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PEER TEACHING IN PERMANENT PROJECT TEAMS (PT2)

The University of Oklahoma PH.D. 1982

THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

PEER TEACHING IN PERMANENT PROJECT TEAMS (PT^2)

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

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Norman, Oklahoma

1982

PEER TEACHING IN PERMANENT PROJECT TEAMS (PT^2)

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ABSTRACT

PEER TEACHING IN PERMANENT PROJECT TEAMS (PT^2)

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"Peer Teaching in Permanent Project Teams (PT^2)" is an instructional technique designed to encourage students to teach each other. The technique is based on concepts from the literature on "Group Dynamics". Data from 288 students in eight experimental (PT^2) and eight match control sections of an introductory zoology laboratory course were analyzed. Results indicate that PT^2 resulted in increased cooperativeness and academic performance. Results were inconclusive with respect to the effect of PT^2 on the quantity and quality of peer teaching and student satisfaction. Implications for many educational and training situations are also discussed.

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ACKNOWLEDGEMENTS

The choice of "Peer Teaching in Permanent Project Teams (PT^2)" was the culmination of numerous discussions with Dr. Larry Michaelsen and experimentations with various aspects of PT^2 in my classes over a period of about thirty months. Additionally, the opportunity to design and direct a quasi-experiment presented itself, and this was very inviting to me as a real, research learning experience. The whole process has been very gratifying, but I never failed to underestimate the magnitude of each step in the process and without a great deal of help from my family, friends and colleagues may never have completed what I now recognize as a project of sizable proportions. Therefore, I will attempt to partially express my gratitude by acknowledging those who assisted and asking the forebearance of any I may have inadvertently overlooked.

I particularly appreciate Dr. Larry Michaelsen allowing me to formally conceptualize and empirically test his "brain-child". Dr. Michaelsen was most generous in devoting substantial time and effort to this dissertation

while serving as chairman of the committee. My gratitude to Dr. Daniel Wren, for going far beyond the call of duty for a committee member, is inexpressible. The other committee members have all made significant contributions, and must be recognized by name: Dr. George W. England, Dr. Larry Toothaker and Dr. William Whitely. Additionally, I wish to thank Dr. William F. Weitzel and Dr. Marion Phillips for serving as excellent "sounding boards" and offering sage advice on numerous occasions.

Of course, the experiment would not have been possible without the cooperation and assistance of the Zoology 1121 Course Coordinator and the Graduate Teaching Assistants. I extend my thanks to Dr. Penney Hopkins, Course Coordinator, and the Graduate Teaching Assistants: Carroll, Cramer, Gage, Groeger, Lodes, Martin, Milstead, Peck, Shaprio, and Watt. Several other individuals assisted by administering questionnaires. The questionnaire administrators were: Les Fiechtner, Jane Burman-Holtman, Chris Knapp, Jim Kraemer, Dr. Larry Michaelsen, Rob Rolff, Marla Scafe, Ben Trotter, and Linda Vorwerk. General support was provided by the Division of Management Director, Dr. Roger Atherton and the Division's secretary Shelia Hartnett and Ray Dacey, Doctoral Student Advisor. A very

special thanks to Barbara Fletcher, typist, who labored long and hard to meet crucial deadlines.

These acknowledgements would not appear here now if it were not for the support and understanding provided by my loving wife, Kathy, my son, Clay, and daughter, Charla. Only Kathy and I will ever know the full impact of the pressures we felt. I can only hope that this completed dissertation in some way partially repays my family for all the sacrifices they made so that it could be completed.

COY A. JONES

PEER TEACHING IN PERMANENT PROJECT TEAMS (PT^2):

CHAPTER I

INTRODUCTION

One of the most pervasive issues in education is how to more effectively transfer knowledge and skills. A common means of achieving this transfer is teaching, that is, one person shows or helps another person learn. There are numerous approaches to (or methods of) teaching, e.g., lecture, interactive discussions, case method, experiential exercises and small group problem solving. Each of these teaching methods produce both advantages and disadvantages to the educational process. Providers of education should consider these advantages and disadvantages in light of costs to deliver the education and the effectiveness of the method.

Academic institutions and corporate training centers continually search for means of improving the quality of training while holding down costs. An estimated $150

billion is spent annually by large and medium size firms for organization-sponsored training, development or education programs (Gilbert 1976). In the fiscal year 1979 the Federal Government spent $9.4 billion on various training programs (Employment and Training Report of the President, 1980) and the expenditure for instruction in institutes of higher education exceeded $15.3 million in the school year 1979-80 (Digest of Education Statistics, 1980). The objectives of improving teaching effectiveness while holding down delivery costs has become even more important in recent years with general trends toward increasing student to instructor ratios and higher costs of delivering education in institutes of education.

Unfortunately, teaching methods which tend to improve the student participation and interest also tend to increase the cost of delivery. The straight lecture method, where one instructor addresses as many students as room facilities permit, may be the most cost efficient means of delivery because only one instructor is required for a large (80-300) number of students and usually no special materials or equipment are utilized (other than lecturn and chalk board. Employing the experiential or case teaching methods tend to create more student interest, but increase teaching costs because these techniques necessitate smaller

instructor to student ratios and usually require special materials or equipment.

The main drawbacks to the straight lecture method are insufficient attention to individual student problems, increased focus on learning facts with little emphasis on integration and application, and increased use of true/false and multiple choice exams. These drawbacks limit opportunities for student-instructor or student-student interaction which has often led to student apathy, low attendance, poor academic performance and disenchantment with the university system (Filley, Foster, Herbert, 1979).

The case analysis and experiential methods encourage student-instructor and student-student interaction, and these methods allow students to grapple with the integration and the application of concepts. However, the case analysis and experiential methods can increase teaching costs in several ways: development or purchase of cases or experiential excercises, additional time to complete the analysis or exercises and the requirement of small classes for effectiveness (i.e., more instructors or instructor time are needed to teach the same number of students).

Most methods designed to improve teaching effectiveness by providing more individual instruction involve some means of providing more student to instructor

or student to student interaction (e.g., seminars, discussion sections, small group projects, etc...). The main criticisms of these techniques are increased expenses, longer periods of training needed to cover required materials, and students may not learn the course content (i.e., concepts, skills, etc...) as well.

Statement of Objectives

The technique to be studied in this dissertation has been developed to increase student to student interaction which may result in students assisting each other and actually improving the students' learning of course contents. This process of student to student assistance has been labeled "peer teaching". The proposed advantages of peer teaching include: (1) students learn more by being active in a learning situation, (2) students learn by interacting with peers and authorities (e.g., an instructor or those cited by an instructor), and (3) students learn by teaching others. (Goldschmid and Goldschmid, 1976).

The purpose of this study is to determine whether the use of a specific technique can significantly increase the quantity and quality of peer teaching and to determine whether this technique increases individual student academic performance and individual student satisfaction with the

learning process in comparison to a more traditional teaching method. For convenience the specific technique for initiating peer teaching which is to be tested in the present study will be called peer teaching in permanent project teams (PT^2). Another way to state the objectives of this study is: to determine whether and to what extent employing PT^2 encourages peer teaching and does PT^2 result in improved student performance and satisfaction.

Definition of Key Terms

Terms with a special meaning for the purposes of this dissertation are:

group cohesiveness - mutual respect among group members, displayed by adhering to group norms of cooperative behavior in achieving group goals.

group goals - goals agreed to by the group members for the timely completion of group projects and an agreed to quality of the group's product (i.e., mini-test or lab report).

group interaction - group discussion for purposes of organizing to complete an assigned project, resolving differences, asking or answering questions, clarifing a member's role in project completion, or assembling the group product.

group interdependence - necessitates cooperative behavior on the part of the group members in order to complete group projects and optimize their grade on group performance.

group organization - the assignment of members to roles and tasks and coordination of efforts for the completion of a group project.

group participation - the involvement of each group member in group interaction.

group performance - the quality of a group product in the judgement of the course instructor (i.e., the grade assigned to the group product).

group product - the responses and solutions to group projects which the group agrees to turn in to the instructor for grading (i.e., mini-tests and lab reports).

group project - a mini-test or lab report assigned to the group members to complete as a group and agree to the responses in the group product to be turned in and graded.

heterogeneous group - group members selected so as to vary membership by the ages, academic levels, major academic interests, native languages, sexes, members of fraternities or sororities or independents, and their ratings of their high school biology course.

individual goals - the goals of individual group members, primarily concerning outcomes an educational experience, may be similar to or very different than the goals of their group.

individual performance - the quality of an individual product in the judgement of the course instructor (i.e., the grade assigned to the individual product).

individual product - the responses and solutions to individual projects to be graded by the instructor.

individual project - a mini-test, lab report, mid-term exam, or final exam assigned to individuals to complete on their own.

inter-group competition - the desire of groups to do better than other groups on the group projects, this desire is heightened by announcing the grades on group projects to the class.

PT^2 - a set of techniques and processes designed to provide opportunities and incentives which stimulate peer teaching.

peers - the students enrolled in the course.

peer evaluation - the rating of each group member's value to the group according to the other group members.

peer teaching - members (peers) of the student groups assisting one another in learning the course content. This assistance may be provided in any form of group interaction as defined above.

permanent group - the membership of the student groups formed at the beginning of the semester is not changed at any time during the semester.

quality of peer teaching - the value of or benefits received from peer teaching in the opinion of the students and as indicated by changes in individual performance.

quantity of peer teaching - the amount of time the students spend in peer teaching.

