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A comparison of the effects of command and guided discovery styles of teaching on college students' cognitive achievement and their attitudes toward a winter camping class

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A COMPARISON OF THE EFFECTS OF COMMAND AND GUIDED DISCOVERY STYLES OF TEACHING ON COLLEGE STUDENTS' COGNITIVE ACHIEVEMENT AND THEIR ATTITUDES TOWARD A WINTER CAMPING CLASS

by

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Directors: Dr. Gary Nygaard and Dr. Joel Meier

The purpose of this study was to test the effects that two of Muska Mosston's styles of teaching have on college students' cognitive achievement and attitudes toward a recreation class.

Sixty-four University of Montana students participated in this study during winter quarter 1975. Twenty-nine students finished in the guided discovery class and thirty-five students in the command class. Both classes studied identical subject material on winter camping for a nine week period. Prior to instruction, both classes were administered a winter camping knowledge examination and a semantic differential attitude test. During the course of instruction ten twenty minute tape recordings were randomly taken to establish teaching style purity and consistency. An expert in the field of Flanders Interaction Analysis System analyzed the recordings and concluded that the guided discovery and the command styles of teaching were used in the respective classes. After the nine weeks of instruction both classes were given post-tests on achievement and attitudes, utilizing the same knowledge and attitude tests used in the pretest.

The Z-statistic was applied to the pretest and post-test results of the cognitive knowledge examination for both classes. Hypothesis One was tested at the 5% level of significance and no significant findings resulted between the two groups. Both classes did gain in subject knowledge, however this study indicates that no one class learned significantly more than the other.

The student t was applied to all the attitude analysis data. The semantic differential attitude tests indicated significant differences between the two experimental groups. Significant differences were found within the command class between field trip participants and non-participants. The participants had more positive attitudes toward winter camping than the non-participants. The guided discovery class' attitudes were significantly more positive toward winter camping than the attitudes of the command class.

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In the fall of 1974, I approached various faculty members of the HPER Department with my thesis proposal. Then it was all an exciting dream, first of a kind research, and I was the researcher. Now that it's over I am very pleased with the results and the educational experience in writing a professional work. Dreams do sometimes come true but often because certain special people believe in you. I wish to thank those few believers for helping me make this thesis a reality. I personally extend my thanks and best wishes to Gary Nygaard and Joel Meier.

I also wish to extend my best wishes and thanks to a very good friend, Sandy Robbins, who has the personal understanding and appreciation for a writer like me.

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CHAPTER I

INTRODUCTION

In recent years literature dealing with methodology in teaching physical education has increased. In the field of recreation, however, very little literature exists. According to Fitzgerald, college training for professional recreational leadership has become one of the most significant contemporary movements in the field of recreation (10). Today, more so than ever, more emphasis should be placed on the professional training of recreation teachers, instructors, and leaders. The addition of certain teaching courses could be incorporated in the recreation teacher's curriculum, and the recreation teachers could utilize literature dealing with methodology in teaching. In far too many cases, professionals in the areas of physical education and recreation have failed to employ findings in educational psychology in their processes of teaching; findings that could be beneficial in teaching teachers how to teach. In theory, research provides a source of information that the recreation teacher could put into practice in order to teach better. The relationship between theory and practice, however, needs to be examined.

In the past, education has been criticized for being teacher-centered and for failing to meet the needs of the individual student. Many critics of modern day education complain that the emphasis is on the product rather than the process involved in learning (22). A major difficulty of product-centered education is that the teacher becomes

the center of the learning experience. All knowledge flows from the teacher to the student (36). However, there is a trend away from this type of education to one in which the student is an active participant in the learning process. "Knowing is a process, not a product (2)." Mosston recognizes this trend and states so in the following:

> The past decade of educational research and development has brought increased recognition of the fact that man fundamentally prefers to learn in creative ways through creative and problem-solving activities. Teachers generally have insisted that it is more economical to learn by authority. It now seems that many important things. though not all, can be learned more effectively and economically in creative ways rather than by authority (29).

Teachers are constantly confronted with decisions about what styles of teaching they should use in their classrooms. The teacher will make at least one choice, whether the issues are Skinner vs. Bruner, creativity vs. conformity, individualized instruction vs. group drills, flexible scheduling vs. traditional modes, media vs. man, the teacher's own idiosyncratic preferences vs. generalized models, or others (29). The recreation teacher is faced with difficult decisions regarding the selection of opposing teaching approaches. It is generally believed that the recreation teacher should adopt a large repertoire of behavioral models instead of just one style of teaching with which he is comfortable (29). A variety of behavioral models will give the recreation teacher mobility and greater freedom to handle classroom situations.

TEACHING STYLES

Locke stated that the most significant advance in theory of pedagogy is Mosston's spectrum of teaching styles (26), as described in a book titled Teaching: From Command to Discovery. Seven styles

of teaching are presented along a continuum of student involvement and decision making. The continuum consists of a range of possible teaching behaviors, each of which can stand alone, yet is integrally connected to the styles that precede and follow it on the continuum. The continuum emphasizes the integration of various kinds of knowledge about teaching rather than their fragmentation. Mosston defines a style of teaching as the involvement of a number of decisions made by the teacher and the student in connection with the process of instruction (29). Shifting from one style to the next higher style is characterized by the transfer of decision making from the teacher to the student.

In theory, the continuum has the ability to awaken teachers to their potential for reaching more students than is possible with traditional teaching methods.

Mosston contends that alternative teaching styles have a significant effect on the intellectual development of the learner (29). The student's behavior in the classroom is influenced by the specific teaching behavior in practice. When the teaching style is viewed as favorable by the students, the process of teaching-learning will exist. Favorable student attitudes toward the teacher and class may also develop, as well as an increase in student's cognitive knowledge.

Attitude

Most social scientists agree that attitudes are learned and implicit (31). They are inferred states of the organism that are presumably acquired in much the same manner that other such internal learned activity is acquired (31). Attitudes are predispositions to respond, and are distinguished from other such states of readiness in

that they predispose toward an evaluative response. Attitudes, according to Osgood, are referred to as "tendencies of approach or avoidance," as "favorable or unfavorable," or as "good or bad," and so on. Osgood (31) and Summers (35) both share the view that attitudes can be ascribed to some basic bipolar continuum with a neutral or zero reference point, implying that they have both direction and intensity and providing a basis for the quantitative indexing of attitudes (31).

Iverson (19) stated that attitudes are the things that tip behavior or beliefs one way or the other in making a final choice. The final choice is dependent on a person's attitude and may change with an outside influence or action. There are various theories of attitude change and the most relevant today is the theory of consistency. In the consistency theories, attitude change takes place for the creation and maintenance of a dynamic balance between beliefs, attitudes, and behaviors. Consistency theories have the common characteristics of familiarity, redundancy, stability, and conformation of expectance, while avoiding the predictable and the new (19). Social scientists claim that a property of all consistency theories is that one's knowledge, beliefs, and attitudes shift around in respect to one another to maintain a logical, rational consistency between what one knows, believes, and does (19). This theory proclaims that when new knowledge is presented to a student, it will have some bearing on his attitudes and values. The belief is that new knowledge may cause a change in attitude values but it need not change them. New knowledge can effect attitudes and attitudes can also effect knowledge (19).

Verbal Behavior

An important and essential part of the teaching styles is the verbal interaction between students and teachers. What happens in the classroom verbally can be recorded systematically and analyzed to lead to a better use and understanding of teaching principles and styles. Verbal behavior is one specific behavior that researchers focus on to objectively analyze the classroom situation. An important and highly applicable instrument for measuring verbal behavior in the classroom is Flanders System of Interaction Analysis. This instrument is widely used by colleges to analyze classroom verbal behavior, types of professional leadership, and teaching styles.

STATEMENT OF PROBLEM

This study compared the effects of command and guided discovery styles of teaching on college students' cognitive achievement in, and their attitudes toward, a class in winter camping. The specific hypotheses tested are listed on page 37.

PURPOSE OF THE STUDY

The recreation teacher who is interested in reaching as many students as possible should be interested in making an assessment of the interaction in his classroom. A teacher who follows the styles identified by Mosston's spectrum and employs Flanders System of Interaction Analysis to evaluate his leadership abilities can make changes to improve the teaching-learning climate. Therefore, it was the purpose of this study to test the effects that two of Mosston's styles of teaching have on college students' cognitive achievement and attitudes toward a recreation class.

SIGNIFICANCE OF PROBLEM

Teachers are responsible to the students they teach. John Dewey once said:

> Education has no more serious responsibility than making adequate provision for enjoyment of recreative leisure: not only for the sake of immediate health, but ...for the sake of its lasting effect upon habits of mind (6).

The recreation teacher is responsible to the students he teaches, therefore, his teaching behavior needs periodical examination. Periodical examination will insure a high quality of educational standards and provide guidelines for changes and improvements when necessary.

Recreation leaders have neglected the application of Mosston's spectrum of teaching styles and descriptive analytical systems in theory, in research, and perhaps in practice. Increased concern and research in the area of student attitudes in relationship to knowledge could be undertaken by the recreation teacher. Recreational research dealing with various teaching styles can provide valuable benefits for the field of recreation by improving educational programs in teaching, providing a self-evaluating tool for leaders, and professionals in the field. The need for recreational research in the classroom situation arises from the lack of such activity.

DELIMITATIONS

The following are the delimitations of this study:

The subjects for the study were sixty-four University of Montana students who registered for two separate winter camping classes offered by the Department of Health, Physical Education and Recreation. Class

break down resulted in thirty-five students in the command group and twenty-nine students in the guided discovery group.

Each winter camping class met for 50 minutes per day, two days per week, for the entire quarter (9 weeks). One class met on Mondays and Wednesdays at 3:00 p.m. and was taught under the command style by one instructor. The second class met on Tuesdays and Thursdays at 3:00 p.m. and was taught under the guided discovery style by the same instructor. Both classes met in room 204 of the Women's Center (University of Montana campus). The two classes went on separate field trips for two days at the end of the course and the respective teaching styles were used. The field trip consisted of traveling into a wilderness area and camping overnight in snow shelters (application of classroom knowledge in the outdoors).

LIMITATIONS

The following are the limitations of this study:

There was no control over who registered for the winter camping classes. Registration was on a first come first served basis, and there were no set restrictions or classifications such as age or sex, that had to be met. Therefore, pre-class differences may have existed in attitudes toward winter camping and in cognitive knowledge. Sample size did not exceed 35 students per class because supervision of a larger group would have been impossible in the field trip experience.

The separate field trips were taken as scheduled regardless of weather conditions (snow, precipitation and cold temperatures were encountered on both field trips and may have affected the learning

experience). Lack of field trip participation may have affected student performance (although all efforts were made to have complete class participation, only 25 students in the command group and 20 students in the guided discovery group participated in the field trip).

Class absence may have affected student performance and therefore all students who missed more than three class sessions were dropped from this study and their pre-test scores removed from this research.

The instructor for both classes was the researcher and there may have been some bias. Every effort, however, was made to remove specific class or teaching style bias.

Each class session was not checked for accuracy of each teaching style. However, five twenty-minute verbal recordings were taken for each class, at random times, unknown to the investigator. Therefore, the recorded verbal behavior pattern used in the classroom may not be fully indicative of the teaching styles used.

The pre-tests may have served as a learning experience for the post-tests.

DEFINITIONS

Activity dimension--a semantic differential factor used to describe semantic space and account for a large portion of the semantic loading (whether the individual views the concept as fast or slow).

Command style--the first style in Mosston's spectrum of teaching styles, in which the teacher makes all the decisions regarding the pre-impact, impact, and post-impact of the class and the students make none.

Evaluative dimension--a semantic differential factor used to describe semantic space and account for a large portion of the semantic loading (whether the individual views a concept favorable or unfavorable

Flanders System of Interaction Analysis--a ten category system set up to objectively record spontaneous verbal interaction within the classroom including organization of the data and analysis of results in order to study patterns of verbal interaction.

Guided discovery style--the fifth style on Mosston's spectrum of teaching styles and the first style that crosses the cognitive barrier. The significant of this style is that students for the first time make decisions about subject matter during the impact set. The teacher makes decisions about the focus, the initial phases (pre-impact), sequence of questions, and size of each step.

Matrix--a 10 row by 10 column table used as a method of recording the sequence of events which occured in the classroom.

Orbit--an identifiable course of category selection that can be associated with a specific style of teaching.

Potency dimension--a semantic differential factor used to describe semantic space and account for a large portion of the semantic loading (how strong an individual feels about a concept).

Primary interaction pattern--the primary pattern as interpreted by the Flanders System of Interaction Analysis shows the sequence of verbal events used by a teacher in the classroom.

Semantic Differential Scale--an instrument that measures people's reactions to stimulus words and concepts in terms of rating on bipolar scales defined with contrasting adjectives at each end. The semantic differential in practice is often used as an attitude scale.

Semantic space--the point in space which serves as an operational definition of meaning. Semantic space has two essential properties--direction from origin, and distance from origin (quality and intensity respectively).

Winter camping--a recreational activity that takes place during the winter months (where there is snow) and involves actual over-night camping in a wilderness environment. Sleeping shelters may vary from tents to snow caves or igloos and the mode of transportation from cross-country skis to snowshoes.

Winter camping test--a cognitive knowledge test containing multiple-choice type questions representative of topics covered during the course of instruction.

CHAPTER II

REVIEW OF LITERATURE

The literature reviewed for this study consisted of two major categories: theory and research. In the first section, the theoretical arguments concerning command, expository, discovery and guided discovery methods of teaching are presented. In the second section, studies in education, physical education and recreation are reviewed. Some research was found in the field of education and physical education with emphasis on the teaching styles and on attitudes and knowledge. Several studies dealing with recreational attitudes but not with teaching styles are also presented.

THE COMMAND STYLE

The command style is the first style in Mosston's spectrum of teaching styles. The teacher makes all the decisions regarding the pre-impact, impact and the post-impact of the class and the students make none. The command teacher generally uses verbal command in the form of directions and lectures to disseminate information to the students. The commands issued by the teacher may take the form of either an announcement of the selected subject matter or detailed directions for the students to follow. The traditional view of the teacher-student relationship in command teaching is that since the teacher possesses knowledge and is experienced, the teacher's role is to tell the student and the role of the student is to listen, to absorb, and to comply (8).

The command style teaching is a style which focuses on the teacher and the subject matter. The command teacher determines the social-emotional climate in his class, and he is basically the only one involved in some measure in the cognitive activities. The student in the command style is expected to adhere to the physical limitations set, determined, and controlled by the teacher (3). The role of the command teacher is to control the three variables: pre-class preparation, execution, and evaluation. The role of the student in the command style is to listen, follow instructions, follow the external rhythm, perform while being observed, receive the teacher's comments and attempt to correct the error, and respond to the requirements of the testing procedures (3). Another term used for the command style is the expository method. Expository learning has always been associated with memorization. Expository learning gives a student facts from which he can formulate questions or draw conclusions. Ideas grow best in the minds of students that are well nourished with organized facts (12). It is this lack of factual information which seems to be a hindrance in the discovery theory. Students must have a vocabulary of abstract terms from previous tangible experiences. New materials will not be very meaningful unless the student can organize, explain, or integrate concepts (33).

Both the expository teacher and the command teacher can cover more information in less time than through other teaching methods. Similar to the command, expository teaching is also very ordered and controlled.

THE GUIDED DISCOVERY STYLE

The guided discovery style, as defined by Mosston (29), is the

fifth style on the spectrum of teaching styles and the first style that crosses the cognitive barrier.

In physical education literature, the major proponent of guided discovery learning is Mosston (30). Mosston explained that the reason for using guided discovery is one of cognition. In other methods of teaching physical education, such as command, small groups or individual learning, the learner does not engage in activities which demand great use of his intellectual capacities. The student remains unchallenged except for the occasional use of memory or recall. It is through "cognitive involvement" that a learner can reach a high level of insight and understanding (30).

In this style the teacher guides the student through all sequential discoveries until he discovers the focus, the goal, that the teacher has selected. The student is presented with a sequence of questions (or clues) so meticulously arranged that the student always discovers the correct response until the target (the focus) is reached (26). The importance of this style is that students for the first time make decisions about subject matter during the impact set (presentation of that subject matter). The teacher makes decisions about the focus, the initial phases (pre-impact), sequence of questions and size of each step. Advocates of discovery theorize that learning takes place at the moment of discovery. Guided discovery supporters feel that learning occurs after the discovery is made. It is after the point of discovery that the teacher is needed most to guide and direct the discovery into systematic knowledge (12). Without this guidance, discovery can only be restricted to special usage such as in the learning of isolated facts. This type of discovery does not usually occur in the process of developing concepts.

