
   B. Peary's discovery.
   C. Henson's contribution.
   D. The Eskimos.
   E. The Explorers Club dinner.

23. Your best inference is that Peary was:
   A. Brave.
   B. Kind.
   C. Talkative.
   D. Thorough.
   E. Energetic.

24. Henson's character is revealed chiefly through what?
   A. His conversation.
   B. The testimony of another.
   C. His work record.
   D. The words of friends and neighbors.
   E. His religious beliefs.

Turn to the next page.
We still feel it necessary to retain capital letters, especially for proper names. A suggestion to begin these also with small letters would be met with the objection that a loss of clearness would be entailed. In reality, the cases in which ambiguity between a common and proper noun might ensue would be exceedingly few; the occasional inconvenience so caused would be more than compensated for by increased simplicity of writing and printing. Children would learn their letters in about half the time, the printer would operate with half as many characters, and typewriters would dispense with a shift key. Spanish designates proper adjectives without capitals and encounters no misunderstanding. English telegrams are sent in code that makes no distinction. When we read the newspapers and think that the mixture of capital and small letters is necessary for our easy comprehension, we forget that this same news came over the wire without capitals. We have become so habituated to the existing method that a departure from it might temporarily be a bit disconcerting. We rationalize our cumbersome habit, explaining that this custom is logically best; although a moment's objective reflection shows that the system costs us time, energy, and money without adequate compensation.

25. What is the writer's attitude with respect to the use of capital letters?

A. They are needed to distinguish proper from common nouns.
B. We should cease using capital letters for proper nouns.
C. They should be used to avoid errors in telegrams.
D. The telegraphic code is often responsible for mistakes in newspapers.
E. We should be governed by tradition.

Turn to the next page.
26. Which one of the following would result from eliminating use of capitals?

A. Greater clearness would result.
B. It would be easier to translate Spanish.
C. Cost of printing would be reduced.
D. Telegrams could no longer be sent in code.
E. It would be overthrowing a logical custom.

27. If we were to discontinue the use of capitals for proper names, what gain would be made to compensate in part for the loss in clearness?

A. It would be temporarily disconcerting.
B. There would be a wider use of the telegraphic code.
C. Rationalization would cease.
D. Writing would be a simpler process.
E. It would be easier to avoid ambiguity between common and proper nouns.

28. What habit do we excuse to ourselves?

A. Using capital letters.
B. Mistaking a common for a proper noun.
C. Taking too much time to learn the alphabet.
D. Reading cheap newspapers.
E. Using code in telegrams.

- 19 -
Wherever there is universal agreement that a stage of development was Neolithic, pottery is present. And conversely, wherever pottery occurs, no one has yet doubted that a true Neolithic stage existed. Second in importance is the bow, which in general appeared contemporaneously with pottery. The evidence for its existence is sometime less clear. Pottery is imperishable and unmistakable. The bow and arrow are made of materials that decay in a few years. Only the stone or bone point preserves, and this cannot always be distinguished with positiveness from the head of a light spear. These two culture elements, pottery and the bow, signalized an enormous advance over the past. Both required definite technical skill to manufacture; both were of the greatest service. Whole lines of foods could now be utilized that had formerly been passed by: soups, stews, porridges. Plants whose seeds or parts were inedible were added to the diet. The bow made possible long range fighting, the pursuit of large game, and the capture of many small mammals and birds previously difficult to take. The harpoon had been developed chiefly for fishing. It had proved to be of little help in killing birds, rabbits, etc., or large and dangerous animals like wild cattle.

29. How can the investigator determine that a tribe had entered the Neolithic Age?

A. By their possession of cattle.
B. By their having possessed pottery.
C. By their having possessed weapons.
D. By their use of fish for a food.
E. By their having left records or picturegrams.

30. Which one of the following resulted from the invention of the bow?

A. The harpoon was replaced.
B. Pottery was invented.
C. The taking of rabbits.
D. The dog was domesticated.
E. The use of the light spear was discontinued.
TEST IV (4)

31. What probably was the relationship between the development of the bow and the harpoon?

A. The bow was developed before the harpoon.
B. The bow was developed after the harpoon.
C. The harpoon was useless for killing birds.
D. The harpoon had no relation to the Neolithic Age.
E. One of these displaced the other.

32. Which one of the following was an effect of the introduction of pottery?

A. Urged the capture of large game.
B. The Neolithic Age was ushered in.
C. Porridges were added to the diet.
D. For many years the effect was scarcely noticeable.
E. It led to the invention of the bow and arrow.

Assuming that the physical and moral well-being and the stable social order, which are the indispensable conditions of permanent industrial development, are secured, there remains for consideration the means of attaining that knowledge and skill, without which the battle of competition cannot be successfully fought. A vast system of elementary education has now been in operation among us for sixteen years, and has reached all but a very small fraction of the population. I do not think that there is any room for doubt that, on the whole, it has worked well, and that its benefits have been immense. But, as might be expected, it exhibits the defects of all our educational systems--fashioned as they were to meet the wants of a bygone condition of society. There is a wide-spread and I think well justified complaint that it has too much to do with books and too little to do with things. I am not disposed to make the primary school a mere annex of the shop. It is not so much in the interests of industry as in that of broad culture that I echo the common complaint against the bookish and theoretical character of our primary instruction.

Turn to the next page.

- 21 -
33. How many of the people are reached by the present system of elementary education?

A. A very few.
B. About half.
C. About one in sixteen.
D. Almost all.
E. Everyone.

34. What criticism is made of the present school system?
It is:

A. Too much concerned with books.
B. Too old.
C. Limited to a few.
D. Too much like a shop.
E. Too widespread.

35. What does the author seem to consider the chief function of the school? To provide for:

A. General refinement.
B. Help to industry.
C. Theoretical reasoning.
D. Universal education.
E. Bookish training.

36. What is cited as one of the basic conditions necessary for permanent industrial development?

A. Universal education.
B. Industrial education.
C. Established society.
D. Primary education.
E. Proper educational theory.

STOP

Wait for further instructions.
DIRECTIONS

This test is intended to reveal (a) how well you understand the basic structure of the English language and (b) how effectively you can use that language.

The test has a forty (40) minute time limit. You are not expected to know the answer to every item in the test, but you should try to answer each one. If you have no idea about the answer to an item, GO ON IMMEDIATELY to the next one. Avoid spending an undue amount of time on any one item. Work along at a steady pace, for it will be to your advantage to finish the test. If you need to make notes, use the back of your scratch paper.

Work until time is called or until you complete the test. If you finish before time is called, review your answers.

Read the directions very carefully as you begin each section.
TEST VI (6)

DIRECTIONS:

For items 1 - 3, select the one topic which could be handled best in one paragraph of about 100 words, assuming that you have sufficient information on all the topics.

Example

A. How to tune-up a car.
B. Starting a car.
C. Differences among new model cars this year.
D. The mechanical operation of the automotive engine.
E. The accessories for cars.

The correct answer is "B" because it is the only topic which can be developed adequately in a paragraph of about 100 words.

Now proceed to items 1 - 3, following the directions above.

1. A. Traveling through America.
   B. My trip west.
   C. Visiting Chicago.
   D. Arriving at the hotel.
   E. Walking through the zoo on the 4th of July.

2. A. Summary of a novel.
   B. Summary of a newspaper.
   C. Summary of a one column article in a newspaper.
   D. Summary of a main character in a novel.
   E. Summary of the baseball World Series games last year.

   B. Describe the state flag of California.
   C. Rhode Island, America's smallest state.
   D. My trip to Iowa.
   E. The beautiful items that make New Mexico "The Land of Enchantment".

Turn the page.
DIRECTIONS:

For items 4 - 7 select the one topic which could be handled in an essay of about 500 words, assuming that you have sufficient information on all the topics.

Example:

A. The history of golf.
B. A frustrating incident on the golf course.
C. The many ways the different clubs in a golf set are used.
D. The toughest five golf courses in Scotland.
E. Biography of Arnold Palmer.

