A STUDY OF THE EFFECT OF NON-INFORMATIONAL CUES ON STUDENTS' TEST PERFORMANCE

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CHAPTER I

INTRODUCTION

By the time of the ancient Greeks, the relation of testing to the education of the young was well established and refined. The Spartans, devoted to physical culture, had a graduated series of tests through which every boy had to pass in demonstrating his mastery of the required skills of manhood. In Athens, a more intellectual kind of testing was refined by Socrates to extend and enrich the learning of his pupils. Socrates used a combination of teaching and testing that is popular in certain fields today (14).

Through time, those who taught the young also tested them. Teaching was intensely personal. The teacher generally worked with a single pupil, or with a small group of pupils. Under these conditions, testing was a normal part of the give and take of teaching and seldom was regarded as a separate function. Schooling inevitably became more formal as increasing numbers of young people sought an education. Larger classes were a generally established practice at the time American Education was being organized.

The special problems of teaching created by group instruction were recognized at least as early as the eighteenth century. Around 1800, Pestalozzi and Herbart saw that even though teachers instructed pupils in groups they had to understand them as individuals.

Achievement test have a long history. The Spartan youth demonstrated his fitness by running to the top of a mountain. The young Athenian scholar successfully engaged other scholars in disputation. And in the United States of a generation ago, the eight-grader was required to stand and spell words correctly. At this time the achievement test was designed to find out whether the student had learned what he had been taught. The achievement test was aimed at demonstrating a small piece of learning such as the recall of a single fact.

The design and purposes of achievement tests were further expanded by educators such as Jean Piaget (40). Piaget thought that the design of achievement test should parallel the goals of education. He felt that the primary goal of education was to create men who are capable of doing new things, not simply repeating what other generations have done. A secondary goal was to form minds which can be critical, can verify, and do not accept everything they are offered. According to Piaget, the achievement test should measure how well students have obtained these goals. He felt that the achievement test should cover more than simple recall. It should include a more complex learning such as the application of principles or how well does the student comprehend certain texts.

If these can be considered primary goals of education today, then an understanding of the facts studied is a paramount objective of activities classified as educational. A parallel objective would be developing measuring techniques to determine if a student has understood the facts presented in the classroom.

Along with the design of achievement tests, the early investigators were also concerned with control of testing conditions and absolute objective scoring. This concern was based on a series of experiments that showed how unreliable, and often unfair, was the construction and grading of the traditional essay and objective examination Chauncey (14).

The technique generally used for measuring what a student has learned is the teacher-made examination. The fact that teacher-made examinations are used makes their validity important. A test is valid when it measures what it is presumed to measure (21).

Many teachers have heard students state that they knew the answer to a question but did not know what was wanted. Bloom and Broder (9) found that a student often has the background and technical information necessary for the solution of a problem, but is unable to apply the knowledge to the problem. Non-successful students, on examinations, seem unable to realize fully the implications of the ideas of a problem. If a student has the necessary knowledge but is unable to solve a problem or answer a question, then the examination is not measuring the amount of transfer and may not be valid.

The above aspects of achievement test development and their lack of validity indicates that information is needed on methods to improve the validity of teacher-made examinations. The present study attempts to determine if a student's test performance can be improved by the use of non-informational cues. This study investigates the use of non-informational cues at three different cognitive levels which are knowledge, comprehension, and application.

Hypotheses

The hypotheses that guide this study stated in the null form are as follows:

1. There is no difference (P = 0.05 level) in the means of the correct responses to cued and uncued questions based on the number of correct responses to these knowledge items on a biology examination.
2. There is no difference (P = 0.05 level) in the means of the correct responses to cued and uncued questions based on the number of correct responses to these comprehension items on an English examination.
3. There is no difference (P = 0.05 level) in the means of the correct responses to cued and uncued questions based on the number of correct responses to these application items on a mathematics examination.

Significance of the Study

The significance of this study is found in the following three areas that are of concern to many educators:

1. The improvement of teacher-made examinations. If an instructor would incorporate the idea of using cues to better inform the student as to what type answer he is seeking, he would in turn improve his method of testing.
2. The improvement of students' test performance, which is of benefit to the instructor as well as the student.
3. The addition of knowledge to the area of cues in general.

Limitations of the Study

The results of this study are limited to the populations of students at Oklahoma State University enrolled in BISC 1114, Biological Sciences I; MATH 1513, College Algebra; and ENGL 2543, English Literature. The biology students were enrolled during the spring semester of 1972 and the English and mathematics students were enrolled during the fall semester of 1972. This study is also limited to the cognitive powers that are necessary to answering questions of knowledge, comprehension, or application as these questions are defined later in the study.

Definitions

The following terms have specific meaning in this study:

Cue.--A cue is a hint or intimation.

Non-informational Cue.--Any cue which does not directly give a student information about the correct answer to a problem.

Bloom's Taxonomy.--Classification of levels of learning (Appendix A).

Normal or Regular Instructor.--The biology, mathematics, or English teacher to whom the members of the population are assigned.

Homoscedasticity.--Equal standard deviation or variance.

Basic Assumptions

This study assumes that the student will use the cues provided. It is assumed that no high correlation exists between knowledge, comprehension, and application.

The variances of factors which were not specifically investigated in this study were assumed to have been controlled by randomization.