Discovery learning has no control (1). There is no way to check the thinking and discovery processes of the students. A discovery sequence may be designed for a student to discover a specific concept. However, there is no way to control the discovery of a concept which is not the desired one. This inaccurate discovery process could be very destructive in a learning sequence. A learner who is forced to exchange his incorrect "discovery" for one which is correct could become quite discouraged (1). Discovery learning through mere trial and error is very time consuming. The use of a familiar word achieves the instruction more rapidly and efficiently (14). Therefore, a "guided" process of discovery with the teacher giving clues and directing the learner seems to be the most beneficial.

Bruner (5), one disciple of the discovery method, gave four reasons in support of the discovery method. Through discovery one can: (a) increase his intellectual potential, (b) substitute internal for external satisfaction in learning, (c) learn how to "discover" facts for himself, and (d) aid his memory process.

It is theorized that man prefers to learn in creative and innovative ways rather than through preformulated, authority learning. Authority learning is a "telling" process by which a student is told what to learn and he accepts this to be true because it comes from an authority. The authority can be a newspaper, a book, or another individual's opinion (38). "Many things can be learned more effectively and more economically if they are learned creatively rather than by authority (38)."

Other discovery method arguments would include the importance of a learner being able to find answers and to process information for

himself rather than the retaining of large amounts of factual knowledge(15). Through discovery techniques, the student is challenged to explore facts and make inferences for himself. A student, therefore, can do his own thinking and play an integral part in his own learning process (13).

The spirit of inquiry cannot flourish in conditions where knowledge is absolute and the thinking process is secondary (34). Inquiry can only occur in an uninhibited environment in which the student is free to build his own theories and meet his own needs. A teacher cannot be as aware of the student's needs as is the student himself. When a learner is led through an environment which has been structured for him by the teacher, rote outcomes could occur (34). Increased failure on the high school and college levels could be caused by an over emphasis on rote learning (23).

The arguments for discovery teaching were summarized by Polya in Mosston's book on physical education teaching methods:

> A great discovery solves a great problem but there is a gain of discovery in the solution of any problem. Your problem may be modest, but if it challenges your curiosity and brings into play your inventive faculties, and if you solve it by your own means, you may experience the tension and enjoy the triumph of discovery. Such experiences at a susceptible age may create a taste for mental work and leave their imprint on mind and character for a lifetime (30).

Student involvement can be more fully realized through a mode of teaching which brings forth inquiry and does not allow the cognitive faculties to be inactive (30). An analysis of classroom questions and test questions has shown that these call for reproduction of facts, of which 90 percent are only at the level of recognition or reproduction (37). Teachers can improve the learning quality of their students by asking more questions requiring thinking (37). This seems possible through guided discovery.

Guided discovery for the recreational educator and the learner of recreational skills appears to have great potential as a teaching/learning device. As a learner works for an answer and makes a correct discovery, he has made the knowledge personal. This in turn creates a more meaningful relationship, a more favorable attitude, between the learner and the subject matter.

Hence, the primary concern of this study was to acertain whether a command or a guided discovery teaching method yields better results in the learning of a complex recreational class, namely, winter camping.

RELATED RESEARCH

Dougherty compared the command, task, and individual program styles of teaching on the development of physical fitness and the learning of selected motor skills (8). In this study, one hundred and fifteen college freshmen males were randomly assigned to a physical education activity class with no prior knowledge of the experimental nature of the teaching situation. Two classes were assigned to each style of teaching and all groups met for fourteen weeks. Each class session lasted for thirty minutes, of which the first fifteen minutes were reserved for fitness development, and the latter half to the practice of movement skills. Dougherty administered a five-item physical fitness test and a seven-item test in movement skills to all subjects during the first, seventh, and fourteenth weeks of the experimental period. The results indicated that the styles of teaching used did not significantly affect outcomes between pre- and post-test fitness and movement tests. The command group, in the fitness area, achieved significantly greater gains between the pre- and mid-treatment fitness tests than either the task or the individual program groups.

Between the mid- and post-treatment fitness tests, this trend reversed itself, and the individual program group achieved significantly greater gains than either the task or the command groups. The net effect of this reversal was that there were no significant differences among the groups at the conclusion of the study.

Dougherty also conducted an attitude survey and at the end of the study revealed that the task and individual program groups expressed approval of the individual freedom which they were allowed, while the command group expressed a desire for more freedom.

Mancini compared two decision making models in an elementary human movement program based on attitudes and interaction patterns (28). In one model the teacher made all the decisions (TDMA) and in the second the children were encouraged to take part in making decisions (CDMA). The subjects consisted of five hundred and five elementary school children, grades one through six. The Cheffers and Mancini Human Movement Attitude Scale (CAMHM), a semi-impressionistic scale, was developed and used to measure the attitudes of the children toward the teacher, facilities, and certain processes evident in the human movement program. Cheffer's Adaption of the Flanders Interaction Analysis System (CAFIAS), specially designed for use in physical activity classes, was used to measure the interaction and behavior patterns between the students and the teacher. Mancini used a two by two by three factorial analysis of variance of sex, treatment, and age on the CAMHM Attitude Scale. Scheffe's technique for multiple comparisons was used to determine significant differences. It was concluded that (1) when children are allowed to share with the teacher in the decision-making processes in a human movement program they clearly

show increased enjoyment of the program over children who are not given decision-making opportunities (28); (2) when children are given the opportunity to share with the teachers in the decision-making processes in a human movement program, there is increased positive interaction between the students and their teachers, increased student initiative and contributions, and increased variety in the teaching agencies (28). It was also revealed that there were significant differences at the .01 level between the attitude of the treatment group (CDMA) over the control group (TDMA).

In Heath's (16) study, attitudes related to recreation were compared and applied to a bicultural setting. The specific problem was aimed at studying and measuring the connotative meaning of attitudes related to recreation as they are influenced by the factors of age, sex, and ethnic background. The subjects were high school age youths and adults, females and males, within the Anglo-American and Spanish-American ethnic groups in Albuquerque, New Mexico. The attitude measurement used was the semantic differential and the criteria for using the S-D were objectivity, validity, reliability, utility, sensitivity, and comparability. Heath concluded that there was a significant relative difference of attitude relating to recreation between the groups. The study also showed that the S-D had significant sensitivity in measuring differences existing between age, sex, and ethnic background groups. Heath suggested that the S-D be utilized more often in recreational research.

Another study by Labordi (25) revealed a positive relationship between attitude and knowledge at the .05 level of significance.

Labordi studied the relationship between attitudes toward vocational education and knowledge of vocational education of Tennessee Guidance Personnel. One half of the sample in this study were counselors who attended a summer workshop and the other half were selected at random. The measuring instruments used were designed specifically for terminal evaluation at the termination of the workshop. The people who attended the workshop scored significantly higher in all categories than those who did not attend. Practical experiences and involvement appears to have an effect on people's attitudes and learning outcome. While these studies are not conclusive, it does provide incentive for further speculation and research.

In a study conducted by Boschee (3) the effects of command, task, and individual program styles of teaching were compared to their effects on specific skills in alley soccer, a game knowledge test on alley soccer, one's personal adjustment, and one's social adjustment. The subjects were two hundred twenty one fifth grade students enrolled in a number of schools within a geographic proximity. Teaching styles were assigned randomly to nine groups. All groups were taught for a period of eight consecutive weeks by one teacher. Flanders Interaction Analysis technique was utilized to establish teaching styles purity and consistency. Boschee (3) concluded that the command style of teaching produced more progress in learning skills than did the task and individual program style. No one style was proven better than another style for teaching game knowledge achievement in alley soccer. No noticeable difference was observed between the three teaching styles and their effect on personal adjustment and social adjustment. Several contradictions to Mosston's theoretical predictions of teaching styles

were made in this study (3). However, the question of validity exists, since only several times was interaction analysis used to determine the style of teaching used and the degree of purity and consistency.

In Johnson's (21) study, the comparison of student attitudes on performance based and traditional teaching methods were made. The purpose of the study was to determine the effect of two different teaching methods on the student's attitude in physical education. Evaluation was done under the Wear's attitude scale and a student opinionnaire at the end of eighteen weeks. Students were scored on general attitudes toward physical education. Results indicated that the performance based method developed better general attitudes toward physical education than did the traditional teaching method. It was noted that all classes disliked extra work in performance based teaching methods.

Weesner (39) conducted a study of the comparison of two approaches in the teaching of conditioning and their effect upon the fitness, knowledge, and attitudes of college women. Three instructors each taught two classes, employing the teacher-directed approach in one section and the student-centered approach in the other. Physical fitness was measured by the AAHPER youth fitness test, attitude by the Wear Attitude Inventory, and conditioning knowledge by a multiple-choice test. Questionnaires were used to ascertain course satisfaction and to discover differences in amount of participation. The student-centered approach was significant (ANOVA, $p < .05$) in satisfaction with the methods of instruction. A t-test showed significant gains in post-test and in all tests except for the standing broad jump, softball

throw, and the Wear Attitude Inventory. The teacher-directed classes participated to a greater extent in physical activity outside the class.

In a study by Jamieson (20), four groups were given a test to determine arithmetic ability before the learning sequence began, and a test following the learning sequence on binary numbers. The subjects were eighty females divided into four groups by age. The groupings were young, young adult, adult, older adult. Two groups, the youngest and the oldest, learned significantly better at the .02 level of confidence through a guided discovery technique rather than a programmed or minimal guidance technique. There was a positive correlation of .609 between the standardized arithmetic test score and the binary number test score for both experimental methods. An attitude test which was administered to the subjects showed they preferred the experimental methods of learning over the methods to which they were normally exposed.

MacDonald (27) researched the development of an instrument for determining attitudes toward physical recreation of freshmen college men at a selected institution. A thirty-item summated type attitude scale was developed and administered to two different classes of freshmen male students at Buffalo State University for the substantiation of scale reliability and validity. Reliability yielded coefficients of .97 ($n = 222$) and .95 ($n = 290$). Validity had a significant t for each administration ($P < .05$). Within the limitations of this study it was concluded that the physical recreational attitudes scale developed to measure the direction and intensity of attitudes toward physical recreation held by freshmen college men was valid and reliable

for the groups used. The attitudes held toward physical recreation by the groups studied, between participants and nonparticipants differed significantly with the participants being favorably disposed. Here again participation positively affects subject attitudes.

In a study conducted by Hinde (18), the attitudes toward laboratory experiences of preservice science teachers were compared with their general knowledge on the subject. Hinde's analysis design did in one instance show a significant positive relationship of attitude to knowledge. It was found that those who scored low on the attitude measure also scored low on the knowledge test and that this relationship was significant at the .05 level of confidence. The reverse was not true. Those who scored low on the knowledge test did not necessarily score low on the attitude measure. Over all and for those subjects who scored high on either instrument, no significant difference was found. The results indicate that for this study, knowledge is dependent on attitudes, or more specifically, a poor attitude indicates little knowledge and may be inhibiting the acquisition of further knowledge.

Kormeich (24) used ninety-nine subjects randomly assigned to three groups. The subjects were students enrolled in an introductory psychology course. These students received extra credit for their participation in the experimental research. The students worked with twenty-four concept identification problems in either a discovery, programmed, or guided discovery group. The concepts used were size, color, letter and position. In the programmed learning group, a rule was given every four problems to help define the strategy used. The guided discovery group received the same two rules verbally after every four problems and were told to "rethink what you are doing

before beginning the next problem (24)." The discovery group was told nothing.

The criteria for measurement in the study was the number of subjects in each group that acquired the "focusing strategy." A focusing strategy was defined as a pattern of responses which indicates one particular concept during a number of trials. The guided discovery group was significantly superior to the discovery group at the .001 level of confidence and better than the programmed group at the .05 level of confidence. The discovery and programmed groups did not differ significantly from each other. Kormeich discovered that the group which received less information had a greater number of subjects who discovered the strategy than the group which received more information. He observed that more students in the guided discovery group reread the directions during the learning sequence and seemed to do more thinking than the other groups.

Kersh (22) conducted a study in which two novel rules concerning the concept of addition were taught to ninety high school geometry students by three different methods. The methods used were guided discovery, programmed learning, and minimal guidance. Tests of recall and transfer showed the guided discovery and the minimal guidance groups to be superior to the programmed group at the .05 level of confidence. A questionnaire indicated that the guided discovery group practiced the rules between learning periods and test periods more often than the other subjects.

In a study by Ray (32) of guided discovery and expository teaching, ninety ninth grade boys, equated in age, socio-economic status and intelligence were taught the use of calipers. There was no

significant difference between the groups in initial learning. However, after a period of one week the guided discovery group scored higher than the expository group in retention. After six weeks the guided discovery group scored significantly higher than the expository group at the .05 level of confidence. After the first and sixth weeks the guided discovery group also scored significantly higher on tests of transfer.

Tanner used three hundred eighty-nine ninth grade general science students in fourteen classes in the learning of mechanical principles by different teaching methods (36). The subjects were given a preliminary aptitude test and two weeks later the program was begun. The subjects were randomly divided into three groups including expository, guided discovery, and minimal guidance. The students were tested as to interest, vertical transfer, lateral transfer, and comprehension. Tests of retention were administered four weeks later. There was no significant difference between the groups in comprehension, transfer interest, or retention.

These research studies disclosed little due to their conflicting results and variety of experimental designs. Inconsistencies in the defining and the interpreting of expository, guided discovery, and other teaching styles were also responsible for the different results. These research studies indicated the need to utilize more comprehensive and systematic research techniques and to establish better control over the many variables which have the potential for affecting instructional outcome (7).

CHAPTER III

METHODS AND PROCEDURES

TESTING INSTRUMENTS

In order to assure proper understanding of the teaching styles and the necessary compliance of the research design in this study, the researcher completed a course in the analysis of teaching offered in the Department of Health, Physical Education and Recreation at the University of Montana. The course used Muska Mosston's text, Teaching: From Command to Discovery (29) and a series of descriptive/analytical systems, including Flanders Interaction Analysis System. The class was ten weeks in duration during the fall quarter and provided a suitable background for the command and guided discovery teaching styles used in this study. Video taping sessions of the researcher while teaching provided for a means of self-analysis, peer analysis, and instructor analysis. Changes that had to be made were corrected and the teaching styles were further practiced in order to obtain a higher standard of performance.

Knowledge Test

Additional preliminary procedures involved in this research project began with the search for a standardized knowledge test on winter camping. After all possible sources were exhausted, including the military, the construction of a seventy question multiple-choice objective knowledge test on winter camping was made (Appendix A). The

test questions were evenly distributed according to the full range of winter camping topics that were taught during the nine week period. The knowledge test was reviewed and analyzed by Meier, Black, and Kneiland (winter camping professionals) and after some changes were made the test was administered to an experimental group of college students from the University of Montana.

The Kuder-Richardson formula (9) was selected as the statistic to compute test reliability. This formula was selected because it could be used when only one administration of a knowledge test was available. This technique also yields a coefficient of internal consistency and as such has some of the limitations of the split half method. A reliability coefficient of .996 was evident through the use of the formula. The reliability coefficient was rather high and appeared to be influenced by the length of the knowledge test.

An item analysis by the chi square method (9) was used to compute the validity of the knowledge test. This procedure separately evaluated each test item to determine whether or not an item discriminated in the same way the overall test was intended to discriminate. Two other categories of information were also drawn from the item analysis, namely the difficulty of the item, and the effectiveness of the distractors. The latter was not included in this study because of the nature and purpose of the knowledge test and the fact that no revision of the test was necessary for its administration to the experimental groups. Item difficulty was computed by dividing the number of subjects who answered the item correctly by the number who took the test. The difficulty rating ranged from five percent to

ninety-five percent with a mean rating of 37.64 percent. The discrimination level for the individual items was demonstrated by the chi square method of significance for the difference between two proportions. A total of sixty-five items were significant at the .05 level. Thus, it was concluded that a dependable difference existed between the proportion of high and low scoring subjects who gave correct answers and these sixty-five items were retained. Questions 17, 29, 42, 57, and 61 were found to be significant at the .10 level. These five questions were kept in the test because their mean degree of difficulty was 51.2 percent and considered pertinent to the topic matter. This knowledge test met the requirements of a proper evaluation tool according to Scott and French (33).