The correct answer is "B" because it is the only topic which can be developed adequately in an essay of about 500 words.

Now proceed to items 4 - 7 following the directions above.

   B. The life of William Shakespeare.
   C. The time of day the play was originally presented.
   D. The theme of Hamlet, one of Shakespeare's plays.
   E. The major characters in Hamlet.

5. A. Selecting a new car.
   B. Building a new house.
   C. Buying popcorn at the cinema.
   D. Ordering parts for an automotive manufacturer.
   E. How to choose quality hamburger meat.

   B. An hour in the life of a recruit.
   C. Marine battles of the Korean conflict.
   D. The invasion and securing of Guam.
   E. The function of the Marine Corps in naval warfare.

7. A. Pioneers of the American West.
   B. Kit Carson, the man and the legend.
   C. The purpose of the cattle drives.
   D. The fifty year influence of the Gold Rush upon the settling of California.
   E. The unconquerable Rockies.

Turn to next page.
DIRECTIONS:

In items 8 - 11 only one sentence in each group is free from errors in capitalization, punctuation, quotation marks or in the use of apostrophes. (the incorrect sentences may contain errors in only one area listed above or in several.)

Fill in the letter of the correct sentence on your answer card.

8. A. I walked over to Ruth's house and talked to her sister.  
B. I walked over to Ruth's house, and talked to her sister.  
C. I walked over to Ruth's house; and talked to her sister.  
D. I walked over to Ruth's house and talked to her sister.  
E. I walked over to Ruth's house and talked to her sister.

9. A. I have always wanted to be an English teacher; however, I don't enjoy education courses.  
B. I have always wanted to be an English Teacher, however, I don't enjoy education courses.  
C. I have always wanted to be an English teacher; however, I don't enjoy education courses.  
D. I have always wanted to be an English teacher, however, I don't enjoy education courses.  
E. I have always wanted to be an English teacher; however, I don't enjoy education courses.

10. A. "Will I ever know, asked the student, "Whether I should have gone or not."  
B. "Will I ever know," asked the student, whether I should have gone or not?"  
C. "Will I ever know," asked the student, "whether I should have gone or not?"  
D. "Will I ever know," asked the student, "whether I should have gone or not?"  
E. "Will I ever know?" asked the student, "Whether I should have gone or not?"

11. A. We asked her brother, "what he wanted to get out of college?"  
B. We asked her brother what he wanted to get out of college.  
C. We asked her brother, what he wanted to get out of college.  
D. We asked her brother, "what he wanted to get out of college."  
E. We asked her brother what he wanted to get out of college?

Turn to the next page.

- 26 -
TEST VI (6)

DIRECTIONS:

In items 12 - 14, choose the one sentence in each group which is grammatically correct. Mark your answer on the I.B.M. card.

12. A. Mary and Joan are going with him and me.
   B. Several juniors, including Jerry and I, received invitations.
   C. Everyone went to the party except George and I.
   D. Him and I are going to the game instead.
   E. My roommate and me will be unable to attend your party.

13. A. The doctor said that I must lay down after every meal.
   B. Please do not set there.
   C. Tim runs more swiftly than the other boys.
   D. The red car is the fastest of the two.
   E. He don't like to mow the lawn.

14. A. Jerry was suppose to take his car to the garage yesterday.
   B. Every student know that registration can present frustrating moments.
   C. Mathematics 101 use to be taught by Professor Babcock.
   D. Neither Frank nor I feels eager to go.
   E. Many apple were still on the tree after the storm.

Turn to the next page.
TEST VI (6)

DIRECTIONS:

In items 15 - 17, choose the one sentence in each group which is free from error in structure (sentence fragment, comma splice, run-together sentence, misplaced modifier, or dangling modifier).

15. A. Falling out of the tree, his arm was broken.
   B. I raised my hand, I was certain I knew the answer.
   C. The rains having finally subsided.
   D. The outcome being, of course, that no one volunteered.
   E. Turning the corner, I noticed the hotel two blocks away.

16. A. Hoping that the dreary day would end soon while I kept on hoeing the garden.
   B. I can't lend you any money; actually I'm near penniless myself.
   C. A warm, lazy day, the kind that makes a person daydream.
   D. The tow truck has broken down, whatever shall we do now?
   E. Besides being an honor student and a member of the debate team.

17. A. Hawkins, unable to play much tennis with his brother-in-law because his free time was very limited.
   B. In the crowded theater lobby we recognized our friends they rushed to greet us.
   C. Poor Mrs. Jenks had to wash all the grease-stained clothes worn by her husband in an old-fashioned hand washer.
   D. The tickets were waiting for us the reservations having been mailed in beforehand and we experienced no waiting.
   E. The police reported that approximately one hundred cars are stranded in the snow and that there is no sign of relief in sight.

Turn the page.
DIRECTIONS:

The items below are in a scrambled order. On a scratch paper, organize them to produce a clear, understandable paragraph. Then choose the best answer for number 18. For example, the correct order for the following items:

1. Looking at the menu
2. Eating the ham sandwich
3. Finding a seat in the restaurant
4. Eating the soup
5. Eating dessert
6. Paying the bill
7. Ordering lunch

is 3, 1, 7, 4, 2, 5, 6.

Now follow the same procedures for the following items and then answer item 18.

1. Overslept
2. Missed breakfast
3. Room seemed dark
4. Alarm went off
5. Opened eyes
6. Decided clock was fast

18. Which one of the following is the correct order for the details?

A. 1, 5, 6, 4, 3, 2
B. 4, 5, 6, 3, 1, 2
C. 5, 4, 3, 6, 1, 2
D. 3, 4, 5, 6, 2, 1
E. 4, 5, 3, 6, 1, 2

Turn the page.
Most of the following sentences, in column one, can be rearranged into a clear, understandable theme of two paragraphs. On scratch paper, rearrange the numbers for such a theme. Then, in column two, answer numbers 19 - 23.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In 1250 Roger Bacon, a philosopher and a scientist, wrote that air, like water, had an upper surface and that if man wanted to fly, he would have to create an apparatus that would float in the air.</td>
<td>19. With which sentence should the theme begin?</td>
</tr>
<tr>
<td>2. After they had made a huge balloon and filled it with smoke and hot air, it rose a thousand feet.</td>
<td>A. Sentence 1</td>
</tr>
<tr>
<td>3. Probably the first record of man's desire to fly appears in the Greek myth of Daedalus and Icarus.</td>
<td>B. Sentence 3</td>
</tr>
<tr>
<td>4. Over four centuries later de Lana used Bacon's idea and designed a kind of air boat to be propelled by oars, but it was never built.</td>
<td>C. Sentence 7</td>
</tr>
<tr>
<td>5. This was not the same Bacon, who, some think, wrote Shakespeare's plays.</td>
<td>D. Sentence 8</td>
</tr>
<tr>
<td>6. However, credit for inventing the first aerostat - the balloon - must go to Stephen and Joseph Montgolfier.</td>
<td>E. Sentence 9</td>
</tr>
<tr>
<td>7. No one knows when man first had the desire to fly.</td>
<td>20. Which sentences should be included in the first paragraph?</td>
</tr>
<tr>
<td>8. The first step toward creating the aerostat or lighter-than-air craft occurred in 1766, when Cavendish discovered hydrogen and proved that it was lighter than air.</td>
<td>A. Sentences 2, 4, 5, 6, 8</td>
</tr>
<tr>
<td>9. Thus the aerostat became a reality, and from it man went on to develop the airplane and the spaceship.</td>
<td>B. Sentences 1, 3, 4, 7</td>
</tr>
<tr>
<td>10. Four months later they made man's first successful ascent into the atmosphere.</td>
<td>C. Sentences 3, 6, 8, 9</td>
</tr>
<tr>
<td></td>
<td>D. Sentences 3, 4, 5, 7, 10</td>
</tr>
<tr>
<td></td>
<td>E. Sentences 1, 2, 9, 10</td>
</tr>
<tr>
<td></td>
<td>21. With which sentence should the second paragraph begin?</td>
</tr>
<tr>
<td></td>
<td>A. Sentence 1</td>
</tr>
<tr>
<td></td>
<td>B. Sentence 3</td>
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<td></td>
<td>C. Sentence 7</td>
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<td>D. Sentence 8</td>
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<td></td>
<td>E. Sentence 9</td>
</tr>
<tr>
<td></td>
<td>22. With which sentence should the theme end?</td>
</tr>
<tr>
<td></td>
<td>A. Sentence 1</td>
</tr>
<tr>
<td></td>
<td>B. Sentence 4</td>
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<td>C. Sentence 5</td>
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<td>D. Sentence 6</td>
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<td>E. Sentence 9</td>
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<tr>
<td></td>
<td>23. Which sentence is irrelevant and so should be omitted?</td>
</tr>
<tr>
<td></td>
<td>A. Sentence 2</td>
</tr>
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<td></td>
<td>B. Sentence 3</td>
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<td>C. Sentence 4</td>
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<td>D. Sentence 5</td>
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<tr>
<td></td>
<td>E. Sentence 7</td>
</tr>
</tbody>
</table>