Scope and Limitations of This Study

This study is intended to determine whether there is a difference in the way individual students respond and perform in a course when a technique for gaining peer teaching is employed compared to the response and performance of students in the same course but taught in a more traditional manner. Several aspects of the study limit its generalizability to other situations. These limiting aspects include: the setting where the study was conducted, the subjects, the lack of teaching experience of the instructors, the nature of the reward for the students, and degree of differentiation between the experimental and

comparison groups. The characteristics of these aspects are discussed below.

The setting was a university educational setting. The subjects were university students and most of them were age 19-23. These students were taking a laboratory section of a first year Zoology course at a major university. The instructors were nine graduate teaching assistants, eight of whom had taught the course before.

The reward for the students was a grade and one semester hour of college credit. This, of course, is quite different from the reward for example for employees/students attending training for which their livelihood may depend (i.e., more immediate tangible rewards). The reward was the same for the subjects in the experimental condition as it was for those in the comparison condition and there was no test of whether or how a more significant reward would effect the results.

An additional characteristic of this study which may be viewed as a limitation or a strength is the degree of differentiation of treatment between the experimental (PT^2) groups and the comparison (non-PT^2) groups. The comparison groups sat at lab tables and worked together on non-graded projects. This arrangement may have encouraged a number of the comparison subjects to study together to a significantly

greater extent than they would sitting next to one another in a strictly lecture section. Therefore, the PT^2 treatment differentiated primarily by purposely forming permanent heterogeneous project teams and including the teams' group performance in the calculation of the students' overall grades. Additionally the PT^2 treatment differed by calculating the team members' peer evaluations of each other into the overall grades.

This study is limited to testing the effects of PT^2 in the teaching situation as described above (i.e., university classrooms) and the generalizeability of its results should be tempered by those limitations. That is, the results may be different in other settings or if students are older or instructors more experienced or if the reward was greater, or if there were greater differentiation in teaching techniques.

Nature and Order of Presentation

The intent of this presentation is (1) to review the literature which explains the potential of peer teaching to improve the performance and satisfaction of students in an educational situation, (2) provide an empirical test of PT^2's capability to evoke peer teaching and (3) examine the

effect of PT^2 on individual student performance and satisfaction.

The order of this presentation is to first state the objectives of the study and explain why these objectives are being pursued. Then, a review of the literature from which the PT^2 method has been derived is presented. Next, a presentation of the various aspects of the PT^2 process and research methodology employed in this study. Then, an analysis of the empirical test of the effects of PT^2 and a report of the results of the test are presented. Finally, a discussion of the results, including conclusions drawn and suggestions for further research, is provided.

CHAPTER II

REVIEW OF LITERATURE

The benefits of utilizing techniques that induce more peer teaching has recently (i.e., the last ten to twelve years) been given more attention by institutions of higher education. A major portion of the research into the uses of peer teaching to date has been done in Europe as is reflected in the review of the peer teaching literature. The current state of the peer teaching literature primarily describes approaches to gaining peer teaching. All of the techniques for employing peer teaching found in the literature differ in various aspects from the technique which will be described and tested in this study.

Peer Teaching

Peer teaching has been defined as the teaching of each other by students of similar age and/or educational level (Goldschmid and Goldschmid, 1976). The primary aim of

peer teaching is to provide individualized instruction and personalized assistance in learning.

Several models of peer teaching have been developed over the past decade. Goldschmid and Goldschmid (1976) offer a logical and comprehensive overview of the most popular models of peer teaching developed to date. Their classification includes: discussion groups or seminars led by teaching assistants; the proctor model; the learning cell; student counseling; and student learning groups. A brief description of the structure, strengths and weaknesses of each of these models follows.

Discussion Groups and Seminars. This model gains peer teaching through the use of discussion groups or seminars led by teaching assistants (T.A.) to supplement larger lecture sections, and save the professor's (primary instructors) time, and may be less costly than hiring more professors to teach smaller sections. It has been proposed that having a teacher (T.A.) closer to the students in age and educational attainment will result in students being more willing to ask questions and admit to not understanding some of the course materials, than they would in the presence of their professor.

The discussion group approach also appears to have some disadvantages as well. For example, McLeish, Matheson

and Park (1973) found that student behavior in such discussion groups or seminars is much the same as in lecture classes, i.e., the students remain passive for the most part and the teaching assistant is seen as another authority figure, rather than as a peer. Students indicated in an extensive survey of experimental physics courses that they attribute many of the same negative and positive factors to discussion groups (or seminars) that they attribute to lecture classes (Krake and Sand, 1973). Even with these problems several investigators have concluded that discussion groups represent a valuable supplement to large lecture courses (e.g., Arbes and Kitchener, 1974; Diamond, 1972; and Wrigley, 1973). Whether these discussion groups are advantageous or not they require additional costs of delivery of instruction.

The Proctor Model. In this model a one on one relationship between "proctor" and student is established. "Proctors" are students who have acquired many skills in their area of specialization which are necessary for the completion of a particular course of study (Keller, 1974). The role of a proctor is to work individually with students pursuing a course of study which requires knowledge of the skills in the "proctor's" area of specialization. A "proctor" may test the student over various units of course

material, then provide constructive feedback based on the test results.

Proctors provide feedback to the course instructors on students' progress and particular areas of difficulty in the course materials. The practice of the skills the proctors have acquired in previous study helps assure their mastery of the subject matter. By working with students one on one the proctors render normally impersonal instruction, personal. The major obstacle in implementing a proctor system is inducing qualified students to serve as proctors.

The Learning Cell. This model is based on structured student dyads, (Goldschmid, 1971). Students write questions on the major points of the reading assignment prior to class. At the beginning of class pairs of students are randomly assigned to dyads and alternately ask and answer questions over the assigned material. During this time the instructor passes among the dyads giving feedback.

The success of the learning cell model is dependent upon a high degree of structure. And certain types of students benefit from the "Learning Cell" more than others. Leith (1973) has shown that the learning cell improves the performance of extroverts when they are paired in the dyads; introverts perform approximately the same when

paired in the learning cell dyads as when they study individually; and mixed pairs of introverts and extroverts are least successful in improving performance. The use of dyads limits the consideration of different perspectives to two which may be a disadvantage even though it permits optimum interaction.

Student Counseling. This model is based on the development of a counseling relationship between senior level students and entering freshman (Goldschmid and Burckhardt, 1974). These counseling relationships are developed in meetings held with the first and fourth year students to explain the purpose and procedures of the program.

In the initial meetings between the first and fourth year students concrete problems which are general to campus life are discussed (e.g., library use, housing, transportation, etc...). Later discussion topics include: educational and vocational goals, study methods, note taking, and laboratory work. Then the students mutually set times for regular group meetings followed by further counseling (often one on one) at the request of the first year students.

A primary advantage of this model is that it provides valuable feed-back to the faculty with respect to

general problems with particular courses, labs, and the university environment. Student reactions have been positive. For example, both the first and fourth year students supported the continuation and expansion of the program. Follow-up achievement measures (grade-point-average and number of failures) indicated that the first year student-participants of this program performed significantly better than non-participants in both their first and second year university work; however, the researchers did not control for other possible intervening variables which may have had significant effects. Some possible intervening variables include: personal problems, quality of instruction, and individual ambitions.

Student Learning Groups. In this model the student groups are self-directed (i.e., no authority figure involved in the group discussions). The model is based on independent study groups which may form as a natural occurrence in dormitories, fraternities or sororities. Beach (1960) has observed that when students in these groups are other-oriented and contribute intellectually or affectively they performed as well as students who attended traditional lecture classes. Beach also observed some factors which inhibited learning in these groups, such as students preoccupation with their own knowledge or point of

view and the inability to direct other students to new insights.

Berman (1975) used an audiovisual program in an attempt to orient and structure student groups who also met without an instructor present. An opinion survey indicated overall student satisfaction with this approach. A large majority of the students said they had read at least part of the text assignment prior to the group meetings, probably because of group pressure and the high dependence of the program on the text.

Davis (1967) found that students in self-directed groups reliably evaluated each other on speech presentations, and course attendance did not suffer. In addition, Tighe (1971) reports that in such student groups the exchange is more open than what typically is observed in "normal" classrooms.

One common aspect of each of the approaches mentioned above is that these student learning groups are more effective when their activities are structured. That is, the students should be given: complete instructions, guidance through the process and assurance that they understand what is expected. The major shortcomings of the attempts presented above was lack of incentives to consistently prepare for the group activities and the lack

of any means of determining the value of group member contributions. Additionally, the literature on all of these models is weak due to a lack of empirical testing of these models in comparison to other teaching techniques.

Guidelines for Implementing Peer Teaching

Beyond specific models the peer teaching literature suggests that there are advantages to certain approaches in utilizing any peer teaching technique. For example, structuring of a class in which peer teaching is to be utilized is important to successfully accomplishing peer teaching objectives of personal, individualized instruction. Therefore, any instructor planning to utilize peer teaching should be aware that: the formation of the peer teaching unit, the course structure, and how benefits accrue from peer teaching will affect the course outcomes (Goldschmid and Goldschmid, 1976).

Forming the peer teaching unit. Encouragement of peer teaching can be provided by selecting students into dyads or groups. Many studies have been conducted in order to determine the optimal mix of member characteristics. The results of these studies are not generalizable to overall conclusions of how best to match students to groups. Even if conclusions could be drawn, gathering the necessary data

on member characteristics would be an enormous task. For many peer teaching situations it has been found that a balance of various ages, sex and major area study is usually sufficient to enable a group to be effective (Michaelsen, Cragin, and Watson, 1981).

Generally smaller groups provide greater opportunity for peer teaching. It appears, the groups of six or fewer members are most effective (Hare, 1952; Slater, 1958; Thomas and Fink, 1963). The nature of the task, classroom facilities and instructor preference are potential modifiers of group size. The smaller the group the greater the potential for interaction among all members. The more the students interact the more involved they become which increases the number of learning opportunities (Abercrombie, 1974). Ideally in the process of this interaction the students alternately teach and learn from each other.