Semantic Differential

Osgood, the designer of the semantic differential attitude scale, defines this instrument as a tool to measure people's reactions to stimulus words and concepts in terms of ratings on bipolar scales defined with contrasting adjectives at each end (31). The semantic differential was developed as the result of an attempt to devise an adequate method of measuring meaning which would meet the criteria of a satisfactory measuring instrument. The criteria used by Osgood were objectivity, reliability, validity, sensitivity, comparability, and utility. Research dealing with the semantic differential is extensive and appears to be favorable in the measuring of attitudes and other social and psychological properties (17). The semantic differential is easy to set up, administer, and code. This fact in conjunction with the demonstrated reliability and validity of the semantic differential

procedure, gives it favorable cost-effectiveness (17). Heise (17) has found that the semantic differential correlates highly with measurements on traditional attitude scales.

The three psychological dimensions (evaluative, potency, and activity) which have an unprecedented amount of cross-cultural validation, yeild a wealth of information about effective responses to a stimulus (17). Heise suggests that all three dimensions of the semantic differential should be used when studying attitudes in order to permit the increased power of analysis. The semantic differential's most important general contribution is the provision of a single attitude space for all stimuli. This permits analysis, comparison, and insights that were virtually impossible with traditional attitude instruments.

Heath (16), in his research with the semantic differential, stated that the semantic differential measures connotative meanings which stimulus concepts have for different individuals. Connotative meaning refers to the private association which arises in connection with stimulus words through the learning history of the individual concerned. In Heath's study as well as in this one, connotative meanings were of importance when attempting to determine attitudes toward recreational concepts.

The semantic differential space covers three psycholgical dimensions: evaluative, potency, and activity. In Osgood's research, it was discovered that the pervasive evaluative factor in human judgement regularly appears first and accounts for approximately half to three-quarters of the extractable variances (35). Thus, the attitudinal

variable in human thinking, based as it is on the foundation of rewards and punishments both achieved and anticipated, appeared to be primary--good or bad (31).

The evaluative dimension is also associated with adjective contrasts such as: nice-awful, important-unimportant, beautiful-ugly, and pleasurable-painful. Various concepts which lie on the positive (good) side of this dimension are: God, family, doctor, church, happy, peace, success, truth and beauty. Some concepts which lie toward the negative (bad) pole are: Devil, discordant, abortion, divorce, fraud, hate, disease, sin, war, enemy, and failure. What is good depends heavily upon the concept being judged--strong may be good in judging athletes and politicians, but not in judging paintings and symphonies; harmonious may be good in judging organized processes like family, life, and hospital, but not so much so in judging people.

The second dimension of the semantic space to appear is usually the potency factor, and this typically accounts for approximately half as much variance as the evaluative factor. This is concerned with power and the things associated with it; size, weight, toughness, and the like. Some scales which define the potency dimension are powerful-powerless, big-little, strong-weak, heavy-light, free-constricted, and hard-soft. Concepts which lie toward the positive (powerful) pole are: war, army, brave, cop, mountain, engine, building, duty, law, steel, power, and science. Concepts which lie toward the negative (powerless) pole are: girl, baby, wife, feather, kitten, kiss, love, and art.

The third dimension, usually about equal to or a little smaller in magnitude than the potency dimension is the activity factor,

concerned with quickness, excitement, warmth, agitation, and the like. Some activity scales are fast-slow, alive-dead, hot-cold, noisy-quiet, and young-old. Some concepts high in activity are danger, anger, attack, city, fire, sword, tornado, win, child, and party. Among concepts which lie on the negative pole on the activity dimension are calm, snail, death, egg, rest, stone, and sleep.

The pairs of bipolar adjectives as selected for all concepts were good-bad, ugly-beautiful, important-unimportant, painful-pleasurable, hard-soft, light-heavy, constrained-free, passive-active, cold-hot, and simple-complex. These bipolar adjectives were selected on the basis of three criteria, (1) high factorial composition, (2) relevance to the concepts, and (3) semantic stability for the concepts and subjects in this particular study.

Referring to the section on attitudes, pages 3 and 4 in Chapter One, it can be inferred that attitudes have both direction and intensity. Students will make a decision in one direction or the other, towards adjectives that best describe their feelings toward a key concept. The intensity of their feelings toward a concept will be reflected by the space on the semantic differential scale that they select.

In this study the semantic differential was used to make comparisons on all three dimensions between the two classes (command teaching style group and guided discovery teaching style group). A sample of the semantic differential test used in this study is included in Appendix B.

Flanders Interaction Analysis System

In the last few years there has been an increased use of

descriptive-analytical instruments for the description and study of verbal behavior in the classroom. The instrument used in this study was Flanders Interaction Analysis System. This system objectively examines verbal behavior between teachers and students. In this technique, a trained observer records, every three seconds, the number of the verbal category used as shown on the Flanders Interaction Analysis Categories (Table I). Results are then transferred by a method of double pairing to a ten-by-ten matrix. In a matrix the sequence of events which occur in the classroom are recorded to allow examination of the classroom verbal interaction. Verbal behavior patterns can be analyzed as well as the amount of time spent in each category, directness or indirectness of the teacher's verbal behavior, teacher response ratio, teacher question ratio, pupil initiation ratio, instantaneous teacher response ratio, and content cross ratio. It should be emphasized that Flanders Interaction Analysis System is not an evaluative tool, but a descriptive instrument that merely describes what happens verbally in the classroom.

The sequence of verbal behavior used by the teacher and the students can be associated with some of Mosston's teaching styles. A pure command teacher would primarily use categories 5 and 6, lecturing and giving directions, and the majority of all recorded tallies in a teaching session would be 5 or 6. There should be no significant evidence of other verbal patterns. The pure guided discovery teacher's primary interaction pattern would be 4, 8, 2, 4, teacher asks question, pupil talk-response, teacher praises or encourages, teacher asks question. On many occasions, teachers overlap in a number of teaching

TABLE I

FLANDERS INTERACTION ANALYSIS CATEGORIES*

Teacher Talk	Indirect	1.	Accepts feeling. Accepts and clarifies an attitude or the feeling tone of a pupil in a nonthreatening manner. Feelings may be positive or negative. Predicting and recalling feelings are included.
		2.	Praises or encourages. Praises or encourages pupil action or behavior. Jokes that release tension, but not at the expense of another individual; nodding head, or saying "um hmm?" or "go on" are included.
		3.	Accepts or uses ideas of pupils. Clarifying, building or developing ideas suggested by a pupil. Teacher extensions of pupil ideas are included but as the teacher brings more of his own ideas into play, shift to category five.
		4.	Asks questions. Asking a question about content or procedure base on teacher ideas, with the intent that a pupil will answer.
	Direct	5.	Lecturing. Giving facts or opinions about content or procedures; expressing his own ideas, giving his own explanation, or citing an authority other than a pupil.
		6.	Giving directions. Directions, commands, or orders to which a pupil is expected to comply.
		7.	Criticizing or justifying authority. Statements intended to change pupil behavior from nonacceptable to acceptable pattern; bawling someone out; stating why the teacher is doing what he is doing, extreme self-reference.
Pupil Talk		8.	Pupil-talk-response. Talk by pupils in response to teacher. Teacher initiates the contact or solicits pupil statement or structures the situation. Freedom to express own ideas is limited.
		9.	Pupil-talk-initiation. Talk by pupils which they initiate. Expressing a new topic; freedom to develop opinions; freedom to develop opinions and a line of thought; like asking thoughtful questions; going beyond the existing structure.
Silence		10.	Silence or confusion. Pauses, short periods of silence and periods of confusion in which communication cannot be understood by the observer.

*There is no scale implied by these numbers. Each number is classificatory; it designates a particular kind of communication event. To write these numbers down during observation is to enumerate, not to judge a position on a scale.

styles; however, the primary teaching style can be identified along with the secondary interaction pattern. Discussion of this measuring instrument will be limited to the degree to which the researcher maintained teaching style consistency and purity throughout the study. The tape recordings of the five twenty minute sessions for each group were analyzed by an expert in the field of Flanders Interaction Analysis System and will be reviewed in Chapter Four.

SELECTION PROCEDURES

Selection of Classes

Prior to the commencement of winter quarter classes, it was necessary to select according to a Table of Random Numbers (9), five class sessions for each of the two groups (the command style class and the guided discovery class). A course outline had already been written consisting of a total of fourteen class sessions. Sessions 3, 7, 9, 10, and 13 were selected for the command teaching style (Monday and Wednesday group). The sessions randomly selected for the guided discovery teaching style (Tuesday and Thursday group) were 4, 8, 9, 12, and 13. The tape recording of the classes was conducted by two graduate student volunteers (class non-participants who sat in on all sessions).

Selection of Subjects

During the fall of 1974, authorization for teaching two winter camping classes during winter quarter 1975 was obtained from the chairman of the Department of Health, Physical Education and Recreation, University of Montana. The winter camping classes then became a part of the winter quarter HPER course program. Direct selection of the

subjects was then eliminated due to the process of registration for courses at the University. Students from the University of Montana registered on a first come first served basis until the class was completely filled.

There was no previous camping experience required of the student, nor any set restrictions. There were no classifications such as age, and sex that had to be met. The total number of subjects at the end of the quarter and for the length of this study was sixty-four college students.

INSTRUCTIONAL PROCEDURES

The first class, the command group, met every Monday and Wednesday at 3:00 p.m. in room 204 of the Women's Center (University of Montana), and the second class, the guided discovery group, met every Tuesday and Thursday at 3:00 p.m. in the same classroom. Prior to the first class session and subject introduction, the cognitive knowledge and attitude pre-tests were administered to the two classes. Both classes were tested separately due to alternate class meetings. Identical testing instructions were given to the two groups. Both classes had a total of 45 minutes to complete the knowledge test and all students finished within the time period allowed. No discussion was allowed between students and the teacher during the test. Following the knowledge tests, the students were not allowed to discuss the questions with the instructor.

During the second class meetings, the semantic differential attitude tests were administered. With the consensus of selected

professionals in education ten target concepts were selected to represent main components of the winter camping program: (1) Wilderness, (2) Winter Camping, (3) Shelter Construction, (4) Exposure, (5) Winter Safety, (6) Snow Travel, (7) Multiple Land Usage, (8) Restricted Land Usage, (9) Cold Weather, and (10) Snow Blindness. An eleventh concept, Summer Camping, was also included for recreational interest and comparison with winter camping.

All students were given a copy of the test instructions (Appendix B) and the administrator read the instructions thoroughly and added the following directions: "Sometimes you may feel as though you've had the same item before on the test. This will not be the case, so do not look back and forth through the items. Do not try to remember how you checked similar items earlier in the test. Make each item a separate and independent judgement. Work at a fairly high speed through this test. Do not worry or puzzle over individual items that we want. On the other hand, please do not be careless, because we want your true impressions (35)." Discussion of the concepts prior to the administration of the test was not allowed.

All materials and subject matter covered in one class was discussed in the second class. All subject matter could be found in the course text, The Complete Snow Camper's Guide, by Raymond Bridge (4). In this respect the classes were similar, except for the teaching style, verbal, and non-verbal behavior used. Lesson plans were prepared prior to class meetings and contained identical content for the two different groups.

Winter camping topics included all of the following: winter camping, winter survival, planning, terrain and limitations, clothing,

equipment, packs, boots, sleeping bags, fires, foods, cooking, camp sites, tent shelters, igloos and snow shelters, map and compass, transportation, cross-country skiing, snowshoeing, weather conditions, storms, types of snow, avalanches, first aid, snow blindness, hypothermia, environmental impact, and wilderness ethics. Class instruction began for the command group on January 15, 1975 and ended March 12, 1975. Instruction for the guided discovery group commenced January 14, 1975 and terminated March 13, 1975. The two winter camping classes both met for eighteen class sessions.

The recording of the verbal interaction in the class was conducted with a Panasonic tape recorder. Five twenty minute sections were randomly recorded for each group. The instructor at no time knew what section of a class period was being recorded. This was only possible due to the silent remote control unit of the tape recorder and its concealment from the instructor. The tape recording was conducted by two graduate student volunteers. No difficulty was encountered with the clarity of the recording. The situating of the remote microphone in the center of the classroom contributed to the good quality sound recording.

Towards the end of the course both classes took part in a field trip consisting of one over-night camp out in a wilderness area. The command group went on its field trip on March 8 and 9, 1975; only twenty-five students participated. The command style of teaching was also carried out during the outing. Twenty students from the guided discovery group went on their March 15 and 16, 1975 field trip. The guided discovery style of teaching was used during the outing.

Snow precipitation and cold weather were encountered on both field trips. Both field trips were located in the same wilderness area and included the same type of snow traveling conditions and equipment, namely snowshoes and cross-country skis. The same number of miles were traveled to the campsites by both parties. All students from both groups constructed snow shelters and slept in them overnight.

Following the field trips, both classes were administered post-tests on winter camping cognitive achievement and the semantic differential attitude test. The same instructions given for the pre-test were used and the same time was allowed to complete the knowledge test. This was the same knowledge test used in the pre-test. The attitude test was given along with the same instructions used for the attitude pre-test. Students who met all the requirements in this study were considered to be subjects. Those who missed three or more class sessions were not considered subjects and their pre-test and post-tests were removed from the study. All collected data was recorded and analyzed.

HYPOTHESES

This study compared the effects of command and guided discovery styles of teaching on college students' cognitive achievements in, and their attitudes toward, a class in winter camping.

The following hypotheses were examined in this research study:

1. There will be no significant difference in students' cognitive avhievement between the command group and the guided discovery group.

2. There will be no significant difference in the evaluative dimension mean E (selection of evaluative factors on the semantic differential scale) between the command group and the guided discovery group.

3. There will be no significant difference in the potency dimension mean P (selection of potency factors on the semantic differential scale) between the command group and the guided discovery group.

4. There will be no significant difference in the activity dimension mean A (selection of activity factors on the semantic differential scale) between the command group and the guided discovery group.

5. There will be no significant difference in total students' attitudes toward winter camping between the command group and the guided discovery group.

STATISTICAL ANALYSIS

All statistical analysis of the data was designed with the assistance of a statistical consultant from Eastern Washington State College, Cheney, Washington.

Statistical procedures for Hypothesis One are as follows:

A. Construction of histograms on the pretest and post-test distribution for the command and the guided discovery groups provided visual means of describing the data for preliminary evaluation.

B. In order to substantiate implications drawn from the histograms and as a check on the assumption of normality for the difference in means analysis, a chi square goodness of fit test was run on the pretest and post-test data.

C. A difference of means statistic (Z test) was given to pretest and post-test data at a 5 percent level of significance. This statistic provided necessary information on the difference between the command group and the guided discovery group prior to the courses of instruction.

Statistical procedures for Hypotheses Two, Three, and Four are as follows:

A. The t-statistic was used to test the difference in means between the guided discovery group and the command group. Also tested within each of these groups was the difference in means between those students who participated in the camping trips and those who did not.

B. The assumption underlying differences in means analysis using the t-statistic are (1) small sample size, (2) samples are drawn from populations which are approximately normally distributed and have equal variances. In order to test the assumption of equal variance, an hypothesis test using the F-statistic (analysis of variance) was run between groups.

C. A mean and standard deviation was computed for each class on each bipolar scale for the evaluative, potency, and activity dimensions (four bipolar scales for evaluative, three for potency, and three for activity). With the derived information a difference in means test was then run for each bipolar scale at the 5 percent level of significance. The critical value for t-statistic at 5 percent level of significance for a two-tailed test between groups is $\pm$ 1.9998 with 62 degrees of freedom.

Hypothesis Two was tested according to the following statistical principle: Reject Hypothesis Two only if a significant difference

in means for the two classes is found in a majority of the bipolar scales pertaining to the evaluative dimension.

Hypothesis Three was tested following the same principle used for Hypothesis Two. Similarly, reject Hypothesis Three only if a significant difference in means is found on a majority of the bipolar scales pertaining to the potency dimension.

Hypothesis Four was tested following the same principle used for Hypotheses Two and Three. Similarly, reject Hypothesis Four only if a significant difference in means is found on a majority of bipolar scales pertaining to the activity dimension.

The statistical procedures for Hypothesis Five are as follows:

Hypothesis Five is based on data from the testing of Hypotheses Two, Three, and Four, and Hypothesis Five will be rejected only if a majority of Hypotheses Two, Three, and Four are rejected.

CHAPTER IV

ANALYSIS OF DATA

In this chapter the results and analysis of the tape recordings are reviewed. The analysis of the data by hypotheses and discussion of the statistical procedures used are also reviewed.