Homoscedasticity is assumed due to the identical subjects design used in this study.

CHAPTER II

REVIEW OF SELECTED LITERATURE

Introduction

Testing, as practiced in education, is conducted for a variety of purposes. These purposes may be generally grouped to include appraisal of achievement, appraisal of curriculum effectiveness, and assessment of general educational progress (62).

Those tests which measure achievement are of prime concern in this study. Tests which measure achievement are used as a major factor in student certification.

Teacher-constructed tests are an important part of the sampling procedures of student behavior. In this sampling procedure the student is presented questions to which he may respond. The response, it is hoped, indicates the extent to which the student has learned the material presented by the teacher.

Selected Literature Related to Achievement Tests

Achievement tests, in a students view, represent sets of clues that are of value to him in determining the behavior that is expected of him in a course of study. The effect that results, because of the nature of achievement testing, is one of directing the students learning activities and his goals.

To emphasize the ability of an achievement test to direct learning John Stalnaker (55) states:

> Pupils adapt their learning to meet the requirements of the test situation. This adaption is to be expected because the tests are the most tangible clues and most potent single influence in determining the goals of the study. The typical pupil is anxious to do well in school work. Parents stress success in school, and the usual incentives to excel are present. Since success in school is measured in terms of marks and since marks are based in a large part on the results of tests, the pupil soon learns that the test is a real hurdle. He therefore directs his learning in the paths which he believes will lead to high grades on the test, and if there are short cuts, he will use them.

By the time a student has completed high school he has had extensive experience with achievement testing. He knows all too well the effect of achievement tests on his educational success.

In discussing the relationship between educational success and testing programs Robert Ebel (18) states:

> Tests can be valuable tools for motivating and directing student achievement if they are good tests and if the student and teacher know of their general nature at the beginning of a course of instruction.

Good achievement tests are aimed at measuring to what extent a student has obtained the objectives stated at the beginning of a course of study. These objectives must be stated in behavioral terms before they can be measured. They must also serve as a basis for the construction of examination questions. Baker (3) states:

> In order for objectives to have an impact on the performance of students, they must be adopted in more than a curriculum guide, teachers must make substantial changes in the way they usually plan their instruction and tests.

In order to aid in the construction of tests and to insure that these items measure the stated educational objectives, Bloom (8) developed the Taxonomy of Educational Objectives.

Taxonomy of Educational Objectives

In Bloom's Taxonomy the approach to classification of tests is different than most other classifications. Course objectives serve as a basis of classification rather than test questions. Bloom classified educational objectives into six major categories: knowledge, comprehension, application, analysis, synthesis, and evaluation. Each category is presumed to be a necessary part of the category that follows it and thus a hierarchy is formed.

A substantial amount of evidence for the workability of such a system of classification has been accumulated. Stanley and Balton (56) found that the Taxonomy could be used with reliability. Stoker and Kropp (57) used the Taxonomy to construct two multiple choice tests. A reading passage was presented first followed by nine questions in each of the categories of the Taxonomy. The questions were submitted to judges for separation into categories. The conclusion was:

> Thus it would appear that the Taxonomy serves as a basis for constructing items to measure the behavior described herein, judges can assign the items to the appropriate categories with some accuracy. Lack of complete agreement can be ascribed to at least the following two reasons, both of which have a common basis in that the item writer and the item judge have different notions about the competencies and the problem solving methods used by students for whom the items are intended. First, the item writer might prepare an item for an upper level of the Taxonomy, and the rater believes the student will know the answer to the item because of prior knowledge. Second, the item writer might prepare an item to evoke behaviors regarded as "Evaluation" for example but the student might answer the questions by systematically eliminating distractors; thus, the intended process differs from the obtained process.

Schmitt, Montean, Winter, and Farr (46) developed seven unit tests for high school chemistry. They consolidated the categories as follows:

Recall: Any item which had been taught in substantially the same form as that in which it appeared in the test, requiring mere resurrection of a particular bit of information. Rephrasing, inversion of sentences, and similar form changes do not remove any item from the recall category.

Comprehension: Any item requiring the application of a principle under circumstances different from those constituting the teaching context of the principle, but in such a form that the correct principle is implied in the question.

Application: Similar to comprehension, but required principle is not implied in the question, so that the student must select the appropriate principle from his repretoire of learning principles as well as apply it correctly. Quantitative problems were considered in this category.

The questions developed were judged and administered to students. Intercorrelation among test items for category combinations of recall, comprehension, and application were all between 0.87 and 0.80. They concluded that "a common factor is influential in determining performance on all three types of items".

Herron (25) used the Taxonomy in comparing the Chemical Education Materials Study Course with the conventional high school chemistry course. He found that the students performed differently at the same level on several sub-tests, indicating that the abilities tested were different. Robert McFall (33) also found that evaluating the higher cognitive powers was difficult. McFall's study produced relatively high correlation between higher mental processes and recall. McFall (33) states:

> A much lower correlation was anticipated. Theoretically, the ability to handle items characteristic of Subtest B (higher mental processes) should not necessarily be related to the facility with which specific knowledge can be recalled.

It is obvious that many variables are present when dealing with achievement test questions. An investigator should be alert to these variables as an attempt is made to explore the effect of any one variable in a test situation.