Turn the page.
DIRECTIONS:

Each of the following items, 24-29, contains four sentences expressing the same general thought. Decide which sentence in each group expresses the thought MOST EFFECTIVELY.

For example:

A. Because of the rain, our picnic was postponed.
B. The postponement of our picnic was because it was raining.
C. Due to the fact that it was raining, our picnic had to be postponed.
D. Being as it was raining, our picnic was postponed.
E. Having rained, our picnic had to be postponed.

Choice "A" is the best response; it expresses the thought clearly in the fewest words.

Now proceed to items 24-29, following the directions above.

24. A. Before he proposed, he wanted to meet the girl's family whom he hoped to marry.
B. He wanted before he proposed to meet the family of the girl he hoped to marry.
C. Before he proposed, he wanted to meet the family of the girl he hoped to marry.
D. He wanted to meet the family of the girl he hoped to marry before he proposed.
E. None of the above.

25. A. He was so bald it made people think he was older than he was.
B. He was bald, which made people think he was older than he was.
C. Because he was bald, people thought he was older than he was.
D. Being bald, people thought he was older than he was.
E. Both "A" and "D" are acceptable.

26. A. Just because a woman is beautiful is no reason why she should be arrogant.
B. Being beautiful, there's no excuse for a woman's being arrogant.
C. Being beautiful is no excuse for being arrogant.
D. Just because a woman's beautiful, there's no excuse for being arrogant.
E. Both "A" and "B" are acceptable.
TEST VI (6)

27. A. We don't tear your laundry with machinery; we do it carefully by hand.
   B. No machinery will tear your laundry, instead we do it carefully by hand.
   C. Doing your laundry carefully by hand, no machinery will tear it.
   D. We don't tear your laundry with machinery; we wash it carefully by hand.
   E. Both "B" and "C" are acceptable.

28. A. Printed in the directions, I see that the oil can be removed with gasoline.
   B. The directions say that the oil can be removed by anyone with gasoline.
   C. The directions say to remove the oil with gasoline,
   D. In the directions it says that the oil can be removed with gasoline.
   E. Both "A" and "B" are acceptable.

29. A. The natives are patient and industrious, and they have the habit of showing courtesy to tourists.
   B. The natives are patient, industrious, and courteous to tourists.
   C. The natives are patient and industrious and showing courtesy to tourists.
   D. The natives are patient and industrious, while showing courtesy to tourists.
   E. Both "C" and "D" are acceptable.
TEST VI (6)

DIRECTIONS:

In items 30-33, Part I expresses ideas in choppy, repetitious sentences. Decide which sentence in Part II expresses these same ideas MOST EFFECTIVELY. For example:

I. There was a student. He went to school. He wanted to go to the school library. The student wanted to work on his term paper.

II. A. To the library went the student to work on his term paper.

B. To work on his term paper the student went to the library in the school.

C. The student went to the school library to work on his term paper.

D. The school library was the place where the student went to do the work for his term paper.

Choice "C" is the best response; it expresses the thought clearly in the fewest words.

Now proceed to items 30-33, following the directions above.

30. I: There was a man. He stood on a railroad bridge. The bridge was in northern Florida. The man looked down. He looked at the water. It was fifteen feet below him. It was swift.

II. A. A man in northern Florida, who was standing on a railroad bridge, looked down into the water which was swift fifteen feet below him.

B. Fifteen feet below a man who stood on a railroad bridge in northern Florida was some swift water at which he was looking down.

C. Looking down into the swift water fifteen feet below him was a man in northern Florida who stood on a railroad bridge.

D. A man stood on a railroad bridge in northern Florida, looking down into the swift water fifteen feet below.

- 33 - Turn to next page.
31. I: The man's hands were not in their usual position. They were behind his back. The wrists were tied. There was a cord around them.

II. A. The man's hands were behind his back, the wrists bound with a cord.
B. Not in their usual position, the man's hands were behind his back, and a cord bound his wrists.
C. With his hands behind his back, a cord bound his wrists.
D. His wrists were bound with a cord, and his hands were behind his back.

32. I: There was a rope. It encircled the man's neck. It was fairly tight. It was attached to a cross-timber. The timber was stout. The timber was above the man's head.

II. A. A rope, which was attached to a stout cross-timber above the man's head, closely encircled his neck.
B. A rope closely encircled his neck, which was attached to a stout cross-timber above his head.
C. Closely encircling his neck was a rope which was attached to a stout cross-timber which was above his head.
D. A rope encircled his neck, and it was fairly tight, and it was attached to a stout cross-timber above him.

33. I: There were some loose boards. They supplied a footing for the man. They also supplied a footing for his executioners.

II. A. Laid on the railroad ties, the man stood on some loose boards which supplied a footing for him and his executioners.
B. Some loose boards laid on the railroad ties provided a footing for the man and his executioners.
C. Some loose boards laid on the ties supporting the rails provided a footing for the man and his executioners.
D. On the railroad ties were some loose boards, and they provided a footing for the man and his executioners.
TEST VI (6)

DIRECTIONS:

In items 34-36, combine the ideas in Part Y and Part Z into a single sentence by choosing the best connective. For example:

<table>
<thead>
<tr>
<th>Y</th>
<th>CONNECTIVE</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>The team played a great game under the worst weather conditions</td>
<td>A. , in fact,</td>
<td>they did not win the national championship.</td>
</tr>
<tr>
<td></td>
<td>B. , for example,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. ; likewise,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. ; as a result,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. ; however,</td>
<td></td>
</tr>
</tbody>
</table>

Choice "E" is the best answer because the connective needed is one that requires a contrast in thoughts. However is the only connective in the list providing this kind of CONNECTION.

Now proceed to items 34-36, following the directions above.

34. 

<table>
<thead>
<tr>
<th>Y</th>
<th>CONNECTIVE</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have never seen an art museum</td>
<td>A. ; therefore,</td>
<td>I live in Podunk.</td>
</tr>
<tr>
<td></td>
<td>B. , for</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. ; however,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. ; in the last analysis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. ; in any case,</td>
<td></td>
</tr>
</tbody>
</table>

35.

<table>
<thead>
<tr>
<th>Y</th>
<th>CONNECTIVE</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>The contractor took too long to finish the building. Plaster began to crack right away. The heating system soon broke down.</td>
<td>A. In the first place, someone was taking graft.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. However,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. Evidently,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. For example,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. Nevertheless,</td>
<td></td>
</tr>
</tbody>
</table>

36.