GENERAL DESCRIPTION

This study involved seventy-two University of Montana students who registered for two separate winter camping classes offered by the Department of Health, Physical Education and Recreation. Thirty-five students finished the course in the command group and twenty-nine students finished in the guided discovery group after eight withdrawals. Each winter camping class met for 50 minutes per day, two days per week, and for one field trip outing. Both classes were exposed to 20 hours of teaching. Only twenty-five students in the command group participated in the winter camping field trip and only twenty students in the guided discovery group participated in their field trip. Both classes were administered separate pretest and post-tests on knowledge and attitudes. Five twenty minute recordings were randomly taken for each class and analyzed by an expert in Flanders Interaction Analysis. All data were statistically treated according to the outline in Chapter Three.

INTERACTION ANALYSIS RESULTS

The matrix (Table II) for the Monday and Wednesday class (command teaching style) indicates that the category most used was 5: "Lecturing. Giving facts or opinions about content or procedures; expressing his own ideas, giving his own explanations, or citing an authority other than pupil (11)." Referring to Table II it can be observed that categories 4, 9, and 6 were used occasionally. The instructor diverged from lecturing to a pattern of 5, 4, 5 (lecturing, asking questions, lecturing). A 5, 9, 5 (lecturing, student-talk-initiation, lecturing) orbit was also noted. The use of category 6 (giving directions), was used to direct the flow of instruction back to category 5 (lecturing).

The instructor asked questions only 3 percent of the time while 87.3 percent of the time was spent lecturing. Only 1.7 percent of class time was spent on category 6 (giving directions). Student-talk-initiation resulted in 3.9 percent of total class time. Overall teacher talk accounted for 93.2 percent of class time, and student talk only 4.5 percent. Further analysis of the matrix shows the percentage of direct teacher influence to be 89.2 percent which strongly indicates thet the teaching style used was definitely command.

In Table III, the matrix for the Tuesday and Thursday class (guided discovery teaching style), indicates that the primary interaction pattern used by the teacher was 4, 8, 2, 4 (asks questions, pupil-talk-response, praises, asks questions), and the secondary pattern was 5, 4, 10, 4 (lecturing, asks questions, silence, asks questions). Student talk accounted for 22.3 percent of total class

TABLE II

MATRIX FOR COMMAND STYLE TEACHING GROUP

CATEGORY	1	2	3	4	5	6	7	8	9	10	Total Tallies
1											0
2				2	11	1			2		16
3											0
4		3		13	13			8	6	4	47
5				27	1280	21		1	24	8	1361
6					18	2			2	4	26
7					3						3
8		5		1	3						9
9		8		1	22		3		26	1	61
10				3	11	2			1	19	36
Total Tallies	0	16	0	47	1361	26	3	9	61	36	1559
INCIDENTS	0	16	0	34	81	24	3	9	35	17	
PERCENT	0	.010	0	.030	.873	.017	.002	.006	.039	.023	
Percent of Total	4%				89.2%			4.5% Student Talk		2.3% Silence or Confusion	
	Teacher Talk 93.2%										

TABLE III

MATRIX FOR GUIDED DISCOVERY STYLE TEACHING GROUP

CATEGORY	1	2	3	4	5	6	7	8	9	10	Total Tallies
1											0
2		4	4	144	31	3		17	3	5	211
3			3	5	4						12
4		6	1	177	11	2		210	8	39	454
5		1		56	170	13	1		6	8	255
6				12	4	1		2	2	13	34
7				2	1			4			7
8		186	3	26	15	4	5	40		1	280
9		13	1		4	1	1		6		26
10		1		32	15	10		7	1	25	91
Total Tallies	0	211	12	454	255	34	7	280	26	91	1370
INCIDENTS	0	207	9	277	85	33	7	240	20	66	
PERCENT	0	.154	.009	.331	.186	.025	.005	.204	.019	.066	
Percent of Total		49.4%			21.6%			22.3% Student Talk		6.6% Silence or Confusion	
		Teacher Talk 71%									

time and teacher talk, 71 percent. It was recorded that the teacher overlapped into a second orbit in which 5, 4, 10, 4 categories were used. However, only 18.6 percent of class time was spent on category 5 (lecturing). 15.4 percent of class time was spent on category 2 (praises or encourages) and 33.1 percent on category 4 (asks questions). Only 2.5 percent of class time was used in giving directions, category 6. Overall, the percentage of direct teacher influence was only 21.6 percent. This matrix indicates that the teacher used the guided discovery style of teaching.

The comparison of Table II and Table III indicates that the command and guided discovery styles of teaching were used in the respective classes throughout the study. A high degree of teaching consistency existed for both teaching styles. Comparing the percentages of student talk (categories 8 and 9) in both matrices, one will find that students in the guided discovery group participated in student response and initiation five times more often than did the students in the command group. Category 2 (praises or encourages) was used 15.2 times more often in the guided discovery class than in the command class. The teacher used category 4 (asks questions) 33.1 percent of class time in guided discovery and only 3 percent in the command. Category 5 (lecturing) was used 87.3 percent of the class time in the command and only 18.6 percent in guided discovery. This data substantiates the significant difference of teaching styles used for each class.

ANALYSIS OF DATA BY HYPOTHESIS

Hypothesis One: There will be no significant difference in students' cognitive achievement between the command group and the guided discovery group.

Histograms were constructed to describe pretest and post-test distributions for the command group and guided discovery group (Appendix C, D, E, and F). The histograms suggest that the pretest data were normally distributed while the post-test data were slightly skewed. This is consistent with the expectation of gaining knowledge with both teaching techniques.

Chi-square goodness of fit tests were run on pretest and post-test data to substantiate implications drawn from histograms and to support assumptions of normality for difference in means analysis (Table IV). As a result, pretest data may be assumed to be normally distributed with a small probability of error; specifically, the probability of observing the particular pretest data for the command group when, in fact, the data is not normally distributed, is less than .025. Similarly, the probability of observing the particular pretest data for the guided discovery group, when, in fact, this data is not normally distributed, is less than 0.005. The results of this test on the post-test data were less desirable; probabilities of 0.25 and 0.10 for the command and guided discovery groups respectively (Appendix G, H, I, and J for goodness of fit calculations).

A difference in means analysis was run on pretest and post-test data at 5 percent level of significance (Appendix K and L). The z-statistic was used for both sets of data.

TABLE IV

GOODNESS OF FIT TESTS FOR COMMAND AND GUIDED DISCOVERY STYLE TEACHING GROUPS

Group	Test	n	Mean	Standard Deviation	D^2
Guided Discovery[1]	Pre	29	30.207	5.759	22.6516
Command[2]	Pre	35	29.8	5.794	14.8260
Guided Discovery[3]	Post	29	42.517	5.448	1.4574
Command[4]	Post	35	41.543	5.716	6.9960

[1] $P(D^2 \geq 22.56) < .005$ k = 5 degrees of freedom

[2] $P(D^2 \geq 14.83) < .025$ k = 5 degrees of freedom

[3] $P(D^2 \geq 1.4574) < .10$ k = 5 degrees of freedom

[4] $P(D^2 \geq 6.996) < .25$ k = 5 degrees of freedom

The underlying assumptions for the z-statistic are normally distributed data and "large" sample sizes. The commonly accepted guide for deciding whether a sample is large or small is a size of 30. The sample sizes of 29 and 35 are sufficiently close to this guide to use the z-statistic. The critical value for z, at the 5 percent level of significance, is 1.96 (two-tailed test).

Difference in means analysis for the pretest resulted in $z = .281$, and $z = .696$ for the post-test. Both pretest and post-test data imply that there were no significant differences between the groups, either in cognitive knowledge prior to the courses of instruction, or cognitive achievement resulting from instruction. No significant difference was found, thus Hypothesis One was accepted. Because of the fact that $n = 29$ borders on the line of a t-statistic, a t-test was also run on the achievement data. The conclusions parallel those of the z-statistic (Appendix M, N, and O).

ATTITUDE DATA AND ANALYSIS

The t-statistic was used on attitude data to test difference in means between command and guided discovery groups. To rest the assumption of equal variances, the F-statistic of hypothesis testing was used between groups. All of the F-tests were tested at the .02 level of significance. The F-test is a one-tailed test, because the main concern here was with the part of the F distribution with values greater than 1. Obtained results were significant at the 1 percent point. When interpreting from a two-tailed test table an F significant at the .01 point must be read at the .02 level.

The F-statistic analysis and results are presented in Table V. As may be seen in Table V, bipolar scale 2 was omitted. A mean and standard deviation was computed for each class on each bipolar scale for the evaluative, potency, and activity dimensions (Tables VI and VII). A difference in means test was then run for each bipolar scale (Table VIII). Hypothesis Two, Three, and Four were tested according to the statistical design in Chapter Three.

Hypothesis Two: <u>There will be no significant difference in the evaluative dimension mean E (selection of evaluative factors on the semantic differential scale) between the command group and the guided discovery group.</u>

Hypothesis Two was tested at the 5 percent level of significance using a t-statistic with a critical value of $\pm$ 1.9998 and 62 degrees of freedom. Table VIII breaks down attitude results between the two groups for each bipolar scale. The following scores were derived for the four evaluative scales used: 1.81, *, -2.84, and -1.42. Bipolar scale 3 (important-unimportant) was found to be the only significant scale for the evaluative dimension. In this case the guided discovery group regarded winter camping to be significantly more important than did the command group. Since a majority of significant evaluation scales were not obtained, Hypothesis Two was accepted. No significant differences in the evaluative dimension mean E was found between the guided discovery group and the command group.

TABLE V

F-TEST BETWEEN COMMAND AND GUIDED DISCOVERY GROUPS

Bipolar Scales	Standard Deviation S_1 = G. D. n = 29	Standard Deviation S_2 = Command n = 35	F	P(f > F)
Good-bad	.856	.728	1.38	.182
Ugly-beautiful	.509	1.42	7.78	1.77×10^{-7}
Important-unimportant	.884	1.18	1.78	.06
Painful-comfortable	1.5	1.62	1.17	.341
Hard-soft	1.57	1.18	1.77	.056
Light Heavy	1.42	1.40	1.03	.464
Constricted-free	1.88	1.69	1.24	.275
Passive-active	.846	1.15	1.85	.050
Cold-hot	1.54	1.12	1.89	.039
Simple-complex	1.41	1.41	1.00	.495

The critical value for F is 2.36 at 2% level of significance.

TABLE VI

MEANS AND STANDARD DEVIATIONS FOR COMMAND GROUP (PRETEST)

Bipolar Scales	Total Class n = 35		Field Trip Participants n = 25		Field Trip Non-participants n = 10		Semantic Differential Dimensions
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	
Good-bad	-2.57	.7284	-2.64	.5571	-2.4	1.0976	
Ugly-beautiful	+1.6	1.4182	+2.44	1.2986	+2.5	.25	Evaluative
Important-unimportant	-1.91	1.1801	-2.24	.9499	-1.1	1.69	
Painful-comfortable	1.314	1.6173	+1.36	1.741	+1.2	1.56	
Hard-soft	- .914	1.1801	- .96	1.28	- .8	.76	
Light-heavy	+ .257	1.3953	+ .4	1.5232	+ .2	.96	Potency
Constricted-free	+1.057	1.6931	+ .96	1.3953	+1.3	2.81	
Passive-active	+2.00	1.1464	2.08	1.0925	+1.8	1.56	
Cold-hot	-1.686	1.1154	-1.88	1.1426	-1.2	.76	Activity
Simple-complex	+1.314	1.4096	+1.52	1.3891	+ .8	1.76	

TABLE VII

MEANS AND STANDARD DEVIATIONS FOR GUIDED DISCOVERY GROUP (PRETEST)

Bipolar Scales	Total Class n = 29		Field Trip Participants n = 20		Field Trip Non-participants n = 9		Semantic Differential Dimensions
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	
Good-bad	-2.482	.8558	-2.650	.5723	-2.111	1.1958	
Ugly-beautiful	+2.756	.5088	+2.840	.3647	+2.560	0.6849	Evaluative
Important-unimportant	-2.103	.8845	-2.300	.7810	-1.670	0.9426	
Painful-comfortable	+1.172	1.4987	+1.400	1.3565	+ .670	1.6340	
Hard-soft	-0.931	1.5742	-1.100	1.3748	- .670	1.8920	
Light-heavy	+1.206	1.4192	+1.300	1.1000	+1.000	0.4473	Potency
Constricted-free	+ .714	1.8775	+0.750	1.8940	+ .560	2.0049	
Passive-active	+2.207	.8461	+2.300	0.8426	+2.000	0.8188	
Cold-hot	-1.379	1.5346	-0.935	1.6002	-2.110	1.1000	Activity
Simple-Complex	+1.483	1.4149	+1.350	1.3518	+1.780	1.4730	

TABLE VIII

ATTITUDE ANALYSIS BETWEEN COMMAND AND GUIDED DISCOVERY GROUPS

	Attitude	Guided Discovery Group		Between Groups	Command Group		Attitude
		$\bar{x}_1$	σ_2	t	$\bar{x}_2$	σ_2	
Evaluative	Good	-2.48	.856	1.81	-2.57	.728	Bad
	Ugly	2.75	.509	*	1.6	1.42	Beautiful
	Important	-2.1	.884	-2.84	-1.91	1.18	Unimportant
	Painful	1.17	1.50	-1.42	1.31	1.62	Comfortable
Potency	Hard	- .931	1.57	-1.97	- .914	1.18	Soft
	Light	1.21	1.42	10.7	.257	1.40	Heavy
	Constricted	.714	1.88	-3.08	1.06	1.69	Free
Activity	Passive	2.21	.846	3.27	2.0	1.15	Active
	Cold	-1.38	1.54	3.70	-1.69	1.12	Hot
	Simple	1.48	1.41	1.91	1.31	1.41	Complex

*The t-statistic is not valid for this bipolar scale because results of the F test imply the assumption of equal variances is not valid.

The critical values, at 5% level of significance for t with 62 degrees of freedom are $\pm$ 1.999. Thus, the null hypothesis for bipolar scales 3, 6, 7, 8, and 9 are rejected.

Hypothesis Three: <u>There will be no significant difference in the potency dimension P (selection of potency factors on the semantic differential scale) between the command group and the guided discovery group.</u>

Hypothesis Three was tested at the 5 percent level of significance using a t-statistic with a critical value of $\pm$ 1.9998 and 62 degrees of freedom. The second section of Table VIII lists the attitude results between the two groups for the 3 bipolar scales in the potency dimension. The following scores derived for the three scales were -1.97, 10.7, and -3.08. Two scales were found to be significant, light-heavy and constricted free. The guided discovery group regarded winter camping to be significantly heavier than did the command group. According to Osgood, heavier can be translated to mean hard to do in relation to work. Thus the guided discovery class regarded winter camping harder to do, work-wise (i.e. building snow shelters, snow traveling, etc.) than did the command group. The command group regarded winter camping to be significantly freer than did the guided discovery group. The field trip experience provided an opportunity for the command student to experience more freedom as in relationship to the classroom structure. Since a majority of significant potency scales was obtained, Hypothesis Three was not accepted. There was significant difference in the potency dimension mean P between the guided discovery group and the command group.

Hypothesis Four: There will be no significant difference in the activity dimension mean A (selection of activity factors on the semantic differential scale) between the command group and the guided discovery group.

Hypothesis Four was also tested at the 5 percent level of significance using a t-statistic with a critical value of ± 1.9998 to 62 degrees of freedom. The last section of Table VIII lists the attitude results of the two groups for the three bipolar scales in the activity dimension. The following scores derived for the three activity scales are 3.27, 3.70, and 1.91. Two scales were found to be significant: passive-active and cold-hot. The guided discovery group regarded winter camping to be significantly more active than did the command group. The command group however, regarded winter camping to be significantly colder than did the guided discovery group. Since a majority of significant activity scales was obtained, Hypothesis Four was not accepted. There was significant difference in the activity dimension mean A between the guided discovery group and the command group.

Hypothesis Five: There will be no significant difference in total students' attitudes toward winter camping between the command group and the guided discovery group.

The decision to accept or reject Hypothesis Five lies in both the construction of the semantic differential and the majority principle. The three dimensions (evaluative, potency, and activity - E P A) of the semantic differential were tested at the 5 percent level of significance using a t-statistic with a critical value of ± 1.9998 and 62 degrees of

freedom. Both Hypotheses Three and Four were not accepted and Hypothesis Two was accepted. A majority of significant semantic dimension was obtained, therefore Hypotheses Five was not accepted. There was significant difference in attitudes between the command group and the guided discovery group. The guided discovery group in this study regarded winter camping as more important, heavier, and more active, while the command group regarded winter camping as freer and colder.