Course structure. Once the groups have been formed the instructor must present the course structure. This presentation should include a discussion of: the materials to be covered in the course, the learning activities, the planned schedule and the method of determining grades. The course structure may be presented prior to group formation but should be reiterated for greater comprehension after the group members have become acquainted. Instructors should

maintain the course structure by making available materials suitable for individualized instruction (Goldschmid and Goldschmid, 1973; 1974), arranging optimal peer teaching opportunities, and guiding and consulting with the students to resolve problems in understanding the course material or problems in achieving group process effectiveness.

To enable optimal peer teaching opportunities the instructor must arrange for a classroom of appropriate size with moveable tables and chairs or desks to enable and encourage participation. Most of the students will have to adjust their competitive orientation to the more cooperative peer teaching environment. Goldschmid and Goldschmid (1976) suggest that an open discussion of this need for students to adopt more cooperative attitudes and behaviors may help alleviate potential problems.

Some proponents of peer teaching recommend training sessions to assist the students in adapting to a more active role and acquiring peer teaching skills (Goldschmid and Goldschmid, 1976). The suggested content of these training sessions include: teaching techniques, communications, group-dynamics, or some combination of these. Of course, training sessions of this nature are time consuming and costly.

Benefits and Problems of Peer Teaching

One of the most obvious advantages of peer teaching is that the student-learner benefits from the more individualized instruction which is usually not economically feasible in institutions of higher learning. Several investigators have reported that peer teaching benefits students when they are teaching as well as when they are being taught (e.g., Majors, 1970; Mohan, 1971; Morgan and Toy, 1970; Starlin, 1971). These investigators report that in the teaching mode students profit cognitively from the process of determining how to express concepts (course material) in a way which others can clearly understand. Additionally the student-teachers' self-esteem increases and their attitudes towards the course and learning generally become more positive.

In one study Torrance (1969), observed a greater willingness by students to attempt difficult tasks, and in another (1970) he observed students were more creative in peer teaching situations. Improved retention has been claimed as a benefit of peer teaching by Dick (1963); however, this claim has not been substantiated by other studies testing the effects of peer teaching. Enhanced conceptual development has been observed by Murray (1972) and by Cloutier and Goldschmid (1972). Many investigators

have reported students expressed great satisfaction and enjoyment from peer teaching situations (e.g., Goldschmid, 1970; Schirmerhorn, Goldschmid and Shore, 1974).

A potential difficulty with peer teaching is that group discussion time may increase the time required for the participants to complete group assignments. Kelley and Thibaut (1969) have commented on the potential inefficiency of group problem solving processes:

> If groups are not always more efficient than individuals as problem solvers, they are not, for that reason, to be dismissed as objects of scientific investigation. For group problem solving is an inevitable and omnipresent phenomenon whether effective or not.

The technique studied in this dissertation provides opportunities to make group problem solving more efficient.

The peer teaching technique tested in this study groups students into permanent project teams (i.e., teams for the duration of the course) which are structured and treated in a manner such that peer teaching is encouraged. The occurence of this peer teaching is dependent upon the dynamics of the groups. The effectiveness of the peer teaching is dependent upon how well the groups organize to solve problems. The formulation of the technique is based in the group dynamics and group problem solving literature. Therefore, it is appropriate to review pertinent portions of this literature prior to discussing the conceptual framework

of the peer teaching technique which was tested in this study.

Peer Teaching and the Dynamics of Groups

The pioneering experiments of Kurt Lewin touched off a proliferation of studies on human behavior in group settings. The term "group dynamics" is a general term used to express the interworkings of groups, their nature and the behavior of indivduals within a group. The general term group dynamics, then, encompasses a wide variety of behavioral concepts. Many of these concepts have been utilized in the development of the opportunities and incentives provided by the peer teaching technique tested in this study. These include: group cohesiveness, group norms and group goals.

Group Cohesiveness

Cartwright and Zander (1968) have attributed three different meanings to group cohesiveness:

(a) attraction to the group, including resistance to leaving it

(b) motivation of the members to participate in group activities

(c) coordination of the efforts of members

In more cohesive groups members are: attracted to and desire to remain in the group; motivated to participate in the group activities; and coordinate efforts.

There are two generally agreed to major sources of attraction to a group: (a) the group itself as a satisfier of the personal needs of its members, and (b) group membership as a means of satisfying needs lying outside of the group. The personal needs of members which may be satisfied by group membership include needs for affiliation, recognition and security. Needs to participate in activities which require a group can be satisfied by the group itself. That is, since it is very difficult to: play a game of softball, belong to a fan club or be a charitable association by oneself, a person who feels a need to participate in such group activities may join or form a group for that purpose.

Group membership may facilitate the attainment of a goal external to the group that would not be possible for an individual acting alone. An example of this is wage increases and/or job security attained by unions for their members. Another example may be the satisfaction of a need for prestige which for some may be fulfilled by membership

in a particular group (e.g., graduating from a prestigious university or belonging to a prestigious country club).

According to Cartwright and Zander cohesiveness can be thought of as the members' feelings of "we-ness" and the degree of cohesiveness is the resultant effect of all the forces acting on all the members to remain in the group. The cohesiveness of a group can be increased by heightening the members' awareness that their needs can be met by continuing to belong to the group. The effect of the awareness of needs being satisfied by remaining in a group has been demonstrated by Ross and Zander (1957).

Results of Cohesiveness. Several studies indicate that members who are highly attracted to a group tend to exhibit more behavior which is beneficial to the group than members who are less attracted to the group. For example: Back (1951) found that highly attracted members participate in meetings more readily, appear to be more willing to listen to others and more frequently change their minds to agree with the views of other members; highly attracted members adhere more closely to group standards and are more secure and less tense (Seashore, 1954); and studies by Sagi, Olmstead and Atelsk (1955) and Libo (1953) have demonstrated that highly attracted members are more faithful in attending meetings and remain members longer.

As discussed earlier cohesiveness is a result of attractiveness. There are several sources of attractiveness: the members as persons, the group's activities or the goals mediated by the group. Whether these different sources of attractiveness effect the amount of cohesiveness in the same manner or differently is not clear from the research completed to date. However, Back (1951) found that the power of a group to influence its members was effected similarly by these three sources of attractiveness.

Group cohesiveness can have positive or negative effects on the quality or quantity of peer teaching. It is important to note that the absence of group cohesiveness may discourage voluntary peer teaching since there would then be little motivation to participate in group activities. Other effects will be discussed after a review of the group problem solving literature which relates to peer teaching.

Group Norms

Group norms are those standards of behavior and expressed opinions which are acceptable to the group. The existence and importance of group norms has been observed by several researchers, notably Roethlisberger and Dickson (1939), Sherif (1936) and Blake, Helson and Mouton (1957).

Group members apply pressure to one another to conform to the group's norms. This pressure for conformity is intended to: help the group accomplish its goals, maintain itself as a group, and help members develop validity or "reality" for their opinions (Cartwright and Zander, 1968). This pressure becomes stronger as group cohesiveness becomes greater and the ability of the group to monitor the behavior of members increases (Hall, 1955). The tendency of a person to yield to these pressures is dependent upon a variety of cognitive conditions as shown by Asch (1952) and personality characteristics as shown by Crutchfield (1955). Finally, Schachter (1959) has found that the more cohesive a group is the greater the pressure to conform to group norms.

For effective group peer teaching to occur the development of group norms to share information in a helpful manner is essential. Effective peer teaching requires that group members prepare in advance for group activities and actually attend and participate in the group activities. Preparation, attendance and participation may be viewed as additional or sub-norms of the group. Whether peer teaching becomes a group norm will depend to a great extent upon the goals adopted by the group.

Group Goals

A group goal is usually conceived of as some sort of composite of the individual members' goals. The least confusing approach to conceiving this composite, according to Cartwright and Zander (1968), is to consider the group as an entity and the group's goal as a composite of the individual members' goals for that group. In this sense the composite goal becomes the property of the group and not of any individual member of the group.

If the group's members are attracted to the composite goal, perceive it as attainable and the costs to them as reasonable, then it will probably be accepted as the group goal. It is important to recognize that the attainment of a group goal requires group activity. That is, the group members are interdependent for the attainment of the group goal. This characteristic of interdependence clearly distinguishes group goals from individual goals. Recall that one of the sources of attraction to a group is the potential of achieving goals which individuals can not achieve acting on their own.

From this discussion it is reasonable to expect that the greater attraction a group goal holds for the group members the more cohesive the group will become. Group

cohesiveness and a desire to attain the group goal may result in the group's members developing and displaying concern for the welfare of the group.

One of the most important implications of group goals for peer teaching is the effect of the interdependence among the group members which is created by group goals. If a group member performs an activity which helps the group reach its goal that member improves the probability that each other member will gain satisfaction. The interdependence leads to a cooperative situation which according to Deutsch (1968) tends to produce the following group characteristics:

(a) a readiness to substitute one member's activities for another, since each person's activity is evaluated not by who does it but by its contribution to progress toward the goal;

(b) a cathexis, or attraction of members for one another, since each contributes to the other's progress toward the goal (even when striving for their own satisfaction);

(c) a readiness to accept influence attempts from other members, since all see that they are helping one another.

It is not difficult to see that the existence of these characteristics in peer teaching groups would positively effect the quantity and quality of peer teaching.