<table>
<thead>
<tr>
<th>Y</th>
<th>CONNECTIVE</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>John received passing grades on everyone of his tests</td>
<td>A. , and the teacher gave him a failing grade for the semester.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. , in brief,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. ; nevertheless,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D. , for</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E. ; therefore,</td>
<td></td>
</tr>
</tbody>
</table>

- 35 -

Turn to the next page.
TEST VI (6)

DIRECTIONS:

For items 37-42, you are given a sentence that is divided into four parts labeled "A" through "D". There is, at least, one error in grammar (subject-verb agreement or tense consistency) or punctuation in ONE part of the sentence. You are to decide which lettered part of the sentence contains the error.

For example:

A. Mary, as well as
B. her brothers and sisters,
C. have the measles, a
D. contagious disease

You should choose "C" as your answer because the verb, have, is not in agreement with the subject, Mary.

Now proceed to items 37-42, following the directions above.

37. A. Every day through the crowded streets
B. move a poor old man with a pushcart
C. as large as, if not larger
D. than, my little sports car.

38. A. After the resignation of Miss King,
B. the manager decided that he would need
C. a replacement for her, he appointed
D. Mr. Pratt to take her place.

39. A. Morris could not be
B. sure, but he thought the
C. man has worked for
D. his father years before.

40. A. Each student taking the test
B. should have the following supplies, a pencil,
C. scratch paper, an eraser,
D. and an answer sheet.

41. A. Deciding on the order of arrangement,
B. took him quite a while longer
C. than the actual work
D. of putting the books on the shelves.

42. A. It was an unusual case
B. in which the judge and the jury
C. interprets the evidence
D. in very different ways.

Turn to the next page
DIRECTIONS:

For items 43-50, you are given a grammatically correct sentence and an unfinished revision of that sentence. You are to complete the unfinished sentence mentally, according to a new sentence plan, by using a given word or phrase. The revised sentence need not be an improvement on the original, but it must be both logical and a grammatically correct restatement of the same idea and an example of acceptable English usage. Following the unfinished revision of the sentence are five single words or groups of words labeled "A" through "E". Choose as your answer the ONE word or group of words that would be included in the new construction. For example:

"When will I be able to see again?" John asked Dr. Brown.

John asked Dr. Brown when he...

The revised sentence contains the word or words

A. will be able
B. might be able
C. can
D. could have been able
E. would be able

You should choose answer "E", because the revised sentence would correctly read, "John asked Dr. Brown when he would be able to see again."

43. Jane asked her father if she could go to the school play.

"Father,...

The revised sentence contains the word

A. I
B. she
C. her
D. should
E. would

44. Jake was told by the stewardess that he could smoke when the plane was in the air.

The stewardess told Jake, "You...

The revised sentence contains the words

A. can...will be
B. will...will
C. might...are
D. may...is
E. could...was

Turn to the next page.
45. Although this is the jet age, 85 percent of the American population has never flown in an airplane.

This is...
The revised sentence contains the word
A. been
B. but
C. had
D. flew
E. may

46. The waiter seated the customers at a table for which they had expressed a preference.

The customers...
The revised sentence contains the word or words
A. express
B. prefer
C. admitted
D. introduced
E. were seated

47. The fisherman mended his nets that had been torn by the storm.

Having been torn....
The revised sentence contains the word
A. were
B. was
C. are
D. is
E. had

48. The most important issue we face today is control of nuclear warfare.

Control of...
The revised sentence contains the word
A. whether
B. any
C. are
D. we
E. many

49. His trembling voice revealed how angry he was.

The extent of his anger....
The revised sentence contains the word
A. him
B. speaks
C. talked
D. when
E. revealing

50. A wealthy man, he was happy and content.

He was happy....
The revised sentence contains the words
A. content and a wealthy man
B. a content, and wealthy man
C. content, and wealthy
D. and content, a wealthy
E. and content, and wealthy

STOP

- 38 -
TEST FOR
COGNITIVE STYLE TEST MAPPING

Dr. Joseph E. Hill

Oakland Community College
Bloomfield Hills, Michigan

UNTIMED TESTING

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TEST X (10)

DIRECTIONS

In this test there are ten (10) situations in which you are asked to imagine yourself. Each situation has four (4) alternative responses. You are to decide which response you would "most likely" make as the first choice or solution, then the second choice, the third choice, and the fourth choice.

Remember **YOU MUST RANK ALL FOUR RESPONSES** for each situation.

EXAMPLE

If you had to organize a baseball team, you would:

1. Pick from previously established teams.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice
2. Get all new untried players.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice
3. Bring older experienced players from retirement.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice
4. Compare each choice to an established star.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

SAMPLE ANSWER CARD

In this example #1 would be your first choice (A), #2 would be your third choice (C), #3 would be your second choice (B), and #4 would be your fourth choice (D).
One: If you were a member of the O.C.C. debate team and had to prepare a speech "in favor of public school education," which approach would you most likely take?

1. Compare American education with other American, European, and Far Eastern educational systems and point out the similarities among all of them.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

2. Tell your audience that despite what appear to be "fads" and "frills" in the public school, it still contains the three R's and holds to standards to excellence and purpose.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

3. Make a survey of all contemporary education pointing up differences between other educational systems and our own.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

4. Compare the similarities and differences in the ideas of professional educators and show to what extent they meet the standards of the past.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

Turn to the next page.
Two: If you were asked to recommend a "very good" restaurant to your best friend's family, what would you do?

5. Determine if the restaurant has the high standards of very good restaurants you have visited in the past.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

6. Find out if its standards are in keeping with older traditions as well as modern ones, and the extent to which it is like or different from other good restaurants and eating places.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

7. Discover in what ways the restaurant resembles and duplicates other fine eating places.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

8. Determine in what ways the restaurant's reputation is different from currently accepted standards of excellence.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

Turn to the next page.
In considering your own ideas about what helps to make a "good" education, how would you rate the following as methods of good classroom management?

9. Arrange a classroom that is as much as possible like the kind of situations the students will encounter in the "real" world (business, military, professional, etc.).
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

10. Place the teacher in position of authority. He should be one who leads, instructs, and controls the activities.
    A. first choice
    B. second choice
    C. third choice
    D. fourth choice

11. Use the latest theories of education to show how today's classroom differs from the past.
    A. first choice
    B. second choice
    C. third choice
    D. fourth choice

12. Recognize how our standards and values are changing and provide a classroom that will aid learning and, at the same time, help in the acceptance of society's standards.
    A. first choice
    B. second choice
    C. third choice
    D. fourth choice

Turn to next page.
If you were asked to rate the performance of a group of workers or students, which method of rating would you most likely choose?

13. Check the past record of the student/worker, compare his performance to that of his fellow workers, and consider his performance in terms of the work of others in the past.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

14. Rate the worker/student in terms of standards and requirements established for the whole group at the beginning of the year.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

15. Rate this year's group in terms of its difference from the best group which performed in the past.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

16. Grade the student in comparison with the performance of his present classmates.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

Turn to the next page
TEST X (10)

Five:

If you believe that a good home is necessary and desirable for a child to make the greatest success in school, which of the following would you most likely choose as the best home environment?

17. One where the "old time" parent and child roles are somewhat followed. Difference and individuality is respected, but attempts are made by the family to fit into the neighborhood by being like other families on the block in most ways.

   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

18. One where the child is sure that his home is pretty much like the home of his friends and classmates.

   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

19. One where the members of the family follow the ideas put forward by social workers, family counsellors and family doctors.

   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

20. One where the best home is considered independent of the rest of the society and is judged by its difference from other families.

   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

Turn to the next page.
Six:

If you feel that a course in psychology is helpful to a better understanding of normal behavior, which would you choose as the most effective way to teach such a course?

21. A method where the teacher lectures and uses a standard textbook which has been highly rated by psychology teachers.

   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

22. Have students read various paperback novels and books which illustrate different psychological problems (such as, "I Never Promised You a Rose Garden") and compare the abnormal behavior brought out in the books with that discussed in class.

   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

23. Have students engage in a discussion of which symptoms are typical of a particular illness and how it is different from another illness.