ATTITUDE DIFFERENCE WITHIN GROUPS

Additional attitude data were derived as a result of the participation and non-participation by students in the winter camping field trips. An hypothesis test using the F-statistic was run on both groups (Tables IX and X). A t-statistic was then run within groups between participants and non-participants (Table XI). The guided discovery group was tested at the 5 percent level of significance with a critical value of $\pm$ 2.0518 for 27 degrees of freedom. No significant difference in attitudes was found in the guided discovery group. The command group was tested at the 5 percent level of significance. The critical value for the student t was $\pm$ 2.0345 with 33 degrees of freedom. Four bipolar scales were found to be significant, two evaluative scales and two activity scales. Only the activity dimension in the command group produced a majority indicating that the attitudes of the field trip participants differed significantly from the attitudes of the non-participants. The command group non-participants regarded winter camping to be significantly hotter than did the field trip participants. The command group field trip participants regarded winter camping to be significantly more complex than did the non-participants.

TABLE IX

F-TEST WITHIN COMMAND GROUP

Bipolar Scales	Standard Deviation S_1 Field Trip Participants n = 25	Standard Deviation S_2 Field Trip Non-Participants n = 10	F	P(f > F)
Good-bad	.557	1.04	3.55	.006
Ugly-Beautiful	1.3	.5	6.76	.003
Important-unimportant	.95	1.3	1.87	.106
Painful-comfortable	1.74	1.25	1.94	.152
Hard-soft	1.28	.872	2.15	.116
Light-heavy	1.52	.98	2.41	.086
Constricted-free	1.4	1.68	1.44	.227
Passive-free	1.09	1.25	1.32	.280
Cold-hot	1.14	.872	1.71	.204
Simple-complex	1.39	1.33	1.09	.472

TABLE X

F-TEST WITHIN GUIDED DISCOVERY GROUP

Bipolar Scales	Standard Deviation S_1 Field Trip Participants n = 20	Standard Deviation S_2 Field Trip Non-Participants n = 9	F	P(f > F)
Good-bad	.572	1.20	4.40	.004
Ugly-beautiful	.365	.685	3.52	.012
Important-unimportant	.781	.943		
Painful-comfortable	1.36	1.63	1.44	.245
Hard-soft	1.38	1.89	1.88	.096
Light-heavy	1.1	1.41	1.64	.178
Constricted-free	1.89	2.01	1.13	.387
Passive-free	.843	.818	1.06	.493
Cold-hot	1.6	1.1	2.12	.140
Simple-complex	1.35	1.47	1.18	.358

TABLE XI

ATTITUDE SUMMARY

	Guided Discovery Group							Command Group							
	Participants			Non-participants		Whole Class		Between Groups	Whole Class		Participants			Non-participants		
-3	$\bar{x}$	σ	t	$\bar{x}$	σ	$\bar{x}$	σ	t	$\bar{x}$	σ	$\bar{x}$	σ	t	$\bar{x}$	σ	+3
Good	-2.65	.572	-1.66	-2.11	1.196	-2.48	.856	1.81	-2.57	.728	-2.64	.557	-2.36	-2.4	1.05	Bad
Ugly	2.84	.365	.752	2.56	.685	2.75	.509	*	1.6	1.42	2.44	1.30	- .376	2.5	.5	Beautiful
Important	-2.3	.781	-1.89	-1.67	.943	-2.1	.884	-2.84	-1.91	1.18	-2.24	.950	-7.70	-1.1	1.3	Unimportant
Painful	1.4	1.36	1.26	.67	1.63	1.17	1.50	-1.42	1.31	1.62	1.36	1.74	.617	1.2	1.25	Comfortable
Hard	-1.1	1.38	- .869	- .56	1.89	- .931	1.57	-1.97	- .914	1.18	- .96	1.28	- .368	- .8	.872	Soft
Light	1.3	1.1	.623	1.0	1.41	1.21	1.42	10.7	.257	1.40	.4	1.52	1.03	.2	.98	Heavy
Constricted	.75	1.89	.246	.56	2.01	.714	1.88	-3.08	1.06	1.69	.96	1.40	-1.64	1.3	1.68	Free
Passive	2.3	.843	.894	2	.818	2.21	.846	3.27	2.0	1.15	2.08	1.09	1.76	1.8	1.25	Active
Cold	- .935	1.6	1.00	-2.11	1.1	-1.38	1.54	3.70	-1.69	1.12	-1.88	1.14	-4.54	-1.2	.872	Hot
Simple	1.35	1.35	- .772	1.78	1.47	1.48	1.41	1.91	1.31	1.41	1.52	1.39	3.74	.8	1.33	Complex

Degrees of freedom:

Within Guided Discovery group:- 27 - critical value for t is $\pm$ 2.0518

Within Command group:- 33 - critical value for t is $\pm$ 2.0345

Between groups: 62 - critical value for t is $\pm$ 1.9998

*Decision to reject null hypothesis concerning equal standard deviations invalidates use of t-statistic.

CHAPTER V

SUMMARY, CONCLUSIONS, DISCUSSION AND RECOMMENDATIONS

This chapter presents summary, conclusions, discussion and recommendations of this research study.

SUMMARY

In this research study the command style of teaching was compared to the guided discovery style. Sixty-four University of Montana students participated in the study. Twenty-nine students finished in the guided discovery class and thirty-five students finished in the command class. Both classes studied winter camping and the same subject matter was covered over a nine week period. Prior to instruction, both classes were administered a winter camping knowledge examination and a semantic differential attitude test. After the nine weeks of instruction both classes were given post-tests on achievement and attitudes, utilizing the same knowledge and attitude tests used for the pre-test. During the course of instruction ten twenty minute tape recordings were randomly taken to establish teaching syle purity and consistency. An expert in the field of Flanders Interaction Analysis System analyzed the recordings and concluded that both the guided discovery and the command style of teaching were practiced in this research study.

The Z-statistic was applied to the pre-test and post-test results of the cognitive knowledge examination for both classes.

Hypothesis One was tested at the 5 percent level of significance and no significant findings resulted between the two groups. Winter camping knowledge achievement for the guided discovery group paralleled the results of the command group. Both classes did gain in subject knowledge, however the inter-class gain was not statistically significant. No one class learned more than the other.

The student t was applied to all the attitude analysis data. The semantic differential attitude tests indicated statistically significant difference between the two experimental groups. The guided discovery class' attitudes were significantly more positive toward winter camping than the attitudes of the command class.

Further attitude analysis resulted in statistically significant differences within the command class between field trip participants and non-participants (Appendix P and Q). The students who went on the camping trip regarded winter camping to be significantly more important, colder and more complex than did the non-participants. This study provides an indication of the importance of field trips and active participation in a recreational class. This study also provides guidelines for future research.

CONCLUSIONS

On the basis of the results of this study the following conclusions were made:

A. The data for Hypothesis One suggest that there were no significant differences between the command and the guided discovery groups, either in cognitive knowledge prior to the courses of instruction, or cognitive achievement resulting from instruction. Hypothesis

One was accepted. It can therefore be concluded that both the command style and the guided discovery style of teaching were similarly effective in increasing cognitive knowledge for a normal college student distribution.

B. The data for Hypothesis Two suggest that there was no significant difference in the evaluative dimension mean E between the guided discovery group and the command group. The guided discovery group regarded winter camping to be significantly more important than did the command group, but since a majority of significant evaluative scales were not obtained, Hypothesis Two was accepted.

C. The data for Hypothesis Three suggest that there was significant difference in the potency dimension mean P between the guided discovery group and the command group. The guided discovery group regarded winter camping to be significantly heavier (harder to do) than did the command group. The command group however, regarded winter camping to be significantly freer than did the guided discovery group.

D. The data for Hypothesis Four suggest that there was significant difference in the activity dimension mean A between the guided discovery group and the command group. The guided discovery group regarded winter camping to be significantly more active than did the command group. The command group however, regarded winter camping to be significantly colder than did the guided discovery group.

E. The data for Hypothesis Five suggest that there was significant difference in attitudes between the command group and the guided discovery group. The decision to accept or reject Hypothesis

Five laid in the construction of the semantic differential and the majority principle. Both Hypotheses Three and Four were not accepted and a majority of significant semantic dimensions was obtained. Thus Hypothesis Five was not accepted.

DISCUSSION

The results of this study indicated that there was no significant difference between the two teaching styles in cognitive learning about winter camping. Both classes had similar gains in achievement which may in fact be attributed to identical subject matter covered in both classes. The results of this study were consistent with the findings of Tanner's study. In the research studies conducted by Jamieson, Kormerich, Mancini, Weesner, Kersh and Ray (20, 24, 28, 39, 22, 32), the guided discovery style of teaching was found to be significantly superior over the command, expository, and other styles of teaching in cognitive learning. They suggested that more subject material can be covered in a certain length of time using the command style than any other style of teaching. In this study the guided discovery class covered the same subject material in the same amount of time as the command class. An instructor of recreational classes should adopt a large repertoire of behavioral models instead of just one style of teaching with which he is comfortable (29).

The results of the attitude test indicated that there was significant difference between the guided discovery and the command group. The guided discovery group's attitudes were more positive with regard to winter camping than were the attitudes of the command group.

This study was consistent with research studies conducted by Mancini, MacDonald, and Dougherty (28, 27, 8). These studies indicated that people prefer to learn in creative and innovative ways rather than through preformulated authoritarian learning. More positive attitudes developed in the guided discovery classroom which offers more student freedom and student decision-making responsibility.

In this study positive relationships between cognitive learning and attitudes, were not consistent with Labordi's study (25). He revealed that practical experiences and involvement appears to have an effect on people's attitudes and learning outcome. Again in this study significant difference in attitudes was found between participants and non-participants in the camping trip of the command group (Appendix P and Q). Those students who participated had more positive attitudes toward winter camping than did the non-participants. This study is consistent with the studies of MacDonald and Hinde (27, 18). All three studies indicated that field trips, class participation and class involvement are all important in the forming of attitudes. This study is not conclusive but it provides strong evidence of the importance of participation and involvement in a recreational class. It also indicated that more positive attitudes flourish in the guided discovery class than in the command class.

RECOMMENDATIONS

The following recommendations have been indicated in view of the results and conclusions of this study.

A. Studies should be conducted at all levels of the educational continuum to determine what the effects, if any, the two styles of

teaching may have on students' attitudes and achievements.

B. A study should be conducted in which the command and the guided discovery styles of teaching would be utilized for a longer period of time with various group sizes to determine the effects on students' attitudes and students' achievement.

C. A study should be conducted in which active participation and a control group can be observed over a longer period of time to measure the effects on attitude when different instructors and teaching styles are used.

D. A specific study should be conducted on the guided discovery style to determine the critical classroom body size for maximum achievement gain.

E. Further studies which compare the effectiveness of other teaching styles should be conducted in recreation.

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APPENDICES

APPENDIX A

WINTER CAMPING KNOWLEDGE TEST

Winter Camping Knowledge Test

Instructions: Read each question carefully and select only one letter that corresponds with the correct or best answer. Work as quickly as possible and when troubled by one question, skip it and come back to it later. When you have made your selection place the correct letter in the blank line on the left of the question. This test is strictly for research purposes only and will not count toward your final grade for the course.

_____ 1. When traveling in deep powdered snow, a person should use:
   a. downhill skis
   b. light touring skis
   c. snowshoes
   d. cross-country skis

_____ 2. Which one of the following is not an advantage of winter camping?
   a. traveling over obstacles is made easier
   b. crossing streams is made easier
   c. going cross-country is made easier
   d. observing more wildlife is made easier

_____ 3. In winter which shelter will retain more body heat?
   a. one man tent with one man inside
   b. a snow-trench with one man inside
   c. two man tent with two men inside
   d. three man tent with four men inside

_____ 4. To cook safely inside a snow shelter one must:
   a. leave the door way open and cook in the center of the shelter
   b. dig a small air hole in the roof
   c. cut out a block window in the wall
   d. cook only in the doorway

_____ 5. To be able to cook safely inside a nylon tent, what must the tent have?
   a. a zippered floor panel
   b. a rain fly
   c. a high ceiling of at least 4 feet
   d. a high ceiling of at least 5 feet

_____ 6. The best type of insole for cold weather is:
   a. felt insole
   b. aluminum mesh insole
   c. plastic mesh insole
   d. no insole at all

____ 7. To waterproof boots for cold weather, one should use:
a. bear grease
b. chicken fat
c. a wax base compound
d. all of the above
e. none of the above

____ 8. When waterproofing boots with seams you should:
a. concentrate on the seams heavily
b. ignore the seams because they are waterproofed when made
c. treat the seams with one coat of mink oil
d. none of the above

____ 9. The warmest clothing when wet is composed of:
a. goose down
b. wool
c. orlon
d. dacron

____ 10. When treating for frostbite one should:
a. never rub a frozen part
b. never apply snow or ice
c. never exercise a frozen part
d. a and b
e. all of the above

____ 11. The best type of sole design for winter hiking is:
a. the logger's calks
b. the montagne
c. the tricoune
d. the bramani

____ 12. The cause of many cases of frstbite is:
a. tight footwear
b. non-breathable footwear
c. oversize footwear
d. b and c
e. none of the above

____ 13. The most important consideration that one must make about winter footwear is:
a. your feet are far from the body's main heat source
b. your feet are under the weight of your body
c. if any moisture is around, you are usually in it
d. the footwear must serve many purposes
e. none of the above

____ 14. The marginal information of a map contains:
a. the declination diagram
b. the graphic scale
c. the representative fraction
d. all of the above
e. none of the above

_____ 15. On a map, 1:25,000 is called:
a. the graphic scale
b. the representative fraction
c. a fraction related to elevation
d. the contour interval

_____ 16. On the SILVA RANGER compass each mark on the graduated scale equals:
a. 1 degree
b. 2 degrees
c. 5 degrees
d. none of the above

_____ 17. True north is:
a. the direction a compass needle (red end) will point
b. the Geographic North Pole
c. the earth's magnetic North Pole
d. all of the above
e. none of the above

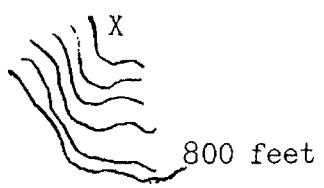
_____ 18. In Montana, which direction must you move your compass to orient to true north?
a. east
b. northeast
c. west
d. southwest

_____ 19. When shooting a bearing, a person should:
a. hold the compass level
b. keep away from metal objects
c. aim the compass like a gun
d. do all of the above
e. a and b only

_____ 20. The North Star is located:
a. in the middle of the Southern Cross
b. south of Cassiopeia
c. in line with the pointers of the Big Dipper
d. none of the above

_____ 21. What does a map scale of 1:75,000 mean?
a. that every inch on the map equals 75,000 inches
b. that every foot on the map equals 75,000 feet
c. that every yard on the map equals 75,000 yards
d. all of the above
e. none of the above

_____ 22. What is the elevation of X when the contour interval is 50 feet?
a. 950 feet
b. 1,000 feet
c. 1,050 feet
d. 1,100 feet



____ 23. The Index contour line tells us:
a. the length of the contour line
b. the elevation of that contour line
c. the difference in altitudes between two lines
d. a and c
e. none of the above

____ 24. The cardinal rule of winter camping and travel is:
a. not to exceed your limitations
b. follow a set plan
c. wear plenty of warm clothing
d. carry extra down clothing

____ 25. Increasing wind velocity has the effect of lowering temperatures. Up to what wind velocity will temperatures drop?
a. up to 30 miles per hour
b. up to 40 miles per hour
c. up to 60 miles per hour
d. up to 70 miles per hour

____ 26. The amount of insulation provided by a layer of clothing depends only on?
a. the type of clothing
b. space-age design
c. its weight
d. its thickness

____ 27. The main dangers of wilderness traveling in winter are many. Select one of the following which lists these dangers in order (most to least critical):
a. avalanches, personal injury, storms
b. avalanches, storms, becoming lost
c. hypothermia, shock, dehydration
d. becoming lost, exposure, avalanches

____ 28. Winter clothing can be characterized by all of the following except:
a. it must breathe
b. it should compress the insulation close to the body
c. it must be adjustable for varying temperatures and exercises
d. fall within a layer system