Problem Solving

Although Bloom's Taxonomy, if followed by the teacher, will definitely aid in the construction of the teacher-made examination. The difficulty is that to succeed in school, a student must be able to answer questions correctly on examinations. Non-successful students are frequently confused about the requirements of a problem. They may present an acceptable solution to a problem they have attacked, but this problem was not the one they were to solve.(9).

Problem-solving research has been successful in finding out for what reasons students miss examination questions. For example, Restle (44) found that for some students time is a related factor. The pressure of time or the lack of it inhibits the problem-solving process. The various problem-solving skills of seventh grade students was explored by Francis Dwyer (17).

James S. Brunner (11) found that some students go beyond the information given in the problem to solve the question correctly. And through many hours of research Ralph Goldner (20) and Karl Dunckner found that the individual differences in problem-solving were numerous.

But still there must be difficulties that are common to all students. Bloom and Broder (9) verified this in their research with college students. Their research found the following four major difficulties encountered by students in solving problems: (1) understanding the nature of the problem, (2) understanding the ideas contained in the problem, (3) general approach to the solution of the problem, and (4) attitude toward the solution of the problem.

Some believe that students may become more successful in coping with these difficulties if they are given new information about the problem. For example, Wichelgren (66) found that a student may remember the appropriate concepts necessary to solve a problem but be unable to achieve the solution because the necessary stimuli for activation of his memory are not present in the problem. If new information or stimuli are added to the problem then the solution is achieved.

Cues

The adequate stimuli could be presented in the form of a cue. Otto (38) found that all students profited from cues in learning a reading list. The cues used by Otto were verbal, but his study suggests that a student may solve the problem if presented the appropriate stimuli. Means and Loree (35) indicated that if a cue is presented to the student while or before he is solving a problem, he is more likely to find a correct solution than if no cue is presented.

Numerous examples can be sited to show that the use of a cue as an appropriate stimuli has been successful. For example, Baker (2) found cues to be very effective in reinforcing teacher behavior.

Cues have been used extensely in teaching reading skills. Held (24) and Allen (1) found cue systems to be beneficial in teaching the reading process. J. P. Williams (68) used cues in his research on visual word recognition. The concept identification of children was aided by the use of cues in the research conducted by Scholnick (48).

Cues have also been used in speech therapy, such as, the research conducted by Rappaport and Bloodstein (42) in which they used random blackout cues in the distribution of moments of stuttering.

Mental retardation research has also found a use for cues. For example, Semmel and Sitko (50) used phrasal cueing to see their effect on free recall of educable mentally retarded students. The phrasal cueing was very effective.

It is evident from the previous examples that cues are beneficial in the testing situation. In fact, Erwin Segal (49) found that students performed better in other work after having responded to cues than students who did not respond to cues. However, only one cue must be presented at a time. If more than one cue is presented, the student is confused.(22).

Overing (39) in a study of irrelevant cues, found that when cues were encountered in the testing situation which were not present in the training situation, the students' level of performance was lowered. McWittrock (34) also found that students' ability to use a cue to solve problems seemed to be related to the types of cues and problems which they have encountered in the past. Therefore, the cues must be familiar to the student before the administration of the test.

Summary

The history of achievement testing is long and varied. It spans time from the ancient Greeks to modern colleges. Although vast progress has been made, in both construction and administration of achievement tests, there remains a deep void concerning the many factors affecting the students performance on these tests. The efforts of such men as Bloom, in classifying levels of learning, have aided educators in their task of constructing good achievement tests. Bloom, along with Brunner and Duncker, have made great strides in their research concerning problem-solving methods.

Throughout the history of achievement tests, men have strived to improve both the construction of the test and the students performance on the test. One of the paths traveled, in achieving this goal, was the use of cues.

Cues have been used in virtually every aspect of the educational process. Their use spans from teaching preschool children the basic colors to investigations concerning the workings of human psychology. Although there has been a vast amount of research done in using cues in the educational process, little has been done concerning the use of cues to improve a student's test performance.

It is the hope of this investigator that the use of non-informational cues in this study will add to the knowledge in this area.

CHAPTER III

METHOD AND DESIGN

Design

An identical subjects or counter-balanced design was used. This type of design is used when all of the members of the sample receive the same treatment Dayton (15). All of the members of the samples selected for this study were presented with both cued and uncued items on the same examination. The cues used represented the level of Bloom's Taxonomy the student had to perform to solve the problem. The letters K, C, and A represented knowledge, comprehension, and application, respectively. These cues did not supply the student with direct information about the correct answer to the problem and therefore were non-informational cues.

Implementation of the Study

A sample of approximately 300 members was selected from biology, 60 members from mathematics, and 35 from English. These students were enrolled at Oklahoma State University during the spring and fall semesters of 1972. The biology students were enrolled during the spring semester of 1972 and the English and mathematics students were enrolled during the fall semester of 1972. The populations received cues and their meaning by their normal instructor approximately one week before the administration of the experimental examination. The students were given a short test over the cues, to insure that they understood their meaning and use.

The instruments used in each section of this study were teacher-made examinations. It was assumed that the students would already be familiar with their instructor's type and method of questioning because two examinations had been given to them by their instructor prior to the experimental examination.

The experimental examinations were presented to a panel of three judges. These judges were teachers in colleges and were selected from the teaching field being studied. The examinations were presented to the judges to insure that they contained items which reached the necessary level of Bloom's Taxonomy. After the examinations were approved by the panel of judges they were administered to a different section of biology, mathematics, and English than the experimental sample in order to determine the level of difficulty of the items before the experimental administration to the sample.