Group Problem Solving

One of the major ways in which peer teaching occurs is when the members of a peer teaching unit help each other in solving problems (i.e., learning concepts, analyzing cases, etc...). Group social processes were discussed in general terms under group dynamics and will now be discussed more specifically in terms of group problem solving since this is the process with which peer teaching is primarily concerned. That is, in order for a group to solve a group problem effectively the group members must understand the problem and the concepts involved. In the process of attempting to gain the understanding of all group members many opportunities for peer teaching are presented. A central problem of peer teaching groups is to determine how well they as a group, can perform on various group projects. The group problem solving literature examines the organizing of groups for sharing and utilizing information, acting on that information, and how groups perform in contrast to individual performance.

Group problem solving has been described by Kelley and Thibaut (1969) as common action taken in an attempt to satisfy common interests which emerge from common problems. They define the process of group problem solving as one of interdependence where the outcomes for each member are

determined partly by the behavior of the other members. By definition, then, a "group problem" is one in which all group members have an interest in finding a solution.

Kelley and Thibaut (1969) identify three sub-processes of group problem solving: outcome distribution, information distribution and response distribution. Outcome distribution is the determination of who gets what at the end of a group activity. In an educational situation the primary outcomes of concern for students are course grades and learning. Since most course grades are distributed by the instructor (not group members), the process of outcome distribution is not usually helpful in understanding the occurrence of peer teaching in groups. Information distribution and response distribution will be discussed separately.

Information Distribution

Information distribution is the pattern or channels and directions in which information is shared. In group problem solving the group members are dependent on one another for information as well as action (responses). According to Jones and Gerard (1967) information dependence is a function of outcome dependence (i.e.; dependence for the purpose of discovering a viable solution to a group

problem). The effectiveness of information dissemination within a group depends upon the extent to which group members cooperate in information seeking, sharing and exchange. This cooperation is greatest when there is no problem of outcome distribution (i.e., determining how group members share rewards, Kelley and Thibaut, 1969) and in educational situations (i.e., the classroom) the outcome distribution of primary rewards (grades) is determined external to the group.

Cooperative information exchange is essential to group problem solving because various group members will have different pieces and amounts of information pertaining to a group problem. When incomplete information held by the various group members becomes compatible it will probably be exchanged and integrated with very little blockage to group agreement on a problem solution. Incompatible information may be withheld if a group member perceives that the group is hostile towards disagreements.

Other factors which impact on information distribution include: size of the group, degree of interdependence for information, the group's information distribution structure, and the cognitive similarity of the members of the group. Gibb (1951) found that as group size increases the proportion of members volunteering information

decreases. The findings of Bales, Strodtbeak, Mills and Roseborough (1951) and Stephan and Mishler (1952) suggest that to maintain good information exchange group size should not exceed seven members. Lanzetta and Roby's (1957) experiment with three man groups has shown that higher degrees of information interdependence leads to greater exchange of information.

In order to minimize errors and maximize learning from information exchange, according to Macy, Christie and Luce (1953), a group's information distribution structure should have:

1. A mechanism for recognizing that errors are in fact occurring: each subject (member) must be able to receive information from at least two others.

2. A mechanism for correcting errors rapidly (symmetric channels).

3. Wide distribution of participation (a decentralized network).

These information distribution structure characteristics are particularly important when information is: highly ambiguous, produces much unnecessary information (noise) or there is a particular need for redundancy of information.

The amount of communication between members of a group does not translate directly to equal amount of accurate information exchange. If members are not using similar terms to describe events their communication may not

result in an effective exchange of information. This similar use of terms and similar understanding is called cognitive similarity. Kelley and Thibaut (1969) define cognitive similarity in terms of, "...(1) the dimensions used for characterizing events and (2) the positions assigned particular events along the demensions."

Peer teaching groups will have greater opportunity to develop more effective information distribution if they: have no more than seven members, are interdependent for information (i.e., heterogeneous), organize an appropriate information distribution structure, and are cognitively similar.

Acceptance and Utilization of Information. Even when the characteristics of a group are ideal for information distribution, there remains a question of whether information will be accepted and used by the group's members. In cooperative groups, the main factors affecting acceptance of information are: verifiability, number of alternatives offered and perceived expertise of the source of information. That is, a group more readily accepts information which is verifiable and offers few alternatives from a source perceived as expert.

Information is considered verifiable when the group can test it for correctness. When a group is confronted

with conflicting information, the group becomes uncertain and unstable. In this event the perceived expertise of the members providing information may become the determining factor of which information is accepted by the group. The perceived expertise of group members is heavily influenced by their history of success in verifying information and the degree of confidence they display (Palmer, 1962).

Disruption caused by new members. When new members join an existing group it may be difficult for them to get their valid information accepted. Ziller and Behringer (1960) have shown that the acceptance of newcomer information is dependent on a group's ratio of prior successes to failures. Groups which have recently enjoyed a high degree of success tend to reject a newcomer's information. Whereas, groups which have recently experienced failures tend to accept the newcomer as a possible source of improvement. Adding a new member, whether the newcomer has valid information or not, can disrupt relationships among other group members; therefore, it may be best in peer teaching situations utilizing groups to form permanent groups early and avoid adding new members if possible.

Disruptive potential of heterogeneous groups. A heterogeneous mix of group members will provide different

information and different perspectives on any given problem. However, because of the powerful forces in small groups toward uniformity of opinions (Festinger, 1950 and Asch, 1951), peer teaching groups should be instructed to be sure that every member be given the opportunity to express their views.

To alleviate the disruptive potential of heterogeneous information, it is recommended that the members of peer teaching groups insist on evaluating every problem systematically by: (1) identifying and specifying the problem, (2) developing alternative solutions, (3) analyzing the alternative solutions, (4) selecting a solution, and (5) discussing and agreeing on how to implement the solution. This procedure is similar to the "developmental" group leadership method suggested by Maier and Maier (1957).

Response Distribution

According to Kelley and Thibaut (1969), response distribution involves the assumption of responsibility for certain actions or responses by group members. Group problem solving tasks usually require a coordinated pattern of overt responses (actions) of the group members (i.e., group members agree to cooperate in the required

activities). The pattern of response may be a specific distribution of different responses in a time sequence or simultaneously. When group members have full information about the other members' behaviors, the accomplishment of the required pattern of responses can be readily met (e.g., Jones and Vroom, 1964; Wegner and Zeaman, 1956).

When the group members do not have full information about the other members' behavior the group problem solving literature suggests at least three alternate methods of achieving the coordination of group member responses. These alternate methods are:

> 1. A dominant, highly active member may take the responsibility to provide the cues and commands that ensure the coordination of the other group members' responses. This method depends on the other group members being willing to accept and respond appropriately to the dominant member's cues and commands. Research supporting this method is provided by Ghiselli and Lodahl (1958) and Smelser (1961).
>
> 2. The second method calls for the group structure to provide for an executive role. The group member occupying the executive serves as a central collector of information and issuer of directions. Roby, Nicol, and Farrell (1963) have found that this method works best when the executive is the most proficient group member, and this method does not work very well if the executive is the least proficient member.
>
> 3. The third method occurs when the group adopts a simple set of rules for coordinating member responses. These rules tend to preserve the groups adaptive mechanisms.
>
> (Summarized from Kelley and Thibaut, 1969)

If one of these alternative methods is employed in lieu of all the group members having full information about the behavior of the other group members, the morale of most of the group members is likely to be diminished (Raven and Rietsema, 1975). A dominant member or an executive can be percieved of by the other group members as highly autocratic. The classic studies by Lewin, Lippitt and White (1939) have shown that other group members usually respond to an autocrat with either apathy or aggression. Another danger of the dominant member or executive method is that these members may prevent the group from considering all the information available and relevant to the task (Hoffman, 1978).

Peer teaching in groups can provide group members with many opportunities to observe and respond to the behavior of the other group members. This may encourage leadership which is shared by several group members. And when group members can observe the behavior of other members then can adapt and behave in a manner which enables the group to pattern its responses appropriately for task accomplishment.

Group Problem Solving Performance

The literature on how groups perform in solving problems holds many valuable implications for successful

peer teaching. The old cliche that "two heads are better than one" exemplifies the common temptation to assume that groups generally perform more successfully than the group members perform individually in solving problems. The validity of this cliche actually depends on several important variables.

Tasks and Problem Solving. Group performance in problem solving depends on the type of problem to be solved. Whether the group performs better than, the same as, or below the level of the group's most proficient member depends on the complexity and difficulty of the problem in relation to the group members' abilities (e.g., Goldman, 1965; Laughlin and Johnson, 1966).

Groups tend to perform above the level of the most proficient member when conditions allow for a "pooling" effect. The pooling effect seems to occur when group members confront tasks of moderate difficulty (i.e., not too easy nor too difficult) for them and each member is capable of solving different but complementary items of the problem.

The mix of high, medium and low ability group members impacts upon the level of group performance. Research indicates that if the problem is moderately easy combinations of low ability individuals results in group performance higher than any individual. In combinations of medium

ability individuals, and combinations of medium and low ability individuals the group performs at the level of the medium ability individuals. And in combinations of high ability individuals, high and medium or high and low ability individuals the group performs at the level of the high ability individuals (Goldman, 1965).

Conversely, other research indicates that group performance is higher than any individual if the problem is moderately difficult and the group is composed of high ability indiviuals or of high and medium ability indiviuals. And in combinations of high and low, combinations of medium, and combinations of low ability individuals, groups perform at the same level as their "best" member (Laughlin and Johnson, 1966).

Group performance at the same level as the most proficient member occurs in all combinations of member ability when all the problem items are easily mastered by the more capable members alone. In this event the less capable members will go along with those who have already solved the problem and members will contribute little to one another in group discussion (e.g., Timmons, 1939; Marguart, 1955; and Beasley, 1958). If the problem is very difficult for the high ability group members the group tends to perform below the level of the most proficient member (Davis

and Restle, 1963). The implication of Davis and Restle study is that when the problem is difficult the group discussion processes interfere with the more proficient members' thought processes and handicap their performance.