____ 29. An excellent piece of bivouac gear is:
a. a nylon rain parka
b. a rain poncho
c. a cagoule
d. all of the above
e. none of the above

_____ 30. The unprotected head can easily pump over _____ of the body's heat production into the surrounding air.
a. one fourth
b. one third
c. one half
d. two thirds

_____ 31. The leading cause of body heat loss is:
a. radiation
b. conduction
c. convection
d. evaporation

_____ 32. When the equivalent chill temperature is a negative 75°F., exposed body flesh may freeze within:
a. 30 seconds
b. 45 seconds
c. 60 seconds
d. 2 minutes

_____ 33. Which are visible symptoms of exposure?
a. irritability
b. slurred speech
c. drowsiness
d. a and b only
e. all of the above

_____ 34. When the body's heat loss exceeds the body's heat production it is referred to as:
a. hypothermia
b. hyperthermia
c. frostbite
d. none of the above
e. all of the above

_____ 35. The major body enemies in order of importance are:
a. yourself, temperature change, injury
b. injury, temperature change, yourself
c. temperature change, yourself, injury
d. yourself, injury, temperature change

_____ 36. Avalanches are most common on slopes of what degree range?
a. 20 to 30 degrees
b. 30 to 45 degrees
c. 45 to 60 degrees
d. 60 to 70 degrees

_____ 37. After one hour, a buried victim in an avalanche has only a _____ chance of surviving.
a. 30%
b. 40%
c. 50%
d. 60%

_____ 38. What is the major problem(s) with a down sleeping bag when the temperatures are below freezing?
a. the formation of ice crystals in the down
b. the loss of insulatoon due to compression
c. the error of buying a 3-lb. bag instead of a 5-lb. bag
d. b and c only
e. all of the bove

_____ 39. In selecting a winter campsite one should avoid:
a. selecting the flat spot of a knoll
b. selecting the bottom of a bowl
c. selecting a site outside of a gully
d. a and c only
e. none of the above

_____ 40. A term used to describe the entrance to a snow shelter is:
a. cold air tunnel
b. cold air hole
c. cold air sump
d. cold air trap

_____ 41. Whenever consolidated snow is unavailable a person should build what type of snow shelter?
a. igloo
b. hole-igloo
c. trench shelter
d. snow cave

_____ 42. What type of foods should one eat for quick energy and fuel while the body is working?
a. carbohydrates such as eggs and corn products
b. proteins such as meats and fish
c. fats such as butter and milk
d. starches and sugars

_____ 43. At high altitudes one should be cautios of what type of food not to eat?
a. fats
b. carbohydrates
c. proteins
d. a and b only
e. none of the above

_____ 44. The first and the most important reason for pacing in winter is:
a. psychological
b. to avoid fatigue
c. to avoid sweating whenever possible
d. to keep the group together

_____ 45. What is the recommended size of a Maine snowshoe for a man and a pack weighing up to 225 lbs.?
a. 12" by 42"
b. 13" by 46"
c. 14" by 48"
d. 15" by 50"

_____ 46. Which is not a brand name for a snowshoe model?
a. Pickerel
b. Wolverine
c. Green Mountain
d. Obibwa

_____ 47. Wooden soles on mountain skis should be made of _____ for longer wear.
a. oak
b. beech
c. birch
d. hickory

_____ 48. On a topography map contour lines:
a. never cross
b. always cross
c. only cross to show an overhanging cliff
d. b and c only
e. none of the above

_____ 49. Magnetic declination is the difference between
a. the direction the compass shows and true north
b. the direction the compass shows and grid north
c. the direction the compass shows and geographic north pole
d. the direction the compass shows and the north star
e. a and c only

_____ 50. Your car is left on a base line reference and you travel south in thick woods for one mile. When returning you should:
a. travel straight for the car
b. travel north to your car
c. deliberately travel to the northeast and turn left at the base line
d. a and b only
e. all of the above

_____ 51. Avalanches are usually triggered under certain conditions. What condition is first necessary in order for an avalanche to be triggered?
a. a loud shock wave from some sound
b. a weather change
c. an overload of snow
d. a skier, snowshoer crossing an avalanche path

_____ 52. You are going to run a ground equalateral triangle with a compass. Go 100 paces per leg, then turn left. Your original heading is 85 degrees. What are the other headings you will follow to return to your original point?
a. 15 degrees and 200 degrees
b. 145 degrees and 205 degrees
c. 205 degrees and 325 degrees
d. 325 degrees and 205 degrees

_____ 53. You are running a square with 100 paces per leg. You are to turn right after every leg. Your original heading is 145 degrees. What headings will you follow to return to the original position?
a. 225^{o}, 305^{o}, 25^{o}
b. 205^{o}, 265^{o}, 305^{o}
c. 235^{o}, 325^{o}, 55^{o}
d. 215^{o}, 295^{o}, 5^{o}

_____ 54. Whenever a group crosses a suspected snow slide area, the group should stay behind natural barriers and cross:
a. in a single line at the bottom of the slope
b. one at a time and at the middle of the slope
c. in a single line at the middle of the slope
d. one at a time and as high up as possible

_____ 55. Which route <u>is not</u> considered safe during winter traveling?
a. a route on a ridgetop
b. a route slightly on the windward side of a ridge
c. the leeward side of a slope
d. the base of a valley

_____ 56. Harscheisen is a name for a:
a. ski crampon
b. snowshoe crampon
c. shoe crampon
d. mountaineering ski

_____ 57. A dry powder avalanche causes a cloud of powder and a shock wave. This avalanche may attain a speed of _____ miles per hour.
a. 100
b. 125
c. 150
d. 200

_____ 58. When considering survival, the mind is considered the best survival tool. What percentage of a survival situation is dependent on the mind?
a. 65%
b. 70%
c. 80%
d. 90%

_____ 59. In reference to question #58, what percentage of a survival situation is dependent on a person's skills?
a. 10%
b. 20%
c. 30%
d. 35%

_____ 60. In reference to question #58, what percentage of a survival situation is dependent upon a person's equipment?
a. 10%
b. 15%
c. 20%
d. 25%

_____ 61. The body's needs in order of importance are:
a. energy, oxygen, water
b. oxygen, fuel, water
c. oxygen, water, fuel
d. water, oxygen, fuel

_____ 62. Hypoxia is a term to use to describe a:
a. nervous condition
b. fear of dying
c. cold condition
d. lack of oxygen

_____ 63. The main cause of fatigue is:
a. overworking
b. a buildup of lactic acid waste in muscle tissue
c. excessive energy loss
d. lack of adequate rest

_____ 64. Snowshoeing is a strenuous outdoor activity. On the average, how many calories may be consumed per day by a snowshoer?
a. 3500-4000
b. 4000-4500
c. 4500-5000
d. 5000-6000

_____ 65. When the body core temperature falls to a range of 85-81 degrees a person will not exhibit one of the following signs or symptoms:
a. violent shivering
b. pulse and respiration slowed
c. stupor
d. total incoherance

_____ 66. When the body core temperature falls to a range of 90-86 degrees, which is not a sign or symptom?
a. amnesia
b. plummeting core temperature
c. inability to stand or walk
d. inability to make decisions

____ 67. Factors which increase heat loss in order of importance are:
a. cold temperatures, wet clothes, wind, depletion of energy reserves
b. wet clothes, wind, cold temperatures, depletion of energy reserves
c. depletion of energy reserves, cold temperatures, wet clothes, wind
d. cold temperatures, wind, wet clothes, depletion of energy reserves

____ 68. Salt deficiency in the body causes all of the following except:
a. muscle cramps
b. dehydration
c. headaches
d. mausea

____ 69. Snow blindness:
a. may be more crippling than a broken leg
b. is a severe medical problem
c. may occur on a cloudy, overcast day
d. all of the above

____ 70. In an emergency situation what order of treatment should be followed?
a. breathing, heart stoppage, shock, severe arterial bleeding
b. severe arterial bleeding, breathing, heart stoppage, shock
c. heart stoppage, breathing, severe arterial bleeding, shock
d. severe arterial bleeding, heart stoppage, breathing, shock

APPENDIX B

SEMANTIC DIFFERENTIAL TEST AND INSTRUCTIONS

TEST INSTRUCTIONS

The purpose of this evaluation is to measure the meanings of certain things or concepts to you by having you rate these according to several scales. Please make your judgements on the basis of what these concepts mean to you.

Model Semantic Differential Form, Showing Placement of Target Concept and Bipolar Semantic Scales.

Target Concept

Good	/ / / / / / /	Bad
Ugly	/ / / / / / /	Beautiful
Important	/ / / / / / /	Unimportant
Painful	/ / / / / / /	Pleasurable
Hard	/ / / / / / /	Soft
Light	/ / / / / / /	Heavy
Constrained	/ / / / / / /	Free
Passive	/ / / / / / /	Active
Cold	/ / / / / / /	Hot
Simple	/ / / / / / /	Complex

If you think the concept found at the top of the page is very closely related to one end of the scale, place your check mark as follows:

fair /X/ / / / / / / unfair

fair / / / / / / /X/ unfair

If you think that the concept is closely related to one or the other end of the scale (but not extremely), place your check mark as follows:

light / /X/ / / / / / dark

light / / / / / /X/ / dark

If you think the concept is closely related to one or the other end of the scale (but only slightly), place your check mark as follows:

strong / / /X/ / / / / weak

strong / / / / /X/ / / weak

If you consider the concept to be neutral on the scale, both sides of the scale equally associated with the concept, or unrelated to the concept, then you should place your check mark in the middle space:

safe / / / /X/ / / / dangerous

Check every scale and place only one check on each scale.

SEMANTIC DIFFERENTIAL

Wilderness

Good	/ / / / / / /	Bad
Ugly	/ / / / / / /	Beautiful
Important	/ / / / / / /	Unimportant
Painful	/ / / / / / /	Pleasurable
Hard	/ / / / / / /	Soft
Light	/ / / / / / /	Heavy
Constrained	/ / / / / / /	Free
Passive	/ / / / / / /	Active
Cold	/ / / / / / /	Hot
Simple	/ / / / / / /	Complex

Winter Camping

Good	/ / / / / / /	Bad
Ugly	/ / / / / / /	Beautiful
Important	/ / / / / / /	Unimportant
Painful	/ / / / / / /	Pleasurable
Hard	/ / / / / / /	Soft
Light	/ / / / / / /	Heavy
Constrained	/ / / / / / /	Free
Passive	/ / / / / / /	Active
Cold	/ / / / / / /	Hot
Simple	/ / / / / / /	Complex

Shelter Construction

Good	/ / / / / / /	Bad
Ugly	/ / / / / / /	Beautiful
Important	/ / / / / / /	Unimportant
Painful	/ / / / / / /	Pleasurable
Hard	/ / / / / / /	Soft
Light	/ / / / / / /	Heavy
Constrained	/ / / / / / /	Free
Passive	/ / / / / / /	Active
Cold	/ / / / / / /	Hot
Simple	/ / / / / / /	Complex

Exposure

Good	/ / / / / / /	Bad
Ugly	/ / / / / / /	Beautiful
Important	/ / / / / / /	Unimportant
Painful	/ / / / / / /	Pleasurable
Hard	/ / / / / / /	Soft
Light	/ / / / / / /	Heavy
Constrained	/ / / / / / /	Free
Passive	/ / / / / / /	Active
Cold	/ / / / / / /	Hot
Simple	/ / / / / / /	Complex

Winter Safety

Good	/ / / / / / /	Bad
Ugly	/ / / / / / /	Beautiful
Important	/ / / / / / /	Unimportant
Painful	/ / / / / / /	Pleasurable
Hard	/ / / / / / /	Soft
Light	/ / / / / / /	Heavy
Constrained	/ / / / / / /	Free
Passive	/ / / / / / /	Active
Cold	/ / / / / / /	Hot
Simple	/ / / / / / /	Complex

Snow Travel

Cold	/ / / / / / /	Bad
Ugly	/ / / / / / /	Beautiful
Important	/ / / / / / /	Unimportant
Painful	/ / / / / / /	Pleasurable
Hard	/ / / / / / /	Soft
Light	/ / / / / / /	Heavy
Constrained	/ / / / / / /	Free
Passive	/ / / / / / /	Active
Cold	/ / / / / / /	Hot
Simple	/ / / / / / /	Complex

Multiple Land Usage

Good	/ / / / / / /	Bad
Ugly	/ / / / / / /	Beautiful
Important	/ / / / / / /	Unimportant
Painful	/ / / / / / /	Pleasurable
Hard	/ / / / / / /	Soft
Light	/ / / / / / /	Heavy
Constrained	/ / / / / / /	Free
Passive	/ / / / / / /	Active
Cold	/ / / / / / /	Hot
Simple	/ / / / / / /	Complex

Restricted Land Usage

Good	/ / / / / / /	Bad
Ugly	/ / / / / / /	Beautiful
Important	/ / / / / / /	Unimportant
Painful	/ / / / / / /	Pleasurable
Hard	/ / / / / / /	Soft
Light	/ / / / / / /	Heavy
Constrained	/ / / / / / /	Free
Passive	/ / / / / / /	Active
Cold	/ / / / / / /	Hot
Simple	/ / / / / / /	Complex

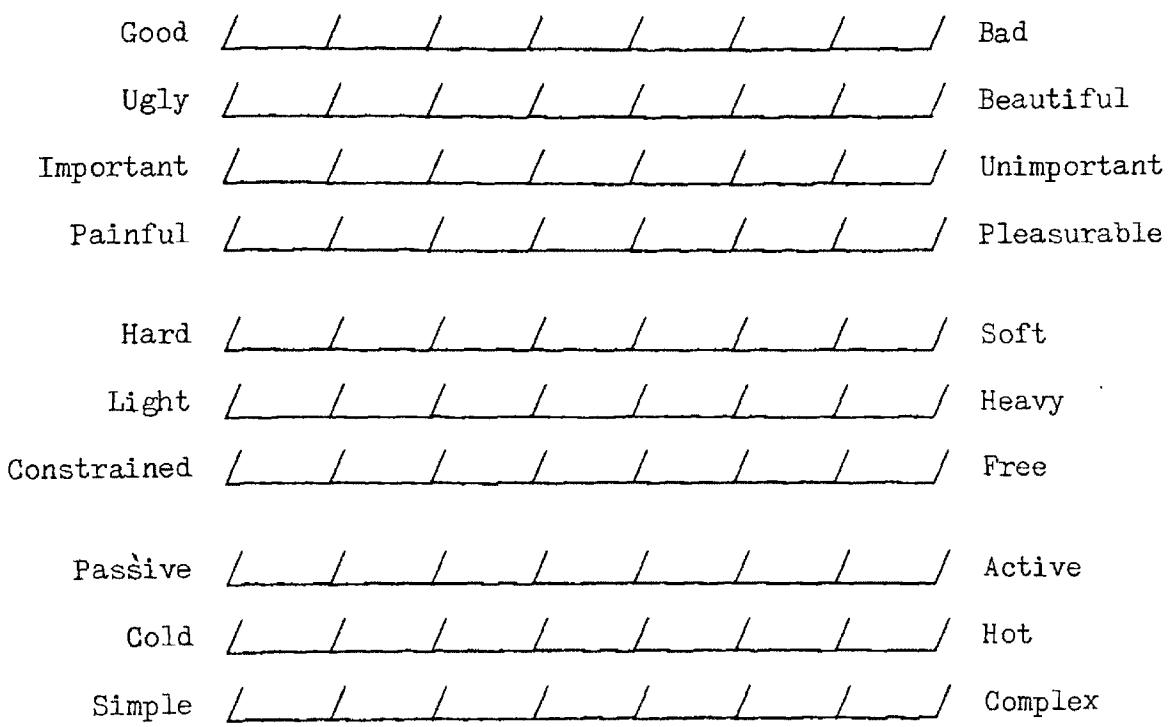
Cold Weather

Good	/ / / / / / /	Bad
Ugly	/ / / / / / /	Beautiful
Important	/ / / / / / /	Unimportant
Painful	/ / / / / / /	Pleasurable
Hard	/ / / / / / /	Soft
Light	/ / / / / / /	Heavy
Constrained	/ / / / / / /	Free
Passive	/ / / / / / /	Active
Cold	/ / / / / / /	Hot
Simple	/ / / / / / /	Complex