The level of difficulty is obtained by the following formula:

$$\text{difficulty} = \frac{\text{upper } 27\% - \text{lower } 27\%}{\text{total sample size}}$$

The level of difficulty was obtained for each item of the experimental examinations. Items of approximately equal difficulty were paired and one of the paired items were cued. This procedure was necessary in order to insure that items of great difficulty were not cued while items of little difficulty were left uncued.

The basic procedure for cueing each experimental examination was the same for biology, mathematics, and English, only the number of items varied. The instrument for biology consisted of 50 items. One-half of these items were cued. The cued items were arranged in two forms. Form one consisted of 1-25 cued and 26-50 uncued. Form two consisted of 1-25 uncued and 26-50 cued. The members of the sample were randomly assigned into two groups, one received Form one and the second received Form two. This procedure should have controlled error due to the ordering of questions.

The instrument was administered to the sample by the students' regular instructor. Hopefully, by using the regular instructor, the students did not know they were being studied.

Statistical Techniques

Parametric statistics were used to test the hypothesis of this study. The data generated by this study were in two forms. The cued and uncued items from the forms were combined. The combined items, both cued and uncued were divided into correct and incorrect responses. Calculations were performed to determine the mean, standard deviation, and correlation coefficient for each set of data.

The correlated t-test was used to determine if there was a significant difference between the number of correct responses to cued and uncued items.

CHAPTER IV

PRESENTATION AND ANALYSIS OF THE DATA

Homoscedasticity was assumed because of the identical-subjects design used in the study. The students correct responses were summed for cued and uncued items. A mean, a standard deviation, a standard error of the mean, and a Pearson Product-Moment correlation was calculated for each set of data.

The t-value obtained for comparing the means of the correct responses to cued and uncued questions (Table I) for the biology section was 0.74. The t-value at the previously set level of confidence should be equal to or greater than 1.96. It was concluded that there is no significant difference between the means of the correct responses to cued and uncued questions for biology.

TABLE I

t-TEST OF SIGNIFICANT DIFFERENCE IN SCORES FOR STUDENTS IN BIOLOGY

M_x	M_y	σX_1	σY_2	SEM_1	SEM_2	r	t
1856	1868	3.76	3.57	0.22	0.21	0.72	0.74

Table t = 1.96 at 0.05 level

The following are thought to be possible reasons for the lack of significance in the hypothesis for biology. (1) When working on the lowest level of Bloom's Taxonomy, students can recognize the type of information required without a cue. (2) Students ignored and did not use the cues.

The t-value obtained for comparing the means of the correct responses to cued and uncued questions (Table II) for the English section was 2.08 with 34 degrees of freedom. The obtained t-value is above the previously set level of confidence value. It was concluded that there is a difference between the means for the English scores and hypothesis 2 is rejected. It was concluded that the students scores on the English examination were improved because of the use of cues.

TABLE II

t-TEST OF SIGNIFICANT DIFFERENCE IN SCORES FOR STUDENTS IN ENGLISH

M_x	M_y	σX_1	σY_2	SEM_1	SEM_2	r	t
5.46	6.91	2.12	2.31	0.35	0.39	0.35	2.08

Table t = 2.03 at 0.05 level

The t-value obtained for comparing the means of the correct responses to cued and uncued questions (Table III) for the mathematics section was 5.65. Thus there is a significant difference between means and Hypothesis 3 is rejected. This result indicates that the cues used on the mathematics examination improved the number of correct responses obtained by the students.

TABLE III

t-TEST OF SIGNIFICANT DIFFERENCE IN SCORES FOR STUDENTS IN MATHEMATICS

M_x	M_y	σX_1	σY_2	SEM_1	SEM_2	r	t
11.7	6.3	2.43	1.85	0.30	0.23	0.29	5.65

Table t = 2.00 at 0.05 level

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to attempt to determine if students answer examination questions incorrectly because they do not have sufficient information or because they do not understand what is required to answer the questions correctly.

A series of non-informational cues were used on examinations, that were administered to student samples, to determine what effect non-informational cues would have on students' test performance.

Students enrolled in biology, mathematics, and English were exposed to experimental tests. The biology test required a demonstration of knowledge of course content. The mathematics test required a demonstration of how well students comprehended course materials, while the English test required the student to apply previous and current learning to answer questions.

A level of difficulty was obtained for each item to be used on the experimental examination. Items were paired according to their level of difficulty and one item of each pair was uncued.

The design of the study was the same for all samples. The subjects of each section were randomly assigned into two groups. One group was given form one of the examination and the other group was given form two. The experimental examination was a teacher-made examination and consisted of approximately 50% cued and 50% uncued items. The correct responses to cued and uncued items for each section were compared. With the exception of the addition of cues to the examinations, the biology, mathematics, and English classes were conducted in the normal lecture-recitation-laboratory routine of college teaching. The null hypotheses were confirmed or rejected on the basis of a t-test.

Conclusions

Factor analysis of educational objectives suggests a hierarchy of cognitive powers. This hierarchy begins with cognitive powers basic to recall. Higher cognitive powers are involved in comprehension and application. The knowledge type questions in this study may be correlated with recall while comprehension and application type questions are higher in the hierarchy.