   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

24. Use standard textbooks, tour a state mental hospital, read psychological research, and determine how accurate is the current method of classification of mental illness.

   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

Turn to the next page.
Seven:

If you wanted to find out more about O.C.C.'s basketball team, with hopes of making the varsity, which would you choose as most helpful?

25. Watch movies of games played in the past, note the strategy used by the O.C.C. winning team as compared with that used by the other team.

A. first choice
B. second choice
C. third choice
D. fourth choice

26. Attend a series of lectures by the coach in which he describes the usual kind of player who contributes to a successful team, and the traditional demands on the player.

A. first choice
B. second choice
C. third choice
D. fourth choice

27. Pay close attention to the players who are on the varsity team, and note the difference between their skills and those of players on the reserve team.

A. first choice
B. second choice
C. third choice
D. fourth choice

28. Listen to talks by coaches on the subject of what makes for success in basketball, compare your skills with those of other players but also realize your shortcomings.

A. first choice
B. second choice
C. third choice
D. fourth choice

Turn to the next page.
TEST X (10)

Eight:

In making plans for getting a job after school graduation, which procedure would you follow?

29. Go to the state employment agency for an interview with the guidance counselor.
   
   A. first choice  
   B. second choice  
   C. third choice  
   D. fourth choice  

30. Ask your high school counselor about job possibilities, look at the want ads in the daily papers, and then make up your mind based on all of the information gathered.

   A. first choice  
   B. second choice  
   C. third choice  
   D. fourth choice  

31. Compare the advantages of the job listed in the want ads with those suggested by the state employment agency.

   A. first choice  
   B. second choice  
   C. third choice  
   D. fourth choice  

32. Check on the differences in pay, fringe benefits, and tasks required for the same kind of job at different places.

   A. first choice  
   B. second choice  
   C. third choice  
   D. fourth choice  

Turn to the next page.
TEST X (10)

Nine:

If you were demonstrating to a group of youngsters a method for learning to draw pictures, which would be the most effective way?

33. To teach it as it is taught in school art classes where the methods are demonstrated by the instructor.
   
   A. first choice  
   B. second choice  
   C. third choice  
   D. fourth choice

34. To show different approaches and methods in teaching art. Analyze the very early methods of African art, the later methods of European and modern artists.

   A. first choice  
   B. second choice  
   C. third choice  
   D. fourth choice

35. To compare the methods of teaching some art skills to sketching, sculpture and the drawing of portraits.

   A. first choice  
   B. second choice  
   C. third choice  
   D. fourth choice

36. To note the differences between new and past methods of teaching art.

   A. first choice  
   B. second choice  
   C. third choice  
   D. fourth choice

Turn to the next page.
Ten:
The issues centering around student rights and censorship of school reading material is of concern to most students. Which of the following do you most agree with?

37. School systems should copy the censoring practices of other institutions of society. (i.e., the courts, publishers, churches, and libraries).
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

38. School policy should recognize the policies of other arms of society, and show how the policies at O.C.C. differ from the usual ones.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

39. The school system should honor its traditions and recognize the wisdom of the past controlling decisions of great leaders in education.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

40. The school administration should secure recommended positions on this issue from as many official offices and unofficial organizations as possible, as well as student's opinions, and shape a policy from this research.
   A. first choice
   B. second choice
   C. third choice
   D. fourth choice

Turn to the next page.
Answer each of the following statements.

Fill in the space on the I.B.M. card using the following code:

A. Rarely  
B. Sometimes  
C. Usually

41. When I am in an argument I avoid probability statements.

42. I enjoy the type of reasoning used in solving arithmetic problems.

43. I enjoy puzzles in which the solution is deduced from the rules.

44. When I am defending a position, I attempt to develop a logical proof.

45. I resent being placed in situations in which I cannot predict what the outcome will be.
TEST IX (9)

DIRECTIONS

The following stories or incidents happen to people. Three possible responses are given. You are required to choose which of these is "most like you" (A) and which is "least like you" (B). You will leave one choice blank in every three answers.

EXAMPLE

A. Sue Bryant is planning to buy some new clothes for a long vacation trip. She should:

1. Consult her parents and sisters on what to buy.
   A. MOST    B. LEAST

2. Make her own decision.
   A. MOST    B. LEAST

3. Ask the advice of her girlfriends.
   A. MOST    B. LEAST

   1. A  B  C  D  E
   2. A  B  C  D  E
   3. A  B  C  D  E

In the above example it would be "most like you" (3A) to ask the advice of your friends and "least like you" (2B) to make a decision alone on what to buy, and you left one choice (1) blank.

ALL of test nine follows this pattern of a combination of A - B - Blank in every three answers.
MARK (9) on the Form line of your next I.B.M. card.

A. Mrs. Jones, a widow with three children at home, is about to be evicted from the flat that she has rented for the past ten years. In order to help her solve her problem, she should:

1. Ask her married children (or sisters or brothers) for help.
   A. MOST  B. LEAST

2. Ask the ladies in her church group to give her some advice and help.
   A. MOST  B. LEAST

3. Realize that no one can really help her and decide to solve it on her own.
   A. MOST  B. LEAST

B. Bill Bowen, a 17 year old at Center High School, is having more and more frequent arguments and encounters with another fellow in school. It is beginning to seem as though a fight cannot be avoided. Bill should:

4. Talk to his best buddies about what he should do.
   A. MOST  B. LEAST

5. Decide for himself what to do and even fight if necessary.
   A. MOST  B. LEAST

6. Talk to folks at home and take their advice.
   A. MOST  B. LEAST

Turn to the next page.
C. Mary is a sophomore student at Colorado University. A number of students are planning to go out on strike to protest "an inadequate educational system." Other students are not supporting the strike. Mary should:

7. Weigh the positive and negative arguments for the strike and make up her mind.
   A. MOST  B. LEAST

8. Call her parents (or brother or sister) and ask their advice.
   A. MOST  B. LEAST

9. Discuss the proposed strike with her friends and follow their suggestions.
   A. MOST  B. LEAST

D. Don Roberts needs a car to get to his new job. He goes to the used car agency with some of his buddies and his Dad. His father wants him to buy one car, his buddies are urging him to buy a different one and he has been thinking about another one. He should:

    A. MOST  B. LEAST

11. Buy what he has been thinking about.
    A. MOST  B. LEAST

12. Buy what his buddies are telling him to get.
    A. MOST  B. LEAST

Turn to the next page.
E. The pastor of the B.C.E. Bible Church has been urging his congregation to boycott some merchants along Tenth Street for unfair sales and hiring practices. Mr. and Mrs. Pitts have shopped at the stores for years and some of the merchants have been fairly nice to them. Mrs. Pitts does not want her family to go without the things they get at the store. However, their fellow church members all side with the pastor. If you were Mr. Pitts:

13. The family's feelings should determine the decision.
   A. MOST  B. LEAST

14. The goals of the members of the church should heavily influence your actions.
   A. MOST  B. LEAST

15. You should weigh the situation and make a decision based on your individual experiences.
   A. MOST  B. LEAST

DIRECTIONS:
Among the following statements choose the one that is "most like you" (A) and the one that is "least like you" (B). Continue to follow this pattern of A - B - Blank in every three (3) answers.

F. 16. To be free to do as I choose.
    A. MOST  B. LEAST

17. To follow the advice given to me by close relatives.
    A. MOST  B. LEAST

18. To have others support and agree with me.
    A. MOST  B. LEAST

Turn to the next page
- 16 -
G. 19. To stick close to the standards developed in our family.
   A. MOST  B. LEAST

   20. To stick firmly to my own opinions and beliefs.
   A. MOST  B. LEAST

   21. To stick to the beliefs of my associates and fellow students.
   A. MOST  B. LEAST

H. 22. To make things for other people.
   A. MOST  B. LEAST

   23. To spend time working on a family project.
   A. MOST  B. LEAST

   24. To work on my own hobbies without assistance.
   A. MOST  B. LEAST

I. 25. To live my life as taught by my parents.
   A. MOST  B. LEAST

   26. To be able to live my life exactly as I wish.
   A. MOST  B. LEAST

   27. To have a way of life much like my friends.
   A. MOST  B. LEAST

J. 28. To be relatively unbound by social conventions.
   A. MOST  B. LEAST

   29. To be praised and approved of by other people.
   A. MOST  B. LEAST

   30. To gain the approval of my family.
   A. MOST  B. LEAST

   Turn to the next page.
DIRECTIONS

The following test is untimed. Work quickly and mark the first answer that comes to you. Your first impression is important. Do not spend a lot of time on any one question.