Peer teaching will be encouraged when the problems (i.e., learning tasks) are moderate to difficult. These problems (tasks) should be provided in advance of group discussion sessions and group members should be encouraged to prepare the problems individually prior to group discussion and actively participate in the group problem solving process. This advance preparation of moderate to difficult tasks should allow groups to perform above the level of the most proficient member a high proportion of the time.

Group organization. Maier (1967) has been credited for developing one of the first comparisons of group assets to group liabilities when groups attempt to solve problems. Maier's comparison is presented here in an abbreviated form.

A. Assets of group problem solving as compared with individual problem solving.

    1. There is a greater total sum of knowledge and information.

    2. A greater number of approaches to problems are proposed with group problem solving.

3. Participation in problem solving increases acceptance of the decision.

4. Better comprehension of the decision by members.

B. Liabilities of group problem solving as compared with individual problem solving.

1. Social pressure in groups is a major force in producing conformity.

2. Once an agreeable solution has been proposed, other suggestions tend to be ignored.

3. Groups are often dominated by individual members.

4. Some group members prefer to win an argument instead of selecting the best alternative.

C. Some factors can serve as assets or liabilities depending on the situation.

1. Disagreement among the group members.

2. Conflicting interests versus mutual interests.

3. Willingness of groups to take greater risk.

4. Time to reach a decision versus time to gain acceptance and compliance with the decision.

5. Who changes (the individuals with the most constructive points of view or those with the least constructive points of view).

6. Mode of persuasion used in achieving change (e.g., majority rule, leader influence, etc. . . .).

Maier concludes that groups can function as an integrated unit or as separate individuals in the unit depending on the role adopted by the group's leadership.

Group performance depends largely upon how well the group organizes to take advantage of assets and lessen the effects of liabilities. For groups to perform their best, time must be allowed for development and organization of the groups. Researchers have found that if an appropriate amount of time (depending on the difficulty of the problem) is not allowed for group development and organization in a problem solving task, group performance will be inferior to individual performance (e.g., Anderson, 1961; Fox and Lorge, 1962). These same researchers found that when appropriate time was allowed groups did as well as or better than individuals.

Even when groups are well organized, the group's members will probably not improve their individual performance, unless feedback relevant to the performance of individual tasks is provided to the group. For example, Pryer and Bass (1959) required groups to rank the size of five U.S. cities first as individuals then as groups after discussion. The results of these experiments showed no improvement in subsequent individual performance, probably because they never ranked the same city in the subsequent ranking tasks. Group performance did improve, possibly because the group members were able to identify the most reliable sources of information for this task.

Intergroup competition effects on problem solving. Intergroup competition may be helpful or harmful to group problem solving. Hammond and Goldman (1961) argue that intragroup cooperation without intergroup competition will yield superior group performance for all groups. However, Kelley and Thibaut (1969) point out that the Hammond and Goldman experiment fails to convincingly differentiate between intragroup cooperation with intergroup competition and intragroup cooperation without intergroup competition.

Some degree of intergroup competition will naturally occur when permanent groups perform and are evaluated on common projects (e.g., Sherif and Sherif, 1953 and 1956). The amount of intergroup competition between peer teaching groups can be elevated by differentiating the evaluations of the various groups' performance on team projects and announcing these evaluations to all the groups at the same time. Intergroup competition between peer teaching groups can be kept to a minimum by not differentiating greatly on the evaluations of team projects and providing each teams evaluations only to that team. When intergroup competition is maintained at a challenging level, but not overwhelming level, it can improve the performance of the groups.

Group member motivation. The motivation of group members has been found to be closely tied to the opportunity

to participate in decisions that affect the group. For example, members usually set aside any prior individual preferences and support the group decisions when groups are allowed to decide whether to make a suggested change or have some say in the parameters of the change and how to implement it (e.g., Bennett, 1955; Coch and French, 1948; French, Israel and As, 1960; and Lewin, 1947). Bass and Leavitt (1963) have shown that member participation and decision in the organization and planning of the group's activities appear to result in superior performance and more favorable attitudes in task completion; whereas, plans imposed on the group appeared not to be as well understood and met with some member resistance to implementation.

Interdependence of tasks. Group members working on interdependent tasks expressed a greater sense of responsibility for each other and were more willing to help each other than individuals working in the same room on the same task independently (Thomas, 1957). Group membership does not guarantee the cooperative individual effort suggested here by Thomas. Zander and Medow (1963) found that individuals performed better in propelling a ball to a target line on succeeding efforts when they were told they had failed on previous attempts, but groups did not improve their performance after being informed of a failure in

propelling the ball. Group members tended to give up under conditions of group failure, denied any personal responsibility for the poor performance and, blamed other group members.

Other studies indicate that groups do not always give up under conditions of failure. For example, Zajonc found (1962) group success depended on the reaction times of every member (rather than just the best member) and when feedback was given to each person about (1) their own and (2) other member's performance (rather than just about group success or failure), group members gave their best performance. These results represent improved performance over individual performance in 20 pretrials on the reaction-time task in which subjects had already approached an asymptotic level of performance.

In reconsidering Zander and Medow's task in terms of Zajonc's criteria for achieving group members' best performance (i.e., information on their own and other members performance), Kelley and Thibaut (1969) say neither are met. First, Kelley and Thibaut claim the member actions necessary for group success in propelling a ball as close as possible to a target line are quite unclear and perhaps highly variable. Further they state, "... a person has little way of knowing how adequate his own performance was,

and his contribution to the total success or failure is hardly indentifiable by the other members". Therefore members receive little feedback which might suggest how to improve their own performance in the Zander and Medow task, and the members are not motivated to improve out of concern for other members' evaluations of their performance since none of the other group members have any means of evaluating individual member contributions to group performance.

Lichtenberg (1957) provides evidence that group members do not give up on all tasks after failure. Lichtenberg found that failure in the early stages of a task is less likely to discourage group members working cooperatively than persons working independently on the same task. Lichtenberg suggests that early failure in the cooperative task may appear to group members to be due to a lack of coordination, which the members may believe they can correct.

Psychological support among group members. Several experiments indicate important consequences of the psychological support group members provide one another. This psychological support has been found to influence the behavior of group members. For example, Stotland (1959) has shown that individuals working in a "membership" condition are ten times more likely to express hostility toward a

supervisor than those working in an "alone" condition on the same task. Additionally, peer support has been found to be a basis for more mature, persistant and aggressive behavior toward a powerful source of frustration (Pepitone and Reichling, 1955; and Wright, 1943).

Summary: The implications for group member motivation in peer teaching situations are numerous. First, the groups should be allowed some meaningful decision making input into how they as a group will organize and plan for completing the various projects they are assigned. Perhaps, groups should be allowed to decide, within reasonable limits, how much their performance on individual and group tasks will count in the evaluation of their overall performance (i.e., course grades). Perhaps most important, group members should be given specific feedback on their own performance and how to improve it and on the performance of other group members and how it effects the group's success or failure. Lastly, instructors in group peer teaching situations should be aware that groups are likely to be aggressive in expressing hostility toward instructors if they feel that the instructor is frustrating their efforts.

In the next chapter a peer teaching technique will be explained using concepts from the group dynamics and group problem solving literature.

CHAPTER III

CONCEPTUAL FRAMEWORK AND METHODOLOGY

This chapter describes the major ideas which in combination define the Peer Teaching in Permanent Project Teams (PT^2) instructional approach. Then, the hypotheses to be tested in this study will be presented. Finally, the research methodology and the sources and means of obtaining data will be discussed.

Background of PT^2

Recognizing the need to improve training effectiveness while not increasing delivery costs, Dr. Larry Michaelsen began developing a learner-centered instructional format at the University of Oklahoma seven years ago. With this format he intended to enrich the educational experience and to encourage student to student interaction and learning assistance. After several years of experimentation with various classroom techniques and processes in Organizational

Behavior classes of 40-45 students, the format was modified for use in classes of 120 or more undergraduate students. The current state of this format is the heart of PT^2.

The results from the initial three semesters of using PT^2 in large classes (86, 121, and 124 students) were highly favorable in three potentialy important areas: individual performance, student attitudes, and the extent to which group norms were a significant factor in influencing the behavior of group members. Data collected from students on the IDEA course evaluation instrument from Kansas State University indicated favorable results when compared to other IDEA data from approximately 50,000 courses at 250 schools nation wide.

Michaelsen's data indicate that in the performance area, overall scores on a series of multiple choice and true/false exams were virtually equivalent to scores from identical tests given to graduate classes of 20-35 students. Student ratings of their progress on achieving the learning objectives including "improvement of thinking and problem solving skills", "understanding principles and theories in the field", and "developing a sense of personal responsibility" were rated well above the 90^{th} percentile of courses of any size included in the IDEA data. Student attitudes toward the course were very positive. In spite of the fact

that the course was rated above the 90th percentile on both the amount of reading and the amount of other work, it was rated as one of the top two courses in the College of Business. In response to a question asking the students how they felt the large size of the class had affected what they gained from taking the course, (supplemental question to the IDEA instrument) 48% responded that it actually "helped more than it hurt" compared to 42% who chose one of the two neutral categories ("it didn't have much effect", and "it helped and hurt about equally") and only 9% indicated that "it hurt more than it helped".

Finally, there is considerable evidence that group norms significantly influenced student behavior. For example, attendance averaged over 97% even though attendance was noncompulsory. On the course evaluation approximately 65% of the students identified either feelings of responsibility or expectations of the group as being the most important factor in whether or not they attended class (other factors included: interesting class - 5%, instructor expectations - 2%, and grades - 23%). Given the same answer choices as with attendance, one of the group oriented factors was selected as being most important in determining whether or not students read the assignments (42%) and the amount of effort they put into the class (44%).