Subject to the limitations of this study, the following were drawn:

1. There was no significant difference (p = .05) between the means of correct responses to cued and uncued items for biology.
2. There was a significant difference (p = .05) between the means of correct responses to cued and uncued items for English.
3. There was a significant difference (p = .01) between the means of correct responses to cued and uncued items for mathematics. This result indicates that the cues were useful to the student and improved their number of correct responses to questions.

Recommendations

The following are recommendations for further study based on the results of this study:

1. Further investigations using non-informational cues to determine if another type of cue was more effective.
2. A study to determine what types of questions, based on Bloom's Taxonomy, students can recognize without the use of cues.
3. Develop a more effective method of test construction.
4. An in-depth study of factors effecting the method students use to answer questions.

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APPENDIX A

PART II

The Taxonomy and Illustrative Materials

APPENDIX B

Eldin
Introduction to Literature

NAME ____________________________

Examination on the Short Story

Part I: 60 pts. (one point for identification)

Choose 15 of the following. Identify the story in which the item or idea is found and briefly, in a few sentences, state why it is important, how it functions in terms of the story.

KC 1. Sequid vuestro jefe (follow your leader)

2. The acythe

3. eyes were like blue stones

KC 4. switchblade

KC 5. freak show

KC 6. the grotesques

7. Mr. Petrie

8. Red Sammy

KC 9. Bachelor's Delight

KC 10. Cudgel

11. grey sleeping suit

12. a splendid screen emroidered

13. thin red whiskers

14. the fly

15. the rocking horse

16. a bazaar

17. a central apple tree and a few straggling bushes

18. man with the red and black painted face

Essay: Choose two. In your essay use, if possible, those literary devices and terms you have learned to support your answer. 40 pts.

1. In your opinion which story makes the most use of irony?

CA 2. Who is the protagonist of "A Good Man Is Hard to Find?" Be sure to support your answer.

CA 3. What are the similarities between "The Egg" and "The Petrified Man?"

Math 1513 TEST II NAME ________________

I.

1. The x^2 is ________________

A 2. The distance between (-17) and (59) is ________________

3. The distance between (-5,2) and (3,7) is ________________

A 4. Solve the following for all values of x.

z) $|4-x| = 7$ b) $|x| = 5$ c) $|x| = -3$

$x =$ ____ $x =$ ____ $x =$ ____

5. Solve for all values of x.

$|7-x| > 15$

6. A circle has center (-7,5) and radius 6. The equation of the circle is ________________

A 7. The equation of a circle is $(x+6)^2 + y^2 = 144$

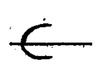
The center is ________ and the radius is ________.

II. Specify relation, function or both.

A a) $\{(1,2), (6,2), (3,2)\}$ ________

b) $f(x) = x^2$ ________

A c) a → 1
b → 2
c → 2 ________

d)  ________

e) $\mu^2 = x$ ________

2. $f(x) = 2x^2 + 3x + 4$ $g(x) = 7x - 1$

A a) $f(g(x)) =$ ________________

b) $g(f(x)) =$ ________________

III.

1. Solve for x.

A a) $x^2 - 7x + 10 = x^2 + 5x - 6$ x = ____________________

b) $\frac{3x-6}{5} - \frac{2x-5}{10} + \frac{x-4}{2}$ x = ____________________

2. Solve these quadratics for x.

A a) $4x^2 + 5x - 6 = 0$ x = ____________________

b) $10x^2 - 9x + 2 = 0$ x = ____________________

3. Solve for all values of x.

A a) $3x + 2x - 10$

b) $\frac{x}{3} + 5 - 7$

A 4. The quadratic equation with integral coefficients having the following numbers -6,4 is ____________________.

5. $t_n = t_1 - (n-1)$ d(use these to work the problem).

$$s_n = \frac{n(t_1 - t_n)}{2}$$

A man is hired with a beginning salary of $5000 a year. However, every year he will receive $300 raise. How much will his salary be in 10 years? How much will his entire earnings be in 10 years?

BIOLOGICAL SCIENCES 1114

McNeill
E-3

Spring 1972
Test 2

DIRECTIONS:
1. Use pencils provided.
2. Use the front side of the card.
3. Write all information on the card.
4. Fill in the correct bubbles for the identification of student and test.
5. Mark answers heavily; and completely fill bubble.
6. To make corrections erase completely.

MATCHING:

(a) producers (b) primary consumer (c) decomposer
(d) secondary consumer (e) abiotic factors.

K 1. The green plants make up this component of the ecosystem.

K 2. The herbivores make up this component of the ecosystem.

3. Wolves would be placed in this compartment of the ecosystem.

4. This group of organisms are usually fewer in number than the other components of the ecosystem.

5. This group of organisms ends most food chains.

K 6. The amount of rainfall affects the growth rate of some plants. What is the rain?

MATCHING:

(a) action (b) coaction (c) reaction.

7. Plants remove water and nutrients from the soil.

8. Deer browsing on shrubs in a meadow in an example of a (an)____.

9. Barnacles are not found where the ocean surf is at its peak. The effect of the surf on the barnacles habitat is an example of_______.

10. A Hawk preying on a rabbit is an example of a (an)______.

MULTIPLE CHOICE:

11. In which of the following areas would you expect to find fewest types of organisms (a) a meadow (b) a forest (c) a lake (d) a river valley (e) a plowed field.