Snow Blindness

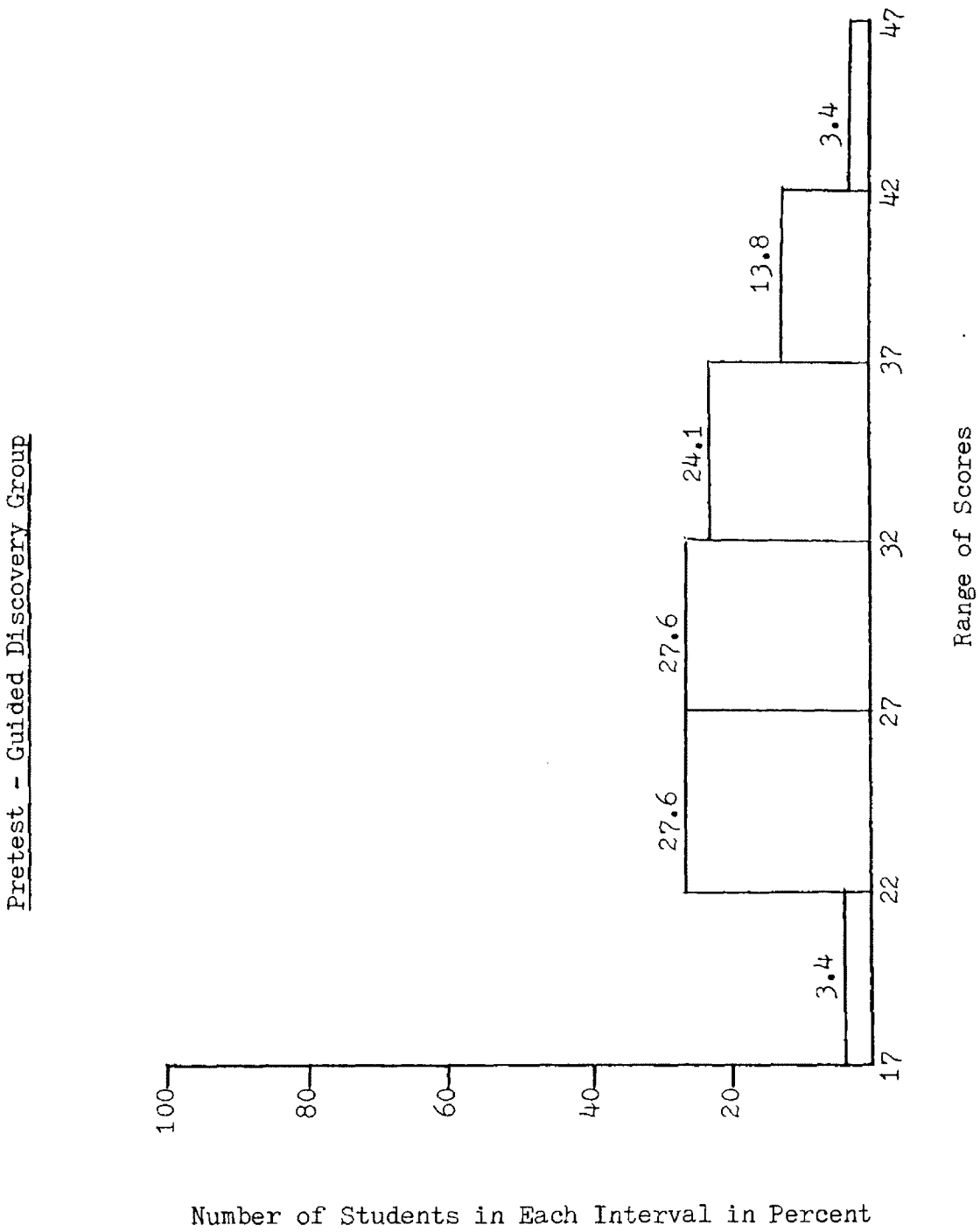
Good	/ / / / / / /	Bad
Ugly	/ / / / / / /	Beautiful
Important	/ / / / / / /	Unimportant
Painful	/ / / / / / /	Pleasurable
Hard	/ / / / / / /	Soft
Light	/ / / / / / /	Heavy
Constrained	/ / / / / / /	Free
Passive	/ / / / / / /	Active
Cold	/ / / / / / /	Hot
Simple	/ / / / / / /	Complex

Summer Camping



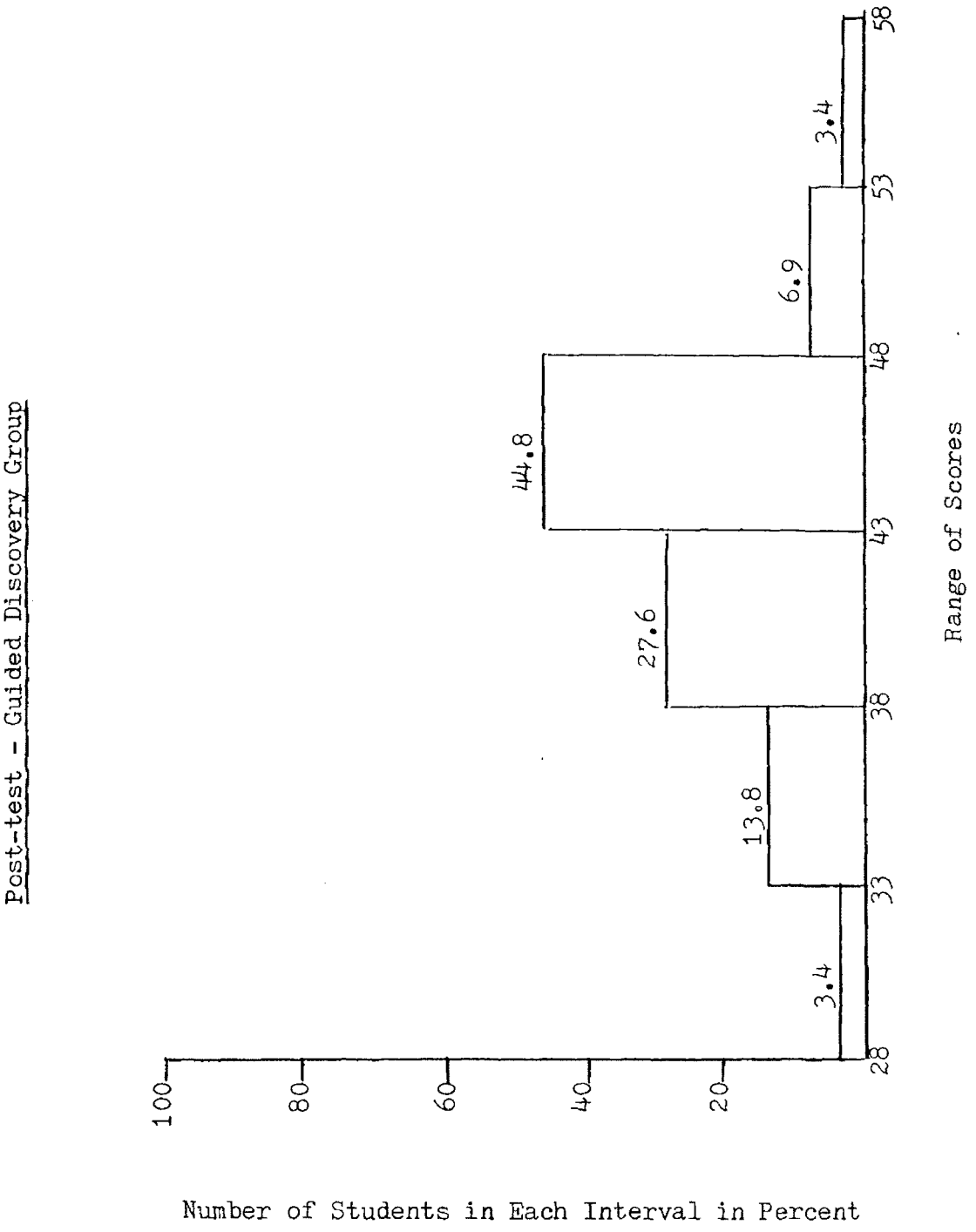
APPENDIX C

PRETEST - GUIDED DISCOVERY GROUP



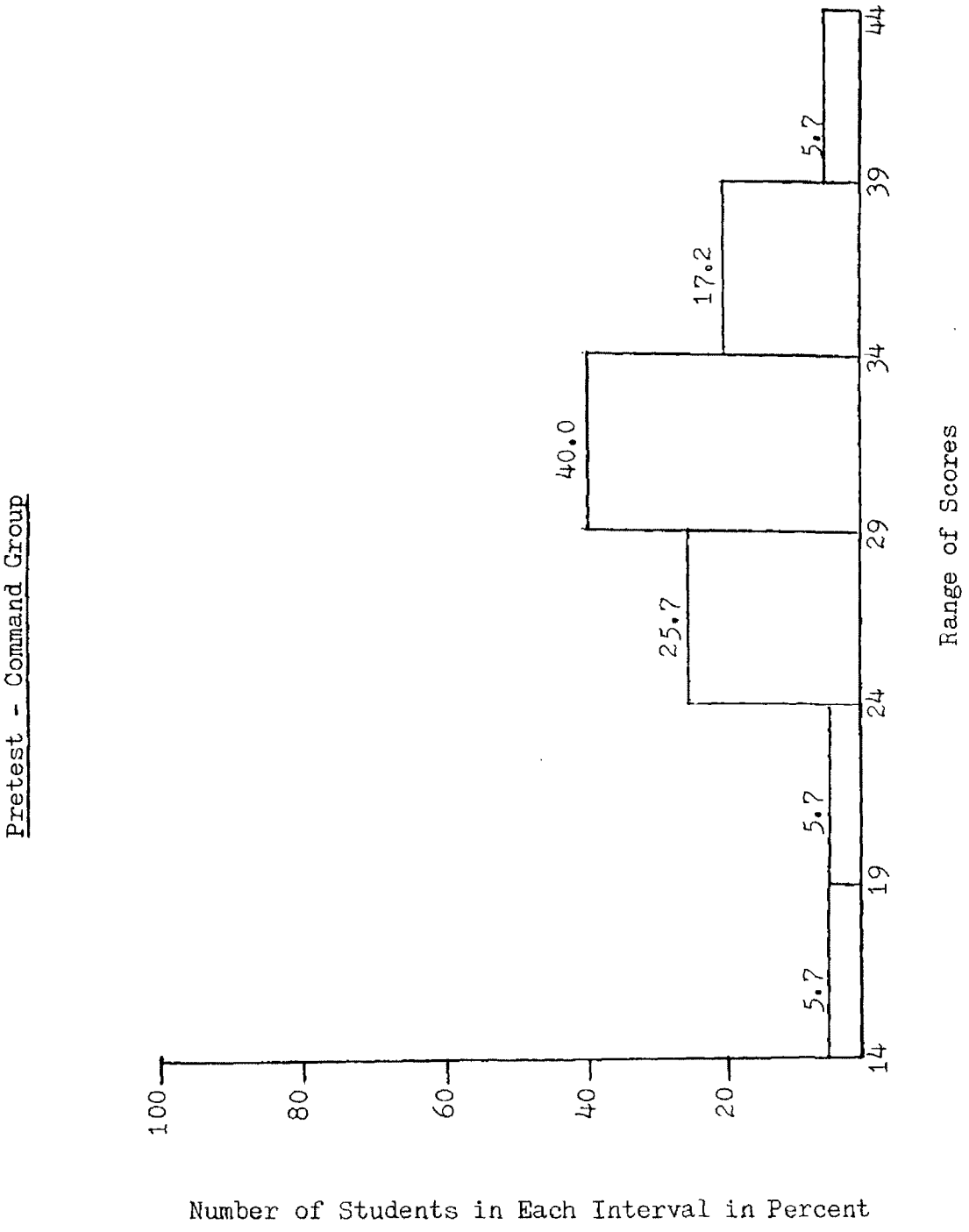
APPENDIX D

POST-TEST - GUIDED DISCOVERY GROUP



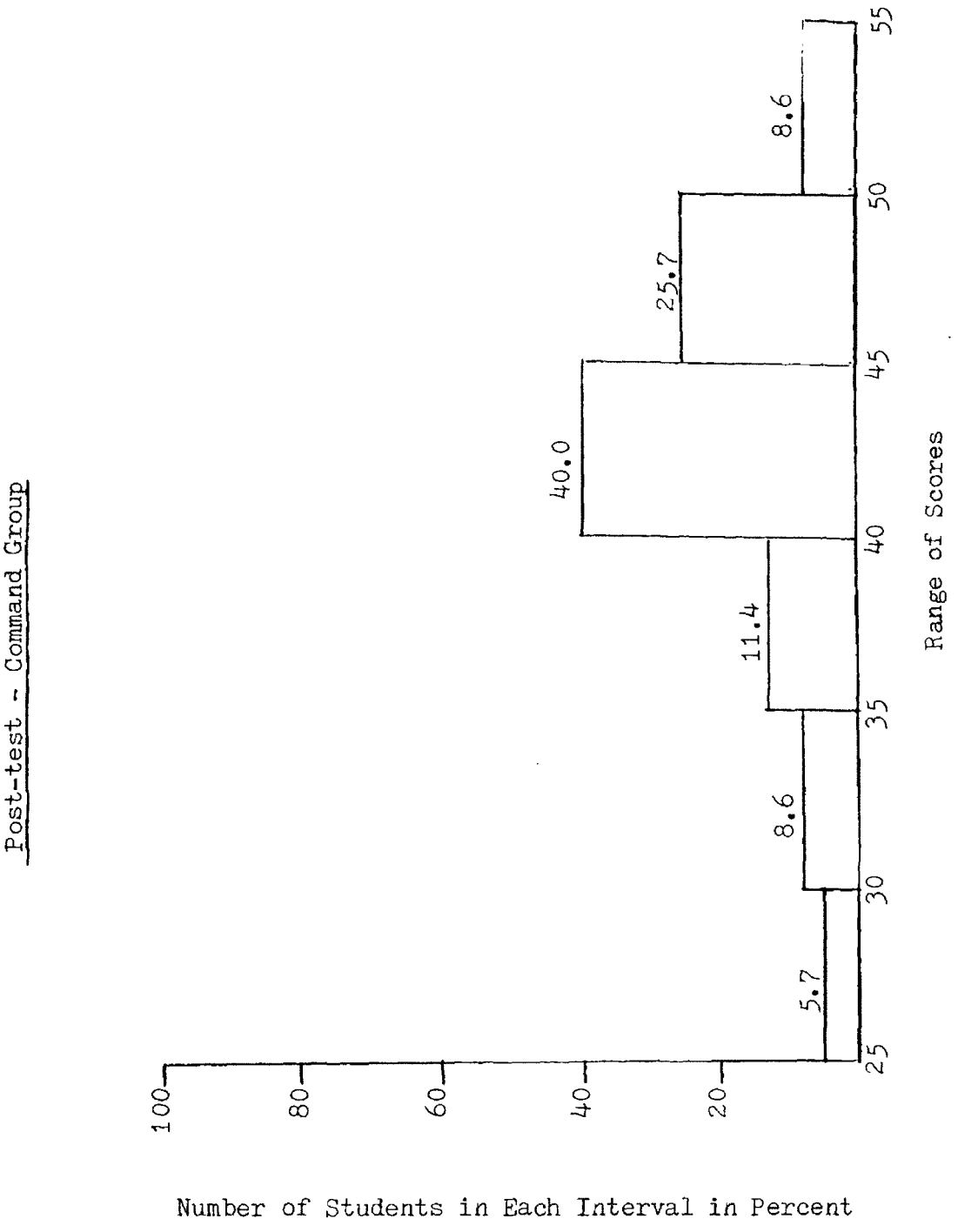
APPENDIX E

PRETEST - COMMAND GROUP



APPENDIX F

POST-TEST - COMMAND GROUP



APPENDIX G

GOODNESS OF FIT - PRETEST GUIDED DISCOVERY GROUP

$N = 29 \qquad \bar{x} = 30.207 \qquad s = 5.759$

$$P(17 \leq X < 22) = P\left(\frac{17 - 30.207}{5.759} \leq Z < \frac{22 - 30.207}{5.759}\right) = \Phi(-1.425) - \Phi(-2.293)$$
$$= .0771 - .0109 = .0662$$

$$P(22 \leq X < 27) = P\left(\frac{22 - 30.207}{5.759} \leq Z < \frac{27 - 30.207}{5.759}\right) = \Phi(-.557) - \Phi(-1.425)$$
$$= .2894 - .0771 = .2123$$

$$P(27 \leq X < 32) = P\left(\frac{27 - 30.207}{5.759} \leq Z < \frac{32 - 3-.207}{5.759}\right) = \Phi(.3113) - \Phi(-.557)$$
$$= .6222 - .2894 = .3328$$