According to Michaelsen, PT^2 appears to have consistently produced a number of other desirable outcomes each time it has been used in organizational behavior courses. Many of these outcomes seem to result from the intensive interaction that is required in the project teams combined with an incentive system designed to encourage members to support and provide inputs into the group. Consequently, students who are better prepared in the subject matter are rewarded through peer evaluations for helping other team members acquire basic skills while at the same time developing their own teaching skils. Older students returning to school are rewarded for providing a real world perspective in problem solving activities while gaining confidence in their ability to work and compete with younger students. Students with less academic preparation or from other cultures are rewarded for raising relevant questions and expanding the problem solving discussions. In addition, the PT^2 process gives students experience with working in groups which many times proves beneficial to the students in later course work and in employment settings where group problem solving and project team skills are important to job success.

These results were spread by word of mouth and various campus publications. Several professors who heard

of the PT^2 experience decided to try it with their courses (e.g., Chemistry, Engineering and Speech Communications). To Michaelsen's knowledge those who have tried PT^2 are positive enough about it to use it again, some with minor modifications. However, the use of PT^2 in these instances has failed to yield much in the way of empirical evidence of any differences in PT^2 and more traditional training processes due to the lack of a comparison group being taught in a more traditional process coincidentally with the use of PT^2.

The PT^2 technique begins by establishing permanent, heterogeneous 4-7 member student work teams for achieving learning objectives. Other prominent features of the PT^2 process include: (1) exposure to course concepts through individual study and group discussion; (2) frequent use of individual and group exams with immediate feedback which identifies any concepts for which additional instructor input is needed; (3) a primary focus on concept applications; (4) extensive use of problems, simulations, and experimental exercises to give students "hands-on" experience with course concepts; and (5) grading based on a combination of individual performance, group performance and peer evaluations. The relative grade "weight" for the three performance areas varies amoung course sections and is set

by the students through the use of a "Grade Weight Setting Exercise" (for details see Michaelsen, Cragin and Watson, 1981).

The PT^2 process differs from the typical use of groups in a number of ways. Two of the most important are the characteristics of the groups themselves and the way in which they are used for instructional purposes. With PT^2 the groups are permanent and heterogeneous, and the group work is the central focus of class activity. A much more typical approach is to convene groups temporarily as a supplement to enrich the students experience in predominately instructor-centered classes. When groups are used in this way, however, their contribution is largely restricted to providing a more interesting climate for the education process and does not result in peer teaching much beyond what is found in the more traditional classroom processes.

This background contributes along with the literature reviewed in Chapter Two to the formal conceptualization of "Peer Teaching in Permanent Project Teams (PT^2)" which follows.

Formal Conceptualization of PT^2

The impetus of PT^2 is the opportunities and incentives it provides for group cooperation and peer teaching. In general the opportunities are provided by forming permanent, heterogeneous project groups which the instructor continually refers to and treats as teams throughout the duration of the course. The incentives are provided by a grading system in which group products contribute significantly to each student's course grade. An additional incentive for individual group members to prepare for the group projects is the peer evaluations which also contributes to each individual's course grade.

The opportunities and incentives provided by PT^2 should result in cooperative group norms and increased efforts to achieve group goals. This should increase the quality and quantity of peer teaching. PT^2 may contribute to improved individual student performance, improved satisfaction and other desirable behaviors such as high attendance and lower rate of withdrawal from the course.

The opportunities and incentives were derived from the group dynamics and group problem solving literature reviewed in Chapter II. The development of the conceptual framework of PT^2 from this literature follows.

The permanence of the project teams should increase the effectiveness of peer teaching in two ways. One is that team members have time to develop norms and goals for the group (e.g., Blake, Helson and Mouton, 1957). Once norms develop team members will seek to conform to these prescribed behaviors (e.g., Cartwright and Zander, 1968). Second, permanence of the teams allows time for the groups to organize effectively and efficiently for problem solving (Kelley and Thibaut, 1969) and prevents possible disruptions that generally accompany changes in group membership (Ziller and Behringe, 1960).

The heterogeneous mix of team member characteristics and backgrounds reduces the forces within the group toward uniformity of opinions, but to encourage this positive result instructors should direct teams to allow, even encourage, all team members to express their views. The heterogeneous mix usually creates information interdependence which leads to greater information exchange (Lanzetta and Roby, 1957).

By keeping team sizes to seven or fewer (3) members the expression of the opinions of all team members (i.e., information exchange) is encouraged, as found by Stephan and Mishler, 1952, Thomas and Fink, 1963, and others. In addition, small team sizes increase the number of learning opportunities (Abercrombie, 1974).

The completion of team projects requires an interdependence of the members. This condition of interdependence leads to cooperative efforts of team members being coordinated for successful project completion (Deutsch, 1968).

The incentives built into the PT^2 grading structure to reward team performance and cooperation is designed to encourage the teams to form performance oriented goals. To enhance this opportunity, the graded team projects should be structured such that no team member acting singlely can complete the project as successfully as a team effort would result in (Cartwright and Zander, 1968). Therefore, properly structured, the group incentives serve as motivation for the team members to cooperate and organize for effective team performance. By allowing these incentives to be the motivation and not imposing organizing plans on the teams, group members will be more satisfied with and support group decisions (e.g., Bennett, 1955 and Lewin, 1947), team performance is likely to be superior (Bass and Leavitt, 1963), and members should feel more responsible for and be more willing to help each other (Thomas, 1957). Findings by these same researchers indicate that the teams determination by concensus of how much the individual performance, group performance and peer

evaluations influence their course grades, should favorably affect team member motivation.

To a great extent the way the instructor structures the course will effect the PT^2 teams' performance. Instructors should provide a systematic approach to the projects and encourage the team members to use such an approach to alleviate the disruptive potential of heterogeneous information (Maier and Maier, 1957). To increase the probability of team performance at or higher than the level of their most proficient member, the instructor should provide moderate to difficult group projects (Laughlin and Johnson, 1966). These projects should be provided in advance to allow team members to prepare individually prior to group discussion (Davis and Restle, 1963). Finally, instructors should provide timely feedback to the teams on their performance in a manner that they can determine how well each team member was prepared and performed their individual task (e.g., Kelley and Thibaut, 1969, Lichtenberg, 1957, and Pryer and Bass, 1959).

A more general responsibility of instructors which continues throughout the course is to recognize team difficulties in organizing and stand ready to facilitate this process (Goldschmid and Goldschmid, 1973). To do this effectively, instructors must be aware of potential assets and liabilities of groups in problem solving (Maier, 1967).

This conceptualization of PT^2 implies certain outcomes in a teaching situation. The occurence and extent of these outcomes may be difficult to recognize from simple observation. Therefore the following hypotheses have been developed for empirical testing.

Statement of Hypotheses

The following hypotheses are drawn from the conceptualization of PT^2 and are intended to frame the tests of certain effects PT^2 may have on students. The flow of hypothesized effects as conceptualized is diagramed in Figure 1, Conceptual Model of Peer Teaching in Permanent Project Teams (PT^2).

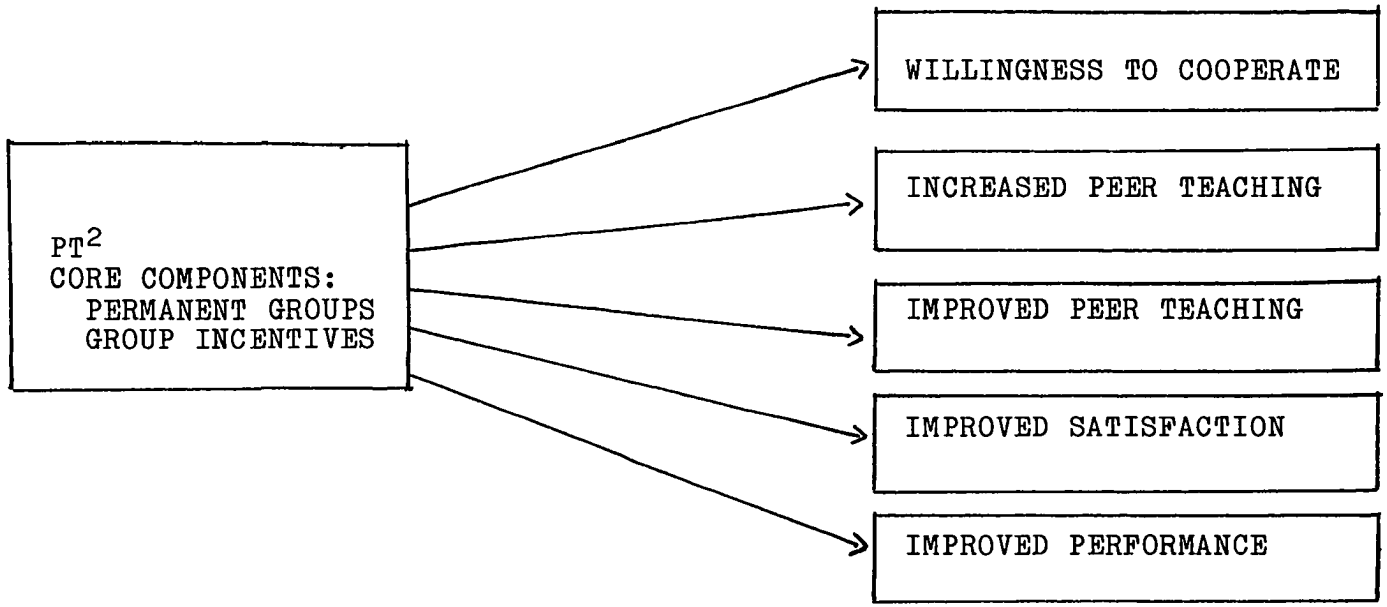


Figure 1. Conceptual Model of Peer Teaching in Permanent Project Teams (PT^2)

Hypothesis 1. There will be no significant difference in the willingness to cooperate between the groups in the PT^2 sections and the students assigned to lab tables in the comparison sections as perceived by individual students.