There are 32 items.

Fill in the space on the I.B.M. card under the proper letter.

A = Usually
B = Sometimes
C = Seldom
D = Never

EXAMPLE:

I would make a good football player.
A. Usually B. Sometimes C. Seldom D. Never

ANSWER CARD

A | B | C | D | E

In this case you believe you would "Usually" be good as a football player.

Mark (8) on the Form Line of your next I.B.M. card. Answer the following statements.

Turn to the next page.
TEST VIII (8)

1. I compete effectively in amateur sports.
   A. Usually   B. Sometimes   C. Seldom   D. Never

2. I wait for an invitation to be seated in making a call
   on a supervisor in his office.
   A. Usually   B. Sometimes   C. Seldom   D. Never

3. I am able to keep at a task which I set for myself.
   A. Usually   B. Sometimes   C. Seldom   D. Never

4. I can be effective in settling a dispute between two parties.
   A. Usually   B. Sometimes   C. Seldom   D. Never

5. I accept criticism without being deeply hurt.
   A. Usually   B. Sometimes   C. Seldom   D. Never

6. I can maintain balance well enough to participate in
   water or snow skiing.
   A. Usually   B. Sometimes   C. Seldom   D. Never

7. I set goals consistent with my own needs and abilities.
   A. Usually   B. Sometimes   C. Seldom   D. Never

8. I can bring a group to some agreement.
   A. Usually   B. Sometimes   C. Seldom   D. Never

9. I play the piano or other musical instrument.
   A. Usually   B. Sometimes   C. Seldom   D. Never

10. I can jump rope for three minutes with less than
    three restarts.
    A. Usually   B. Sometimes   C. Seldom   D. Never

11. I seldom fail to complete an assignment because of
    misjudging my ability to complete the task.
    A. Usually   B. Sometimes   C. Seldom   D. Never

Turn to the next page.
12. I compete effectively with other amateurs in such games as billiards, ping-pong, or dart-throwing.
   A. Usually   B. Sometimes   C. Seldom   D. Never

13. I can influence others to join me in a cause.
   A. Usually   B. Sometimes   C. Seldom   D. Never

14. I can repair or work on an object with small parts.
   A. Usually   B. Sometimes   C. Seldom   D. Never

15. I would wait to be addressed by a supervisor rather than take the initiative in greeting.
   A. Usually   B. Sometimes   C. Seldom   D. Never

16. I reserve discussion of "personal" matters to either those who discuss such things professionally or friends and relatives.
   A. Usually   B. Sometimes   C. Seldom   D. Never

17. I can convince people in disagreement to reach agreement.
   A. Usually   B. Sometimes   C. Seldom   D. Never

18. I am an adequate typist.
   A. Usually   B. Sometimes   C. Seldom   D. Never

19. I accurately predict my prospects for success in most situations.
   A. Usually   B. Sometimes   C. Seldom   D. Never

20. I make minor household repairs.
   A. Usually   B. Sometimes   C. Seldom   D. Never

   A. Usually   B. Sometimes   C. Seldom   D. Never

22. I request permission before taking a seat near a stranger.
   A. Usually   B. Sometimes   C. Seldom   D. Never

Turn to the next page.
23. I can convince others that my opinions are right.  
   A. Usually  B. Sometimes  C. Seldom  D. Never

24. I reserve the use of first name greeting to friends and associates of similar status.  
   A. Usually  B. Sometimes  C. Seldom  D. Never

25. I can give a good description of someone's personality after a short acquaintance.  
   A. Usually  B. Sometimes  C. Seldom  D. Never

26. I am able to predict my own performance in a situation which I had not experienced before.  
   A. Usually  B. Sometimes  C. Seldom  D. Never

27. I give directions in such a way that others want to accept them.  
   A. Usually  B. Sometimes  C. Seldom  D. Never

28. I can anticipate how well I will do in an activity.  
   A. Usually  B. Sometimes  C. Seldom  D. Never

29. I would wait to be introduced to a famous celebrity rather than introduce myself.  
   A. Usually  B. Sometimes  C. Seldom  D. Never

30. I convince others to do the things I think they should do.  
   A. Usually  B. Sometimes  C. Seldom  D. Never

31. I do not borrow money from strangers.  
   A. Usually  B. Sometimes  C. Seldom  D. Never

32. I would make a good salesman.  
   A. Usually  B. Sometimes  C. Seldom  D. Never

Turn to the next page.
TEST VII (7)

DIRECTIONS

The following test is untimed.
Work quickly and give the first answer that comes to you.
Your first impression is important.
Do not spend a lot of time on any one question.

There are 40 items.

Fill in the space on the I.B.M. card under the proper letter.

A = Usually
B = Sometimes
C = Seldom
D = Never

EXAMPLE:

I would make a good football player.
   A. Usually  B. Sometimes  C. Seldom  D. Never

1. A ⊗ B ⊗ C ⊗ D ⊗ E ⊗

In this case you believe you would "Usually" be good as a football player.

Mark (7) on the Form Line on your last I.B.M. card.
Answer the following statements.

Turn to the next page.
TEST VII (7)

1. I try to avoid saying things which hurt other's feelings.
   A. Usually   B. Sometimes   C. Seldom   D. Never

2. I enjoy attending a good theatrical performance.
   A. Usually   B. Sometimes   C. Seldom   D. Never

3. The values of our society are good for everyone.
   A. Usually   B. Sometimes   C. Seldom   D. Never

4. I can effectively participate in a role-playing situation.
   A. Usually   B. Sometimes   C. Seldom   D. Never

5. I "talk with my hands" as one means of communicating.
   A. Usually   B. Sometimes   C. Seldom   D. Never

6. I consider the feelings of others.
   A. Usually   B. Sometimes   C. Seldom   D. Never

7. I enjoy listening to a good concert.
   A. Usually   B. Sometimes   C. Seldom   D. Never

8. I direct my life according to moral values.
   A. Usually   B. Sometimes   C. Seldom   D. Never

9. I am the type of person who can understand how others feel.
   A. Usually   B. Sometimes   C. Seldom   D. Never

10. I use "non-verbal" communication to make a point in a speech.
    A. Usually   B. Sometimes   C. Seldom   D. Never

11. I am able to act in a stage play.
    A. Usually   B. Sometimes   C. Seldom   D. Never

12. I ask personal favors from close friends and associates rather than from strangers or work supervisors.
    A. Usually   B. Sometimes   C. Seldom   D. Never

Turn to the next page.
TEST VII (7)

13. I can understand how others feel.
   A. Usually  B. Sometimes  C. Seldom  D. Never

14. I would give up monetary gain to avoid a compromise of principles.
   A. Usually  B. Sometimes  C. Seldom  D. Never

15. I enjoy eating exotic foods and foreign dishes.
   A. Usually  B. Sometimes  C. Seldom  D. Never

16. I enjoy telling jokes and stories at a party.
   A. Usually  B. Sometimes  C. Seldom  D. Never

17. I would give up an immediate objective rather than sacrifice a principle.
   A. Usually  B. Sometimes  C. Seldom  D. Never

18. I tell amusing stories at parties.
   A. Usually  B. Sometimes  C. Seldom  D. Never

19. I do not permit personal affairs to interfere with completing an assignment.
   A. Usually  B. Sometimes  C. Seldom  D. Never