$$P(32 \leq X < 37) = P\left(\frac{32 - 30.207}{5.759} \leq Z < \frac{37 - 30.207}{5.759}\right) = \Phi(.8322) - \Phi(.3113)$$
$$= .7973 - .6222 = .1751$$

$$P(37 \leq X < 42) = P\left(\frac{37 - 30.207}{5.759} \leq Z < \frac{42 - 30.207}{5.759}\right) = \Phi(2.048) - \Phi(.8322)$$
$$= .9797 - .7973 = .1824$$

$$P(42 \leq X < 47) = P\left(\frac{42 - 30.207}{5.759} \leq Z < \frac{47 - 30.207}{5.759}\right) = \Phi(2.916) - \Phi(2.048)$$
$$= .9982 - .9797 = .0185$$

$$D^2 = \frac{[2 - 29(.0662)]^2}{29(.0662)} + \frac{[2 - 29(.2123)]^2}{29(.2123)} + \frac{[9 - 29(.3328)]^2}{29(.3328)} + \frac{[14 - 29(.1751)]^2}{29(.1751)}$$
$$+ \frac{[6 - 29(.1824)]^2}{29(.1824)} + \frac{[2 - 29(.0185)]^2}{29(.0185)}$$

$$= .0033 + 2.8064 + .0750 + 15.6793 + .0954 + 3.9922 = 22.6516$$

$P(D^2 \geq 22.56) < .005$

$k - 1 = 6 - 1 = 5$ degrees of freedom

APPENDIX H

GOODNESS OF FIT - POST-TEST GUIDED DISCOVERY GROUP

$N = 29 \qquad \bar{x} = 42.517 \qquad s = 5.448$

$$P(28 \leq X < 33) = P\left(\frac{28 - 42.517}{5.448} \leq Z < \frac{33 - 42.517}{5.448}\right) = \Phi(-1.7469) - \Phi(-2.6646)$$
$$= .0404 - .0035 = .0369$$

$$P(33 \leq X < 38) = P\left(\frac{33 - 42.517}{5.448} \leq Z < \frac{38 - 42.517}{5.448}\right) = \Phi(-.829) - \Phi(-1.7469)$$
$$= .2037 - .0404 = .1633$$

$$P(38 \leq X < 43) = P\left(\frac{38 - 42.517}{5.448} \leq Z < \frac{43 - 42.517}{5.448}\right) = \Phi(.089) - \Phi(-.829)$$
$$= .4645 - .2037 = .2608$$

$$P(43 \leq X < 48) = P\left(\frac{43 - 42.517}{5.448} \leq Z < \frac{48 - 42.517}{5.448}\right) = \Phi(1.006) - \Phi(.089)$$
$$= .8418 - .4645 = .3783$$

$$P(48 \leq X < 53) = P\left(\frac{48 - 42.517}{5.448} \leq Z < \frac{53 - 42.517}{5.448}\right) = \Phi(1.924) - \Phi(1.006)$$
$$= .9728 - .8428 = .1300$$

$$P(53 \leq X < 58) = P\left(\frac{53 - 42.517}{5.448} \leq Z < \frac{58 - 42.517}{5.448}\right) = \Phi(2.842) - \Phi(1.924)$$
$$= .9977 - .9728 = .0249$$

$$D^2 = \frac{[1 - 29(.0369)]^2}{29(.0369)} + \frac{[4 - 29(.1633)]^2}{29(.1633)} + \frac{[8 - 29(.2608)]^2}{29(.2608)}$$
$$+ \frac{[13 - 29(.3783)]^2}{29(.3783)} + \frac{[2 - 29(.1300)]^2}{29(.1300)} + \frac{[1 - 29(.0249)]^2}{29(.0249)}$$

$$= .004592 + .11428 + .02523 + .37537 + .8310 + .10695 = 1.4574$$

$P(D^2 \geq 1.4574) < .10$

$k - 1 = 6 - 1 = 5$ degrees of freedom

APPENDIX I

GOODNESS OF FIT - PRETEST COMMAND GROUP

$N = 35 \qquad \bar{x} = 29.8 \qquad \sigma = 5.794$

$$P(14 \leq X < 19) = P\left(\frac{14 - 29.8}{5.794} \leq Z < \frac{19 - 29.8}{5.794}\right) = \Phi(-1.86) - \Phi(-2.73)$$
$$= .0314 - .0032 = .0282$$

$$P(19 \leq X < 24) = P\left(\frac{19 - 29.8}{5.794} \leq Z < \frac{24 - 29.8}{5.794}\right) = \Phi(-1.001) - \Phi(-1.86)$$
$$= .1587 - .0314 = .1273$$

$$P(24 \leq X < 29) = P\left(\frac{24 - 29.8}{5.794} \leq Z < \frac{29 - 29.8}{5.794}\right) = \Phi(.1380) - \Phi(-1.001)$$
$$= .5542 - .1587 = .3955$$

$$P(29 \leq X < 34) = P\left(\frac{29 - 29.8}{5.794} \leq Z < \frac{34 - 29.8}{5.794}\right) = \Phi(.725) - \Phi(.1380)$$
$$= .7657 - .5542 = .2115$$

$$P(34 \leq X < 39) = P\left(\frac{34 - 29.8}{5.794} \leq Z < \frac{39 - 29.8}{5.794}\right) = \Phi(1.59) - \Phi(.725)$$
$$= .9441 - .7657 = .1784$$

$$P(39 \leq X < 44) = P\left(\frac{39 - 29.8}{5.794} \leq Z < \frac{44 - 29.8}{5.794}\right) = \Phi(2.45) - \Phi(1.59)$$
$$= .9929 - .9441 = .0488$$

$$D^2 = \frac{[4 - 35(.0282)]^2}{35(.0282)} + \frac{[6 - 35(.1273)]^2}{35(.1273)} + \frac{[7 - 35(.3955)]^2}{35(.3955)}$$

$$+ \frac{[7 - 35(.2115)]^2}{35(.2115)} + \frac{[3 - 35(.1784)]^2}{35(.1784)} + \frac{[2 - 35(.0551)]^2}{35(.0551)}$$

$$= 9.1977 + .5354 + 3.3829 + .0219 + 1.6854 + .00245 = 14.82595$$

$$P(D^2 \geq 14.83) < .025$$

$k - 1 = 6 - 1 = 5$ degrees of freedom

APPENDIX J

GOODNESS OF FIT - POST-TEST COMMAND GROUP

$N = 35 \qquad \bar{x} = 41.543 \qquad s = 5.7155$

$$P(25 \leq X < 30) = P\left(\frac{25 - 41.543}{5.7155} < Z < \frac{30 - 41.543}{5.7155}\right) = \Phi(-2.0196) - \Phi(-2.894)$$
$$= .0217 - .0019 = .0198$$

$$P(30 \leq X < 35) = P\left(\frac{30 - 41.543}{5.7155} \leq Z < \frac{35 - 41.543}{5.7155}\right) = \Phi(-1.145) - \Phi(-2.0196)$$
$$= .1261 - .0217 = .1044$$

$$P(35 \leq X < 40) = P\left(\frac{35 - 41.543}{5.7155} \leq Z < \frac{40 - 41.543}{5.7155}\right) = \Phi(-.2699) - \Phi(-1.145)$$
$$= .3936 - .1261 = .2675$$

$$P(40 \leq X < 45) = P\left(\frac{40 - 41.543}{5.7155} \leq Z < \frac{45 - 41.543}{5.7155}\right) = \Phi(.605) - \Phi(-.2699)$$
$$= .7274 - .3936 = .3338$$

$$P(45 \leq X < 50) = P\left(\frac{45 - 41.543}{5.7155} \leq Z < \frac{50 - 41.543}{5.7155}\right) = \Phi(1.48) - \Phi(.605)$$
$$= .9306 - .7274 = .2032$$

$$P(50 \leq X < 55) = P\left(\frac{50 - 41.543}{5.7155} \leq Z < \frac{55 - 41.543}{5.7155}\right) = \Phi(2.354) - \Phi(1.48)$$
$$= .9907 - .9306 - .0601$$

$$D^2 = \frac{[2 - 35(.0198)]^2}{35(.0198)} + \frac{[3 - 35(.1044)]^2}{35(.1044)} + \frac{[4 - 35(.2675)]^2}{35(.2675)}$$

$$+ \frac{[14 - 35(.3338)]^2}{35(.3338)} + \frac{[9 - 35(.2032)]^2}{35(.2032)} + \frac{[3 - 35(.0601)]^2}{35(.0601)}$$

$$= 2.465 + .1170 + 3.0714 + .4595 + .5012 + .3822 = 6.996$$

$$P(D^2 \geq 6.996) < .25$$

$k - 1 = 6 - 1 = 5$ degrees of freedom

APPENDIX K

ACHIEVEMENT DATA - DIFFERENCE IN MEANS ANALYSIS

Notation:

$\bar{x}_1$: sample mean of pretest scores for guided discovery group

σ_1^2: sample variance of pretest scores for guided discovery group

$\bar{x}_2$: sample mean of post-test scores for guided discovery group

σ_2^2: sample variance of post-test scores for guided discovery group

$\bar{y}_1$: sample mean of pretest scores for command group

s_1^2: sample variance of pretest scores for command group

$\bar{y}_2$: sample mean of post-test scores for command group

s_1^2: sample variance of post-test scores for command group

Values:

$\bar{x}_1 = 30.207$ $\qquad$ $\bar{x}_2 = 42.517$

$\sigma_1 = 5.759$ $\qquad$ $\sigma_2 = 5.448$

$\bar{y}_1 = 29.8$ $\qquad$ $\bar{y}_2 = 41.543$

$s_1 = 5.794$ $\qquad$ $s_2 = 5.715$

Coefficients of variation:

$\sigma_1/\bar{x}_1 = .1906$ $\qquad$ $\sigma_2/\bar{x}_2 = .1282$

$s_1/\bar{y}_1 = .1944$ $\qquad$ $s_2/\bar{y}_2 = .1376$

APPENDIX L

CALCULATION OF Z

Statement of hypotheses:

Pretest

Null hypotheses A: populations means are the same for both guided discovery and command group.

Alternative A: population mean of guided discovery group is larger than that of command group.

Post-test

Null hypotheses B: populations means are the same for both guided discovery and command group.

Alternative B: population mean of guided discovery group is larger than that of command group.

The critical value for Z, at 5% level of significance, is 1.96 (two-tail test). Thus the null hypothesis is rejected if a value of $Z > 1.96$ is observed.

Calculation of Z:

Pretest:

$$Z = \frac{30.207 - 29.800}{\sqrt{\frac{(5.759)^2}{29} + \frac{(5.794)^2}{35}}} = .281$$

Post-test:

$$Z = \frac{42.517 - 41.543}{\sqrt{\frac{(5.449)^2}{29} + \frac{(5.7155)^2}{35}}} = .696$$

APPENDIX M

DIFFERENCE IN MEANS ANALYSIS OF ACHIEVEMENT DATA USING t-STATISTIC

Notation:

$\bar{x}_1$ = sample mean of pretest scores for guided discovery group

$\bar{x}_2$ = sample mean of post-test scores for guided discovery group

σ_1^2 = sample variance of pretest scores for guided discovery group

σ_2^2 = sample variance of post-test scores for guided discovery group

$\bar{y}_1$ = sample mean of pretest scores for command group

$\bar{y}_2$ = sample mean of post-test scores for command group

s_1^2 = sample variance of pretest scores for command group

s_2^2 = sample variance of post-test scores for command group

n_x = sample size - guided discovery group

n_y = sample size - command group

Values:

$\bar{x}_1 = 30.207$ $\bar{y}_1 = 29.8$

$\bar{x}_2 = 42.517$ $\bar{y}_2 = 41.543$

$\sigma_1^2 = 33.1662$ $s_1^2 = 33.570$

$\sigma_2^2 = 29.680$ $s_2^2 = 32.547$

$n_x = 29$ $n_y = 35$

APPENDIX N

CALCULATION OF T

PRETEST ANALYSIS

F-test on variances

Null hypothesis: population variances are equal

Alternative: population variances are not equal

$$F = \frac{s_1^2}{\sigma_1^2} = 1.012175$$

The critical value for F_1 at the 2% level of significance is 2.46. Therefore the null hypothesis is accepted.

t-test on means

Null hypothesis: population means are equal

Alternative: population means are not equal

$$t = \bar{x}_1 - \bar{y}_1 \Bigg/ \left\{ \left[\frac{(n_x - 1)\sigma_1^2 + (n_y - 1)\bar{s}_1^2}{n_x + n_y - 2} \right] \left[\frac{1}{n_x} + \frac{1}{n_y} \right] \right\}^{1/2}$$

$$= .407 \Big/ (33.38574)\ (.0631) = .28041$$

The critical value for t at 5% level of significance (two tailed test) is 1.99. Hence, the null hypothesis is accepted.

APPENDIX O

CALCULATION OF T

POST-TEST ANALYSIS

F-test on variances

Null hypothesis: population variances are equal

Alternative: population variances are not equal

$$F = \frac{s_2^2}{\sigma_2^2} = 1.09659$$

The critical value for F_2 at 2% level of significance is 2.41.

Hence, the null hypothesis is accepted.

t-test on means

Null hypothesis: population means are equal

Alternative: population means are not equal

$$t = \bar{x}_2 - \bar{y}_2 \Big/ \left\{ \left[\frac{(n_x - 1)\sigma_2^2 + (n_y - 1)s_2^2}{n_x + n_y - 2} \right] \left[\frac{1}{n_x} + \frac{1}{n_y} \right] \right\}^{1/2}$$

$$= \frac{.974}{1.36} = .71 < t_{.025} = 1.99$$

The null hypothesis is accepted.

APPENDIX P

ATTITUDE ANALYSIS

COMMAND GROUP

ATTITUDE ANALYSIS

Command Group

Semantic Differential	-3	Trip Participants $\bar{x}_1$	σ_1	t	Trip Non-participants x_2	σ_2	+3
Evaluative	Good	-2.64	.557	*	-2.4	1.05	Bad
	Ugly	2.44	1.30	*	2.5	.5	Beautiful
	Important	-2.24	.950	-7.70	-1.1	1.3	Unimportant
	Painful	1.36	1.74	.617	1.2	1.25	Comfortable
Potency	Hard	- .96	1.28	- .968	- .8	.872	Soft
	Light	.4	1.52	1.03	.2	.98	Heavy
	Constricted	.96	1.40	-1.64	1.3	1.68	Free
Activity	Passive	2.08	1.09	1.76	1.8	1.25	Active
	Cold	-1.88	1.14	-4.54	-1.2	.872	Hot
	Simple	1.52	1.39	3.74	.8	1.33	Complex

*The t-test is not valid for these bipolar scales because results of the F test imply the assumption of equal variance is not valid.

The critical values, at the 5% level of significance, for t with 33 degrees of freedom are $\pm$ 2.036, thus the null hypotheses for bipolar scales 3, 9, and 10 are rejected.

APPENDIX Q

ATTITUDE ANALYSIS

GUIDED DISCOVERY GROUP

ATTITUDE ANALYSIS

Guided Discovery Group

Semantic Differential	-3	Trip Participants $\bar{x}_1$	$\hat{\sigma}_1$	t	Trip Non-participants $\bar{x}_2$	$\hat{\sigma}_2$	+3
Evaluative	Good	-2.65	.572	*	-2.11	1.196	Bad
	Ugly	2.84	.365	.752#	2.56	.685	Beautiful
	Important	-2.3	.781	-1.89	-1.67	.943	Unimportant
	Painful	1.4	1.36	1.26	.67	1.63	Comfortable
Potency	Hard	-1.1	1.38	- .869	- .56	1.89	Soft
	Light	1.3	1.1	.623	1.0	1.41	Heavy
	Constricted	.75	1.89	.246	.56	2.01	Free
Activity	Passive	2.3	.843	.894	2	.818	Active
	Cold	- .935	1.6	1.99	-2.11	1.1	Hot
	Simple	1.35	1.35	- .772	1.78	1.47	Complex

*The t-test is not valid for this bipolar scale because results of the F test imply that the assumption of equal variances is not valid.

#A decision regarding accepted level of significance for the F test must be made prior to interpretation of this value of t. If the 2% level is desirable for F, the t-testiis valid.

The critical values, at 5% level of significance, for t with 27 degrees of freedom are ± 2.052. Thus, thevnull hypothesis for bipolar scales 3 through 10 are accepted.