Hypothesis 2. There will be no significant difference in the perceived amount of assistance students receive from other students in the course between the PT^2 students and those in the comparison condition.

Hypothesis 3. There will be no significant difference in the perceived helpfulness of assistance students receive from other students in the course between the PT^2 students and those in the comparison condition.

Hypothesis 4. There will be no significant difference in satisfaction with the course due to the PT^2 condition.

Hypothesis 5. There will be no significant difference in performance on examinations between those students in the PT^2 condition and those in the comparison condition.

The method of empirically testing these hypotheses is explained in the following section.

Methodology

To test the hypotheses a quasi-experiment was designed (Campbell and Stanley, 1963). Since it was impossible to select subjects randomly to the experimental (PT^2) and control/comparison conditions, the assignment of these conditions to class sections of students was accomplished in a random manner. The students in both the

experimental and comparison sections were treated alike to the extent possible in every aspect of the course except the application of PT^2 to those in the experimental condition.

Subjects consisted of approximately 360 students in eighteen sections of an introductory Zoology course (laboratory sections) at a major southwestern university. Almost all of these students were university freshmen, a few were sophomores. The students self selected themselves to one of the sections. Eight Graduate Teaching Assistants taught two sections each. A coin toss determined which of each of these Graduate Teaching Assistants' sections was assigned to receive the PT^2 treatment; each Graduate Teaching Assistant's other section became a comparison section structured in the traditional manner. Two other Graduate Teaching Assistants taught one section each, again a coin toss determined which received PT^2 and which became a comparison section.

In each of the PT^2 sections data descriptive of the students was collected and used to form the permanent heterogeneous groups. This information included the student's name, I. D. number, academic level, age, major, native language, whether a member of a fraternity or sorority, and their rating of their high school biology course. The Graduate Teaching Assistants used this

information to form groups in which the members were more likely to have varying backgrounds, interests, and perceptions.

Procedure

The experimental (PT^2) and comparison sections were exposed to the same course material and took exams which, in the opinion of the coordinator of these sections, were standardized. All sections met in one of three identical laboratories. The composition and meeting time for each section is provided in Appendix I.

Since the students in the experimental sections were allowed to participate in the grade weighting exercise, it was thought that in the comparison sections students should have some influence on grade weighting. In the experimental sections group representatives negotiated the weighting of individual performance, group performance and peer evaluations. In the comparison sections the grade weights of exams, reports and Teaching Assistant points were determined by individual votes, mathematical averaging and rounding. The parameters for the grade weighting in the experimental (PT^2) sections are shown in Appendix II and for the comparison sections in Appendix III. The results of the grade weighting for all sections is provided in Appendix IV.

The students in all sections took twelve mini-tests, a mid-term and a final exam. In the experimental sections the groups took the mini-tests and the mid-term exam as a group after individuals had completed and turned in their mini-tests or the mid-term exam. The final exam was taken by individuals only, but the average score of each experimental group accounted for ten percent of the group performance factor of course grades. Peer evaluations were completed at mid-term and course end in experimental sections. Immediately following the mid-term and final exams the students completed a questionnaire designed to measure their perceptions of their group's cohesiveness and cooperation, quantity and quality of peer teaching, and their satisfaction with the course and class structure. The final questionnaire is provided in Appendix V.

Measures

The hypotheses as stated are intended to determine the potential of PT^2 as a means of gaining peer teaching and whether PT^2 results in improved performance and satisfaction of students. If a hypothesis fails to be rejected, then there is a good chance that PT^2 had little or no influence on the factor of that hypothesis. If a hypothesis is rejected that will indicate that PT^2 had an impact on the

factor of that hypothesis. The data and means of determining failure to reject or rejection of each hypothesis is discussed below.

Hypothesis 1. The tests of willingness to cooperate was an analysis of certain responses on the confidential questionnaire. Tests of significant statistical differences and analysis of variance were computed on several single cohesiveness and cooperation items on the questionnaire and on a cooperation composite of items in the questionnaire.

Hypothesis 2. A three item composite of items in the questionnaire was used for tests of significant difference in perceived amount of peer teaching perceived by students in the PT^2 condition compared to the amount perceived by students in the comparison condition. Test of significant statistical difference and analysis of variance were computed on these composite scores.

Hypothesis 3. A three item composite of items in the questionnaire was used for tests of significant difference in the perceived helpfulness (i.e., quality) of the peer teaching in the PT^2 condition compared to the perceived helpfulness of the peer teaching in the comparison condition. Test of significant statistical difference and analysis of variance were computed on these composite scores.

Hypothesis 4. A satisfaction scale adopted from the Job Diagnostic Survey (Hackman and Oldham, 1975) was included in a confidential questionnaire completed by all of the students during the next to last class meeting to measure possible differences in satisfaction between the PT^2 students and the comparison students. The mean of the PT^2 students' satisfaction scale scores was tested for significant difference from the mean of the comparison students' satisfaction scale scores. Then an analysis of variance on these mean scores was computed.

Hypothesis 5. The measure of performance is the composite score of the students' individual raw scores on the twelve mini-tests, the mid-term, and final exam from instructors' records. The mean of the composite scores of PT^2 students was then tested for significant difference from the mean of the composite scores of the comparison students. Then an analysis of the sources of variance of these means was computed.

A summary table of measures is presented in Table 3-1 with previous research source provided when appropriate.

Table 3-1: Summary Table of Measures

Hypothesis 1 -- Willingness to cooperate cohesiveness items on Mid-term Questionnaire:

First students were asked to write the first and last names of the other students assigned to their lab table. Then for tabulation purposes the items 23, 25 and 27 were asked.

Item: 23. How many of the other students, not including yourself, are assigned to your lab table?

25. Of the other students at your lab table, how many of them were you able to write their first and last name?

27. Of the other students at your lab table, how many of them were you able to write their first or last name?

Source: Schachter, 1959.

General cooperation item on Final Questionnaire

Item: 8. In general, how cooperatively do the students at you lab table work together?

1	2	3	4	5	6
Extremely well	Very well	Well	Fair	Not too well	Not well at all

Source: Adopted from Deutsch, 1968.

Items forming the Cooperation Composite

On the next four questions please estimate as closely as you can the percentages of 100 percent. (The sum of your percentages should equal 100% for each question)

About what percent did each of the following contribute to the determination of whether or not you studied the reading assignments.

1. The class/material was interesting _____
2. The instructor expected it _____
3. Feelings of responsibility for others at your lab table _____
4. Expectations of the students at your lab table _____
5. To help earn a better grade _____

Total 100%

About what percent did each of the following contribute to the determination how much effort you put into the course?

1. The class/material was interesting _____
2. The instructor expected it _____
3. Feelings of responsibility for others at your lab table _____
4. Expectations of the students at your lab table _____
5. To help earn a better grade _____

Total 100%

About what percent did each of the following contribute to the determination of whether or not you attended class, particularly on days when you had (or could have had) a good reason not?

1. The class/material was interesting _____
2. The instructor expected it _____
3. Feelings of responsibility for others at your lab table _____
4. Expectations of the students at your lab table _____
5. To help earn a better grade _____

Total 100%

About what percent did each of the following contribute to your performance on quizzes and exams.

1. The class/material was interesting _____
2. The instructor expected high performance _____
3. Feelings of responsibility for the other students at your lab table _____
4. Help received from the other students at my lab table _____
5. The students at my lab table expected high performance _____
6. My drive to earn a high grade _____

Total 100%

Hypothesis 2 -- Increased Peer Teaching Composite Items on the Final Questionnaire:

Item: 1. How often do students that work at your lab table meet to study Zoology 1121 outside of class (including attending Phylum room with another student(s)?

1	2	3	4	5
Several times a week	Once a week	Three to five times this semester	Once or twice this semester	Never

3. How often do you receive assistance from another student(s) at your lab table in understanding a lab exercise?

1	2	3	4
Several times per lab meeting	At least once every lab meeting	Almost every lab meeting	Frequently (example, once every 2nd or 3rd lab meeting)

5	6
Very rarely (example, once or twice that you remember)	Never

6. How often do you discuss the Phylum room displays with the other students(s) from your table?

1	2	3	4
Several times per lab meeting	At least once every lab meeting	Almost every lab meeting	Frequently (example, once every 2nd or 3rd lab meeting)

5	6
Very rarely (example, once or twice that you remember)	Never

Hypothesis 3 -- Improved Peer Teaching Composite Items on the Final Questionnaire (followed the related increased peer teaching items immediately as indicated by item numbers):

Item: 2. How helpful have these meetings been in understanding the course material?

1	2	3	4
Extremely helpful	Very helpful	Helpful	Not too helpful

5	6
Not at all helpful	Harmful

4. How helpful is the assistance and/or discussions with other other students from your lab table in learning the course material?

1	2	3	4
Extremely helpful	Very helpful	Helpful	Not too helpful

5	6
Not at all helpful	Harmful

7. How helpful have these discussions been in understanding the course material?

1	2	3	4
Extremely helpful	Very helpful	Helpful	Not too helpful

5	6
Not at all helpful	Harmful

Hypothesis 4 -- Satisfaction Scale Items on Final Questionnaire:

Now please indicate how satisfied you are with each aspect of this class listed below. Once again, write the appropriate number in the blank beside each statement.