12. If an organism has a wide range of tolerance for temperature its range of tolerance for moisture is (a) usually wide (b) is usually narrow (c) may be wide or narrow regardless of the range of tolerance for temperature (d) none of the above.

Man
Bass
Minnows
Crustaceans
Single-celled animal
Algae & aquatic plants

13. What trophic level is missing from this pyramid? (a) producers (b) primary consumers (c) decomposers (d) secondary consumer.

A 14. The difference in calories between the algae and single cell animals (a) 20,000 (b) 45,000 (c) 10,000,000 (d) 45,000,000.

15. These members are most likely herbivores? (a) bass (b) man (c) single-celled animal (d) minnows.

16. The difference in calories between man and single cell animals is (a) 500,000 (b) 100,000,000 (c) 4,999,500 (d) 9,499,500.

17. How much more energy could man receive if he fed on algae than if he fed on bass? (a) 999,500 (b) 200,000 (c) 4,999,500 (d) 49,999,500.

% of fish choosing each Temp.

40
35
30
25
20
15
10
5
0

0 5 10 15 20 25 30 35 40
Temperature C^{o}

18. The temperature range of $15^{o}C$ to $30^{o}C$ is referred to as the (a) range of tolerance (b) maximum limit of tolerance (c) preferendum (d) minimum limit of tolerance.

19. Which of the following temperature ranges would be considered the range of tolerance (a) $15C^{o}$ to $30C^{o}$ (b) $5C^{o}$ to $35C^{o}$ (c) $10C^{o}$ - $30C^{o}$ (d) $0C^{o}$ - $40C^{o}$.

20. What temperature would exceed the maximum limits of tolerance (a) 2°C (b) 40°C (c) 20°C (d) 4°C.

21. The first forms of life, blue green Algae, and bacteria characterize this time period (a) Cenozoic (b) Mesozoic (c) Paleozoic (d) Pre-cambrian.

22. The net production of a young alfalfa field is greater than that of a mature alfalfa field. This is due to (a) greater respiration in the young field (b) lower respiration in the young field (c) both of the above (d) none of the above.

23. Which of the following is usually not a limiting factor in terrestrial environments (a) water (b) temperature (c) oxygen (d) light.

24. Why do authorities feel that adaptation to the forest environment was important to the evolution of the modern human type? (a) the forest provided a habitat that kept the forerunners of man from interbreeding with other terrestrial forms (b) adaptation to the forest increased the size of the forerunners of man (c) the forest allowed for adaptations that were beneficial to man's existance on the ground such as stereoscopic vision, opposable thumb, coordination of eyes and limbs, (d) none of the above.

25. The major loss in the phosphorous cycle is (a) shallow sediments (b) phosphate rock (c) deep sediment (d) none of the above.

K 26. Which of the following is a taxonomic group with the most general characteristics (a) species (b) genus (c) family (d) order (e) phylum.

K 27. Which of the following is not an accurate statement regarding the general nature of the fossil record (a) there were many groups that became extinct (b) evolution procedes from complex to simple (c) none of the past forms are exactly like today's (d) the most primitive are found in the oldest rocks.

A 28. If the half life of a radioactive substance is 5000 years, how many years would it take for 3/4 of a stated amount of that substance to disintegrate? (a) 5000 years (b) 2500 years (c) 10,000 years (d) 20,000 years.

K 29. The common ancestor of man is believed to have been a (an) (a) arboreal primate (b) aquatic primate (c) carnivore (d) herbivore (e) none of the above.

K 30. Which of the following is the assumed sequence in the evolution of the horse (a) 3-toed browser, 2-toed grazer, 1-toed grazer (b) 3-toed browser, 3-toed grazer, 1-toed grazer (c) 3-toed grazer, 3-toed browser, 1-toed grazer (d) none of the above.

K 31. The Cenozoic was the age of (a) mammals (b) fishes (c) bacteria (d) reptiles.

K 32. Which of the following <u>is</u> <u>not</u> considered to be a reason for mammal radiation? (a) competition with fish declined (b) a cooling of the climate (c) the radiation of flowering plants (angiosperms) occurred at the same time (d) mammals could out compete the reptiles.

K 33. Humans and prehumans are distinguished from one another on the basis of (a) the making of tools and the use of these tools (b) brain size (c) hair on the body (d) stereoscopic vision.

K 34. A system which receives energy from an outside source is said to be a (an) (a) adaptive system (b) closed system (c) open system (d) self-regulatory system.

K 35. The functional status of an organism is known as its (a) habitat (b) trophic level (c) niche (d) preferendum.

C 36. When we speak of self regulatory systems we mean that (a) they can adapt to different conditions (b) they have negative feedback which maintains homeostasis (c) they regulate nutrient cycling and energy flow (d) both a and b (e) both b and c.

K 37. Grass-deer-wolves is an example of a (a) detritus food chain (b) parasitic food chain (c) grazing food chain (d) none of the above.

K 38. The affect that a living organism has on the non-living in the environment is called a (an) (a) action (b) reaction (c) co-action (d) reverse action.

K 39. The reason for there being fewer consumers higher in the food chain is (a) because they can't stand the altitude (b) because of the second law of thermodynamics (c) the first law of thermodynamics (d) none of the above.