20. I understand how a person being punished would feel.
   A. Usually  B. Sometimes  C. Seldom  D. Never

21. I take part in amateur theatricals.
   A. Usually  B. Sometimes  C. Seldom  D. Never

22. I enjoy reading great works in literature.
   A. Usually  B. Sometimes  C. Seldom  D. Never

23. I can mimic a friend using only bodily movements and facial expressions.
   A. Usually  B. Sometimes  C. Seldom  D. Never

Turn to the next page.
24. I understand my friends better than they understand me.
   A. Usually   B. Sometimes   C. Seldom   D. Never

25. I do "play a role" if asked to at a party.
   A. Usually   B. Sometimes   C. Seldom   D. Never

26. I blush in an embarrassing situation.
   A. Usually   B. Sometimes   C. Seldom   D. Never

27. I believe that a promise should be kept.
   A. Usually   B. Sometimes   C. Seldom   D. Never

28. The quality of one's work does not deteriorate when
   the supervisor is away.
   A. Usually   B. Sometimes   C. Seldom   D. Never

29. I can effectively illustrate the behavior of a deaf-mute
   using various movements and actions.
   A. Usually   B. Sometimes   C. Seldom   D. Never

30. I enjoy reading poetry.
   A. Usually   B. Sometimes   C. Seldom   D. Never

31. I communicate well in a "charades" game.
   A. Usually   B. Sometimes   C. Seldom   D. Never

32. I am able to offer criticism without offending
   another person.
   A. Usually   B. Sometimes   C. Seldom   D. Never

33. I pretend to be someone other than myself.
   A. Usually   B. Sometimes   C. Seldom   D. Never

34. I enjoy viewing a display of modern art.
   A. Usually   B. Sometimes   C. Seldom   D. Never

   Turn to the next page.

- 25 -
TEST VII (7)

35. I use facial expressions to express various emotions.
   A. Usually   B. Sometimes   C. Seldom   D. Never

36. I discuss art and painting with friends.
   A. Usually   B. Sometimes   C. Seldom   D. Never

37. I can imitate a famous movie star before a group.
   A. Usually   B. Sometimes   C. Seldom   D. Never

38. I enjoy going to a symphony or opera.
   A. Usually   B. Sometimes   C. Seldom   D. Never

39. I shrug my shoulders when saying "I don't know."
   A. Usually   B. Sometimes   C. Seldom   D. Never

40. I would stop for a "STOP" sign any time even if there were no other person in sight.
   A. Usually   B. Sometimes   C. Seldom   D. Never
APPENDIX I: TYPICAL COGNITIVE STYLE MAP
**Cognitive Style Listing**

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**Test Scores** (Date Processed 09/05/72)

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**Suggested English Course:** ENC052

**Circle K Test**

**Reading Level:** 7.1
APPENDIX J: "MANAGEMENT TEST"
MANAGEMENT TEST

Directions:

This test is used to try and determine your industrial management knowledge.

Please answer all questions on the enclosed IBM answer sheet. Fill in your complete name, date, age, sex, and date of birth in the appropriate area. Give your campus address in the space designated for school and city. In the space labeled "grade" indicate your classification (freshman, sophomore, etc.) and under "test" write "Management Test". In the identification number box please fill in your social security number starting in the second square (LEAVE THE TOP SQUARE BLANK). Mark in the appropriate number to the right of each square in the identification number area.

Note that items on the answer sheet are numbered across the sheet. Responses to the true and false questions are marked as follows:

1 - true, 2 - false

Samples:

True-False

1. Iowa is a state.

1 2 3 4 5
1. [ ] [ ] [ ] [ ] [ ]

Multiple Choice

2. Chicago is

1. a country
2. a mountain
3. a city
4. a state

1 2 3 4 5
2. [ ] [ ] [ ] [ ] [ ]

You may work the problems in any order. It is important you attempt all of the items.
TRUE-FALSE

1. A plant is continually depreciating and therefore requires quarterly plant investment to maintain production capacity.

2. For efficiency of operation, one should strive for 100% of production capacity.

3. There is a direct relationship between cost of production per unit and the number of units produced.

4. Industrial research is predictable in its outcomes.

5. For efficiency of operation, one should strive to operate at the lowest average cost point.

6. As the number of units of production decreases, the cost per unit of production increases.

7. Inventory costs are assessed on the basis of the number of stored units at the beginning of each period.

8. Production changes due to research and development expenditures generally occurs within six months.

9. It is economically advantageous in industrial production to vary output by at least 30% each quarter.

10. There are unpredictable factors which affect the product demand over which individual firms have no control.

11. An increase in dividends tends to lower the price of the stock.

12. The growth in sales by an entire industry is partly due to the rise and fall of the economy in general.

13. A change in a company's profits will not affect its stock price until the end of the year.

14. Variations in production levels from quarter to quarter reduce average production costs per unit because fluctuate demands for the product are met.

15. The effect of marketing expenditures are generally felt within four months.

16. Generally increases in research and development increases the production cost per unit.

17. The general growth of the gross national product causes a growth in sales potential.
18. Stock dividends are computed before taxes are paid.

19. A decline in marketing expenditures by an entire industry results in a greater demand for the industry's product.

20. The business cycle tends to have a definite influence on the amount of money spent on research and development.

21. The gross value of the plant equals the net value of the plant minus the depreciation.

22. Borrowing power for a company is affected by past profits.

23. Taxes take a large portion of profit from industry.

24. In calculating total production costs, marketing expenditures are included.

25. An increase in the values of a company's inventories tends to increase the price of the stock for that company.

MULTIPLE CHOICE

26. Information available to a firm, without market research expenditure, includes
   1. the firm's share of the market.
   2. the attractiveness of the firm's product.
   3. the financial position of all companies in the industry.
   4. more than one of the above.

27. The demand for an individual company's product, in relationship to the demand for the industry
   1. increases when its research and development increases.
   2. decreases when its marketing expenditures increase.
   3. increases when its prices increase.
   4. decreases when its quality increases.

28. By not being able to fill potential sales, due to low inventory (leaving all other factors equal),
   1. sales will decline the next quarter and then stabilize.
   2. sales will increase for the next quarter.
   3. sales will decrease over the entire next year.
   4. sales will return to their previous level after one quarter.

29. Increasing the volume of production
   1. increases the cost per unit of output.
   2. decreases the cost per unit of output.
   3. decreases the fixed costs of production.
   4. has no effect on the cost per unit of output.
30. Market research funds would not have to be expanded for which of the following?
   1. Marketing expenditures for the entire industry.
   2. Competitors' share of the market.
   3. Both of the above require market research expenditures.
   4. Neither of the above require market research expenditures.

31. When the average price of products produced by competing companies decline, generally the total quantity demanded
   1. increases.
   2. decreases.
   3. stays the same.
   4. the two concepts are not dependent upon each other.

32. If a company holds its marketing expenditures constant while other firms within the industry are dropping theirs,
   1. the company's sales will increase.
   2. the company's sales will decrease.
   3. the company's sales will remain constant while the sales of the industry as a whole grows.
   4. the company's sales will remain constant while the sales of the industry as a whole declines.

33. The demand for products from a total industry will generally
   1. decrease with an increase in marketing expenditures by all firms.
   2. increase as companies increase their research and development.
   3. decrease no matter what the industry does.
   4. increase as the smaller companies within the industry increase their prices.

34. An increase in profits by a company will
   1. increase its line of credit.
   2. decrease its line of credit.
   3. maintain its present line of credit.
   4. the one does not affect the other.

35. Discarding part of a plant causes
   1. a decline in capacity.
   2. a decline in efficiency.
   3. a rise in assets.
   4. more than one of the above.

36. Warehousing inventory costs comprise approximately what percentage of the selling cost of a product?
   1. 1%
   2. 4%
   3. 12%
   4. 36%
37. Assuming that during a quarter production costs rise 10%, research costs drop 10%, market research costs drop 10%, and all other factors remain equal; the cost of goods sold during the quarter would
   1. remain the same as the previous quarter.
   2. rise over the cost of the previous quarter.
   3. drop over the costs of the previous quarter.
   4. there is insufficient data to determine the trend.