K 40. Green plants, soil, deer, and fungi are examples of (a) the function of the ecosystem (b) nutrient cycling (c) energy flow (d) the structure of the ecosystem.

K 41. The action of nitrogen fixing bacteria and denitrifying bacteria is a good example of (a) positive feedback (b) negative feedback (c) energy flow (d) none of the above.

K 42. A natural unit in which the biotic and abiotic components interact to produce an exchange of materials is called (a) negative feedback (b) homeostasis (c) ecosystem (d) nutrient cycling.

K 43. The regulation of body temperature in an organism is an example of (a) action (b) coaction (c) homeostasis (d) reaction.

K 44. Which of the following habitats would exhibit the least amount of temperature variation (a) 6" above the soil (b) at the surface of the soil (c) 6" below the soil (d) a shallow pond.

45. The movement of organic materials through the components of the ecosystem is known as (a) a coation (b) energy flow (c) nutrient cycling (d) a food chain.

46. The biomass or amount of biotic material present in an ecosystem at a given time is the (a) primary production (b) standing crop (c) net production (d) respiration.

47. Which of the following would be most susceptable to limiting environmental conditions (a) a cow (b) a frog embryo (c) an adult frog (d) a calf.

48. Any mechanism that assists in maintaining the steady state of an ecosystem is known as (a) positive feedback (b) negative feedback (c) energy flow (d) trophic feedback.

49. The reservoir in the carbon cycle is (a) coal and oil (b) volcanoes (c) atmospheric CO_2 (d) CO_2 of photosynthesis.

K 50. Oxygen is more likely to be a limiting condition in which of the following habitats (a) a pond (b) a stream (c) a wheat field (d) a forest.

BIOLOGICAL SCIENCES 1114

McNeill
E-E

Spring 1972
Test 1

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33. Deer browsing on shrubs in a meadow is an example of a (an)____.

34. Barnacles are not found where the ocean surf is at its peak. The effect of the surf on the barnacles habitat is an example of ________.

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Crustaceans
Single-celled animal
Algae & aquatic plants

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41. The difference in calories between man and single cell animals is (a) 500,000 (b) 100,000,000 (c) 4,999,500 (d) 9,499,500.

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% of fish choosing each Temp.

40
35
30
25
20
15
10
5
0

0 5 10 15 20 25 30 35 40
Temperature C°

43. The temperature range of $15^{o}C$ to $30^{o}C$ is referred to as the (a) range of tolerance (b) maximum limit of tolerance (c) preferendum (d) minimum limit of tolerance.

C 44. Which of the following temperature ranges would be considered the range of tolerance (a) $15C^{o}$ to $30C^{o}$ (b) $5C^{o}$ to $35C^{o}$ (c) $10C^{o}$ - $30C^{o}$ (d) $0C^{o}$ - $40C^{o}$.

45. What temperature would exceed the maximum limits of tolerance (a) $2^{o}C$ (b) $40^{o}C$ (c) $20^{o}C$ (d) $4^{o}C$.

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50. The major loss in the phosphorous cycle is (a) shallow sediments (b) phosphate rock (c) deep sediment (d) none of the above.

APPENDIX C

SCIENCE RAW SCORES

Student No.	CC*	CUC**
1.	19	21
2.	11	13
3.	19	16
4.	18	16
5.	19	23
6.	18	22
7.	14	17
8.	17	15
9.	21	22
10.	18	17
11.	18	21
12.	17	20
13.	16	18
14.	15	18
15.	20	21
16.	12	19
17.	23	24
18.	20	18
19.	16	17
20.	20	20
21.	19	11
22.	15	21
23.	14	7
24.	20	21
25.	18	17
26.	14	14
27.	20	20
28.	21	20
29.	20	19
30.	19	20
31.	18	18
32.	16	17
33.	13	16
34.	21	17
35.	17	16
36.	18	9
37.	15	18
38.	11	11
39.	14	18
40.	15	18
41.	17	16
42.	22	23
43.	18	19
44.	22	21
45.	11	14

SCIENCE RAW SCORES (Cont'd)

Student No.	CC*	CUC**
46.	18	18
47.	18	15
48.	15	15
49.	17	19
50.	16	17
51.	21	21
52.	17	17
53.	13	15
54.	17	21
55.	16	16
56.	14	13
57.	15	14
58.	16	14
59.	22	15
60.	16	21
61.	21	23
62.	9	11
63.	15	18
64.	18	22
65.	17	20
66.	20	19
67.	20	21
68.	20	22
69.	21	21
70.	18	22
71.	21	21
72.	22	22
73.	22	19
74.	21	19
75.	18	18
76.	23	21
77.	21	21
78.	19	19
79.	20	25
80.	15	15
81.	13	19
82.	20	15
83.	21	18
84.	13	16
85.	21	20
86.	16	17
87.	20	19
88.	21	18
89.	20	17
90.	20	21

SCIENCE RAW SCORES (Cont'd)