38. In a 30,000 unit capacity plant one would expect to spend how much for additional plant investment each quarter to maintain present capacity?
   1. $50,000
   2. $100,000
   3. $150,000
   4. $200,000

39. As the capacity of a plant increases
   1. the total production costs fall.
   2. the inventory costs rise.
   3. the cost per unit falls.
   4. the research and development costs per unit rise.

40. The net assets of a company at the beginning of any quarter equals the cash on hand
   1. minus the value of the inventory plus the value of the plant and plus the value of the loan.
   2. times the value of the inventory added to the value of the plant and loan.
   3. plus the value of the inventory plus the value of the plant and plus the value of the loan.
   4. plus the value of the inventory, plus the value of the plant, and minus the value of the loan.

41. The two most important factors influencing profit, of those listed below, are
   1. cost of production and marketing.
   2. price and additional plant investment.
   3. research and development and marketing.
   4. price and research and development.

42. If a firm had an excessive level of inventory which they wished to reduce, they would
   1. increase marketing expenditures.
   2. decrease price.
   3. increase discard of plant.
   4. decrease research and development.

43. Quality of the product would be reflected in expenditures for
   1. marketing.
   2. production.
   3. research.
   4. none of the above.
44. A $5 million plant might expect a quarterly depreciation of
1. $50,000
2. $100,000
3. $150,000
4. $200,000

45. Dividends are determined by a company's
1. price of product and marketing expenditures.
2. stock price and marketing expenditures.
3. stock price and profit.
4. profit and price of product.
APPENDIX K: "BEEF BREEDING TEST"
BEEF BREEDING TEST

Direction:

This test is used to try and determine your beef breeding knowledge. Please answer all questions on the enclosed IBM answer sheet. Fill in your complete name, date, age, sex, and date of birth in the appropriate area. Give your campus address in the space designated for school and city. In the space labeled "grade" indicate your classification (freshman, sophomore, etc.) and under "test" write "Beef Breeding Test". In the area designated "part" please indicate your home town. Also in "part" indicate whether you lived on a farm by writing "farm" or "nonfarm". Under "instructor" give your major. In the identification number box please fill in your social security number starting in the second square (LEAVE THE TOP SQUARE BLANK). Mark in the appropriate number to the right of each square in the identification number area.

Note that items on the answer sheet are numbered across the sheet. Responses to the true and false questions are marked as follows:

1 - true, 2 - false

Samples:

True-False

1. Iowa is a state

1 2 3 4 5

1. [ ] [ ] [ ] [ ]

Multiple Choice

2. Chicago is

1. a country
2. a mountain
3. a city
4. a state

2. 1 2 3 4 5

[ ] [ ] [ ] [ ]

You may work the problems in any order. It is important you attempt all of the items.
TRUE-FALSE

1. The heaviest bull of a herd always has the best genetic makeup for growth.
2. The best bull in one herd may be genetically average in another.
3. A good cow is more important to herd progress than is a good bull.
4. The accuracy of the estimated breeding value obtained from the offspring of an animal is dependent upon the number of offspring.
5. Performance testing is not as important with the use of artificial insemination as with natural service.
6. The percent of retail cuts is the measure of carcass merit.
7. Weaning weight is a more important selection characteristic for slaughter value than yearling weight.
8. The calculated breeding value of a bull is influenced by the particular cows to which he is mated.
9. Maternal sisters would be offspring of the same dam.
10. A breeder is assured of obtaining the heaviest calf by mating the heaviest cow to the heaviest bull.
11. Performance records must be maintained for accurate determination of breeding values of quantitative traits.
12. An animal's breeding value can more accurately be determined from the performance record of the animal's parents than from the animal's offspring.
13. Environmental factors have very little effect on weaning weight.
14. The estimated breeding value of a herd bull is potentially more accurate than that of a cow.
15. Two bulls with the same estimated breeding value, but different accuracies, appear to be genetically equal.
16. Heredity plays an very small part in feedlot gain for beef calves.
17. In improving a beef herd, one should strive for a predetermined goal.
18. The offspring from the same bull and cow are always going to have the same genetic makeup.
19. A calf will usually have more paternal half-siblings than maternal half-siblings.
20. The performance traits of a calf are a combination of heredity and environmental influences.

21. Using the bull's own performance records as a basis, artificial insemination bulls cannot be compared with one another.

22. Feedlot gain accounts for well over half of the yearling weight.

23. The mating of two given animals produces an offspring with predictable quantitative traits.

24. The offspring of a cow may not represent the genetic merit of the cow due to the bull she is mated with.

25. To obtain most carcass traits of an animal, the animal must be slaughtered.

MULTIPLE CHOICE

26. The best estimate of the breeding value of a bull is obtained by measuring the bull's
   1. offspring
   2. siblings
   3. parents
   4. none of the above

27. The accuracy of a breeding value of a yearling calf would most likely be
   1. .20
   2. .45
   3. .67
   4. .86

28. A yearling weight ratio of 110 in a herd averaging 900 pounds indicates a yearling weight of
   1. 810 pounds
   2. 900 pounds
   3. 990 pounds
   4. 1100 pounds

29. The breeding value of a bull is potentially influenced most by
   1. the bull's performance
   2. the performance of the bull's siblings
   3. the bull's offspring
   4. the bull's parents' performance

30. A beef calf should gain approximately how many pounds per day while in the lot?
   1. 1.5
   2. 2.0
   3. 2.5
   4. 3.5
31. The breeder has the opportunity to make the most progress with his herd through
   1. selection of cows
   2. selection of bulls
   3. selection of which calves to slaughter
   4. decision of which animals to mate

32. Yearling weight combines the effects of what two variables to give a meaningful figure?
   1. weaning weight and feedlot gain
   2. birth weight and breeding value
   3. birth weight and feedlot gain
   4. weaning weight and birth weight

33. When selecting bulls from a testing within a herd, they are usually from the upper
   1. 3%
   2. 20%
   3. 35%
   4. 50%

34. The accuracy of the calculated breeding value will increase when
   1. feedlot gain decreases
   2. yearling weight increases
   3. the number of offspring of an animal increases
   4. none of the above

35. The percentage of calves which fail to live in one year is approximately
   1. 2.5%
   2. 5%
   3. 7.5%
   4. 10%

36. The most dependable selection criterion for growth in calves which are to be kept as breeding stock is
   1. weaning weight
   2. yearling weight
   3. average daily feedlot gain
   4. progeny record

37. A breeder with an average herd of animals can expect to increase the average yearling weight per calf crop by how many pounds with no selection?
   1. 0
   2. 10
   3. 20
   4. 30
38. Progeny are the
   1. offspring of an animal
   2. the parents of an animal
   3. brothers of an animal
   4. none of the above

39. Weaning weight measures
   1. maternal ability
   2. early growth
   3. both of the above
   4. none of the above

40. Increasing the number of animals in the calculation of breeding value tends to
   1. lower the average value
   2. cancel out the environmental differences
   3. increases the heredity differences
   4. all of the above

41. The yearling weight of an average beef calf should be approximately
   1. 500 pounds
   2. 1000 pounds
   3. 1500 pounds
   4. 2000 pounds

42. Which of the following information is available before a calf is mature enough to reproduce?
   1. weaning weight and feedlot gain
   2. feedlot gain and yearling weight
   3. weaning weight and yearling weight
   4. all of the above

43. The weaning weight of a beef calf should be approximately
   1. 350 pounds
   2. 470 pounds
   3. 680 pounds
   4. 900 pounds
APPENDIX L: TABLE OF CHI-SQUARE ANALYSES TO DETERMINE MANAGEMENT ACHIEVERS AND BEEF ACHIEVERS
Table L-1. Chi-square analysis to determine management achievers and beef achievers

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