Student No.	CC*	CUC**
91.	14	21
92.	20	21
93.	16	14
94.	21	19
95.	20	23
96.	17	21
97.	19	21
98.	19	21
99.	17	17
100.	22	17
101.	19	19
102.	23	23
103.	15	21
104.	22	21
105.	15	20
106.	17	21
107.	16	19
108.	22	22
109.	20	21
110.	21	20
111.	22	21
112.	21	22
113.	22	20
114.	21	21
115.	23	20
116.	20	21
117.	21	21
118.	17	18
119.	19	23
120.	18	19
121.	14	14
122.	17	20
123.	20	21
124.	19	19
125.	17	20
126.	19	21
127.	20	18
128.	16	17
129.	11	10
130.	19	18
131.	22	21
132.	22	24
133.	14	16
134.	20	21
135.	12	11

SCIENCE RAW SCORES (Cont'd)

Student No.	CC*	CUC**
136.	20	20
137.	17	17
138.	17	12
139.	22	21
140.	24	25
141.	23	23
142.	19	21
143.	22	24
144.	21	21
145.	20	22
146.	21	20
147.	19	21
148.	21	22
149.	19	24
150.	15	17
151.	23	22
152.	22	21
153.	14	15
154.	21	22
155.	17	20
156.	21	18
157.	20	19
158.	18	19
159.	22	24
160.	20	19
161.	23	21
162.	20	17
163.	23	23
164.	18	18
165.	18	18
166.	24	23
167.	14	16
168.	23	20
169.	25	24
170.	17	10
171.	24	22
172.	23	21
173.	19	19
174.	20	20
175	18	18
176.	7	6
177.	18	22
178.	24	23
179.	22	17
180.	23	21
181.	19	21

SCIENCE RAW SCORES (Cont'd)

Student No.	CC*	CUC**
182.	20	23
183.	8	8
184.	20	19
185.	19	14
186.	20	21
187.	17	15
188.	20	20
189.	23	22
190.	19	19
191.	21	21
192.	20	20
193.	20	21
194.	17	20
195.	19	18
196.	14	14
197.	16	16
198.	17	20
199.	24	23
200.	22	24
201.	20	21
202.	14	15
203.	22	24
204.	24	20
205.	17	18
206.	14	14
207.	11	12
208.	24	19
209.	21	15
210.	21	21
211.	10	18
212.	24	24
213.	17	22
214.	23	22
215.	21	21
216.	19	19
217.	19	22
218.	22	21
219.	18	18
220.	19	22
221.	21	17
222.	22	21
223.	25	22
224.	17	19
225.	19	18
226.	22	21
227.	22	19

SCIENCE RAW SCORES (Cont'd)

Student No.	CC*	CUC**
228.	23	19
229.	19	16
230.	20	17
231.	21	17
232.	20	19
233.	22	22
234.	12	13
235.	17	18
236.	19	20
237.	24	20
238.	16	14
239.	12	12
240.	12	10
241.	19	19
242.	23	22
243.	23	22
244.	22	19
245.	14	11
246.	22	20
247.	16	22
248.	23	22
249.	17	18
250.	22	21
251.	23	22
252.	19	17
253.	23	21
254.	12	8
255.	21	18
256.	23	23
257.	19	21
258.	17	16
259.	14	11
260.	19	17
261.	19	19
262.	18	20
263.	16	14
264.	16	17
265.	14	12
266.	16	17
267.	16	21
268.	21	23
269.	21	16
270.	15	17
271.	22	20
272.	13	13

SCIENCE RAW SCORES (Cont'd)

Student No.	CC*	CUC**
273.	21	20
274.	25	23
275.	18	18
276.	16	23
277.	20	22
278.	17	16
279.	15	14
280.	23	22
281.	17	23
282.	19	16
283.	17	17
284.	22	19
285.	8	5
286.	19	23
287.	23	21
288.	20	20
289.	15	15
290.	17	18
291.	19	14
292.	19	17
293.	17	21
294.	13	18
295.	15	8
296.	19	18
297.	20	18
298.	11	19
299.	20	19
300.	20	18
301.	22	20
302.	21	21
303.	21	22

*Correct Cued
**Correct Uncued

MATH RAW SCORES

Student No.	CC*	CUC**
1.	12	5
2.	8	2
3.	14	9
4.	13	9
5.	11	9
6.	15	9
7.	12	8
8.	12	8
9.	12	8
10.	6	8
11.	13	7
12.	15	6
13.	9	7
14.	15	7
15.	16	6
16.	14	6
17.	16	9
18.	9	7
19.	15	8
20.	7	5
21.	13	5
22.	9	7
23.	11	7
24.	14	6
25.	10	9
26.	10	8
27.	12	9
28.	14	8
29.	11	3
30.	14	8
31.	14	8
32.	13	7
33.	13	7
34.	9	5
35.	9	5
36.	8	2
37.	8	2
38.	10	4
39.	10	7
40.	10	6
41.	12	7
42.	12	4
43.	12	3
44.	12	3
45.	14	6

MATH RAW SCORES (Cont'd)

Student No.	CC*	CUC**
46.	10	6
47.	14	7
48.	13	7
49.	12	6
50.	12	6
51.	11	9
52.	7	6
53.	10	6
54.	14	7
55.	14	5
56.	14	4
57.	14	5
58.	8	9
59.	11	6
60.	12	4
61.	13	6
62.	13	6
63.	7	3

*Correct Cued
**Correct Uncued

VITA

Robert Charles Hooper

Candidate for the Degree of

Doctor of Education

Thesis: A STUDY OF THE EFFECT OF NON-INFORMATIONAL CUES ON STUDENTS' TEST PERFORMANCE

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