How satisfied are you with this aspect of this class?

1 Extremely Dissatisfied	2 Dissatisfied	3 Slightly Dissatisfied
4 Slightly Satisfied	5 Satisfied	6 Extremely Satisfied

_____ 31. The people I talk to and work with.

_____ 32. The degree of respect and fair treatment I receive from my Teaching Assistant.

_____ 33. The feeling of worthwhile accomplishment I get from doing my class work.

_____ 34. The chance to get to know other people while working in class.

_____ 35. The amount of support and guidance I receive from my Teaching Assistant.

_____ 36. The chance to help other people in the class.

_____ 37. The amount of challenge in my class work.

_____ 38. The overall quality of instruction I receive in class.

Source: Adopted from Hackman & Oldham's Job Diagnostic Survey, 1975.

Hypothesis 5 -- Measures of Performance were the individual student's actual mini-test, mid-term exam and final exam scores.

Source: Graduate Teaching Assistants' and Course Coordinator's records.

Cronbach Alphas were computed on composite items as test of internal reliability. The results of these tests of the hypotheses are reported in the Chapter IV. Table 3-1 summarizes all of the measures of the formal hypothesis tested. Additionally, correlations between certain items, composites and certain items to composities were computed. These correlations are analyzed for potential relationships between the variables effected by PT^2 (i.e., potential relationships between: willingness to cooperate, increased peer teaching, improved peer teaching, student satisfaction, student performance).

CHAPTER IV

RESULTS OF THE STUDY

This chapter reports the results of the statistical analysis of the data for each hypotheses. The conceptual model of PT^2 suggests that the application of PT^2 may lead to willingness to cooperate in the project teams, increased and improved peer teaching, and improved individual performance and satisfaction of the students in the PT^2 condition. To preserve the flow of the PT^2 conceptual model the results of the hypotheses testing will be presented in the same sequence as the statements of the hypotheses.

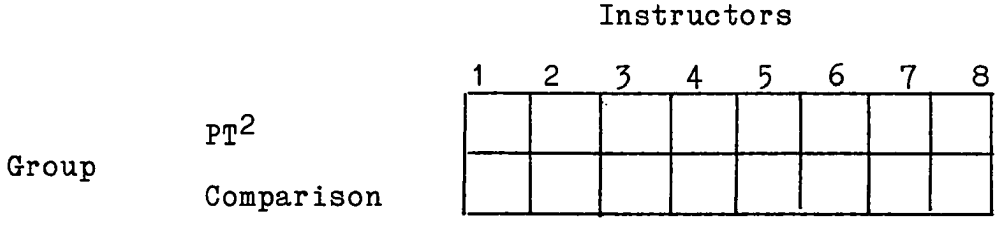
Statistical Techniques Used

T-Test. The t-tests performed in this study are the Aspin-Welch or adjusted t in the T Test Procedure of the Statistical Analysis System User's Guide, 1979. This procedure is designed to compare group means of scores on the same items in the data and adjust for unequal sample (n)

sizes and unequal variances in the data between groups. The procedure is appropriate for this study since the comparisons are the mean score of PT^2 students to the mean score of comparison students on identical items and the sample (n) sizes are not equal.

Analysis of Variance (ANOVA). The ANOVAs performed in this study are from the GLM Procedure in the Statistical Analysis System User's Guide, 1979. Since this is an exploratory study the Type I Sum of Squares test is appropriate (Herr and Gaebelin, 1978). Type IV SS measures sums of squares and each variable due to adding that variable last. In other words, Type I SS measures the effects on variance by adding a variable in the presence of another variable which is being treated as constant. Type IV SS measures the effects on variance of adding a variable in the presence of all the variables.

In this study the instructors (Columns) and Group (rows, either PT^2 or comparison group) are treated as main effects.



The Type I SS treats the effect of instructors as constant then adds the effect of group and finally adds the effect of interaction between instructors and group. The Type IV SS measures the effect of adding each variable last, e.g., instructors, interaction then group. Type IV offers the advantage of leaving the least possible amount of variability in the estimate of error variance. According to Herr and Gaebelin (1978) these model comparisons are appropriate for exploratory research and do not depend on equal cell sizes and tests are of the standard parametric form of no difference in row or column main effects.

Internal Test of Reliability. Several composites of items on the questionnaire were formed for testing the hypotheses. The Alpha procedure in the Statistical Package for the Social Sciences, Update (1981) was used to test the internal consistency reliability of these items for measuring the same factor. The alpha for each composite of items is reported in the appropriate sections which follow.

Willingness to Cooperate

The questionnaire students responded to seven weeks into the semester contained two items which effectively measure cohesiveness in the "feeling of belonging" sense. In a question which asked the students how willing they

would be to transfer to another lab table, the mean response of the PT^2 students indicated they were significantly less willing to transfer than the comparison students (see Table 4-1). Further, the PT^2 students were able to write more of their team members names than were the comparison students. Items similar to these were used by Deutsch (1968) to determine extent of group cohesiveness (See Table 4-1).

A straight forward item which asked, "In general, how cooperatively do the students at your lab table work together?", was used in the fifteenth (final) week to measure differences in cooperation. This measure indicates significantly more cooperation among the PT^2 students than the comparison students (see Table 4-2). An analysis of variance on this item indicates PT^2 and PT^2 in interaction with the instructor significantly effected the variance of responses (Table 4-3).

An additional measure of cohesiveness/cooperation was a composite of several factors taken from sets of items on the questionnaire. These items ask the students to estimate, as closely as they could, the percentage of 100 percent various factors contributed to the students: studying the reading assignments, determination of effort they put into the course, determination of whether they

attended class particularly on days when they had (or could have had) a good reason not to, and performance on quizzes and exams. Reliability and understandability problems appeared with the effort items and they were eliminated from further analysis.

The factors to which students were to assign percentages were:

1. The class/material was interesting.
2. The instructor expected it.
3. Feelings of responsibility to others at your lab table.
4. Expectations of the students at your lab table.
5. To help earn a higher grade.

A sixth factor, "Help received from the other students at my lab table," was included in the performance item. The PT^2 students assigned significantly higher percentages to the factors of "feelings of responsiblity to.." and "expectations of" others at their lab table (cohesiveness/ cooperation factors) on each of the items than did the comparison students. On the performance item, the PT^2 students, again, assigned a significantly higher percentage to the "help" from others at their lab table factor (another cohesiveness/cooperation factor), than did the comparison students (results in Table 4-4).

An analysis of variance was computed on a composite of these cohesiveness/cooperation factors. The test of

internal reliability on this composite of items computed a 0.889 cronbach alpha. The ANOVA results indicate that both the interaction of the condition and the instructor and whether or not the students were in the PT^2 or comparison condition significantly affected the variance on this composite (complete results in Table 4-6). Correlations between this composite and the items in it are provided in Table 4-5.

Table 4-1: Results of Aspin-Welch T-Test on Individual Cohesiveness Items

1. How willing would you be to transfer to another lab work table?
27. Of the other students at your work table, how many of them were you able to write their first or last names?

Item	N	Mean	T	Probability > |t|
1.				
Comparison	135	3.37	-2.65	0.009
PT^2	148	3.71		
27.				
Comparison	98	2.37	-6.51	0.000
PT^2	128	3.27		

Table 4-2: Results of Aspin-Welch T-Test on a Single Item of Cooperation

	N	Mean	Std. Dev.	T	Probability > |t|
Comparison Students	122	2.418	1.14	2.3566	.0197
P_T^2 Students	138	2.094	1.07		

Table 4-3: Results of Analysis of Variance on a Single Item of Cooperation

SOURCE	DEGREES OF FREEDOM	MEAN SQUARES	F VALUE	PROBABILITY > F
MODEL	15	2.459	2.06	0.0130
ERROR	212	1.193		
		TYPE I SUM OF SQUARES		
CLASS	7	5.243	0.63	0.7342
GROUP	1	10.683	8.96	0.0031
INTERACTION	7	20.954	2.51	0.0170
		TYPE IV SUM OF SQUARES		
CLASS	7	7.664	0.92	0.4943
GROUP	1	14.757	12.37	0.0005
INTERACTION	7	20.954	2.51	0.0170

Table 4-4: Results of Aspin-Welch T-Test on Composite of Cohesiveness/Cooperation Items and Individual Questionnaire Items

COMPOSITE	N	MEAN	STD. DEV.	T	PROBABILITY > |t|
COMPARISON STUDENTS	121	4.699	5.07	-10.7029	0.0001
PT^2 STUDENTS	136	13.859	8.11		
ITEMS					
Item R3 COMPARISON	121	5.64	7.35	- 8.46	0.0001
PT^2	136	15.76	11.18		
Item R4 COMPARISON	121	4.72	5.86	- 8.09	0.0001
PT^2	136	13.04	9.87		
Item R13 COMPARISON	119	4.95	6.24	- 9.53	0.0001
PT^2	136	20.39	16.69		
Item R14 COMPARISON	119	4.55	6.38	- 7.64	0.0001
PT^2	136	14.28	12.56		
Item R18 COMPARISON	119	3.71	5.66	- 8.52	0.0001
PT^2	136	12.73	10.27		
Item R19 COMPARISON	119	5.20	7.56	- 4.66	0.0001
PT^2					
Item R20 COMPARISON	119	3.62	5.39	- 7.52	0.0001
PT^2	136	10.90	9.27		

Table 4-5: Correlations of Willingness to Cooperate Composite with the Items in the Composite

Cooperate Composite	1. *(0.89)	2.	3.	4.	5.	6.	7.	8.
Item R3	0.85	1.00						
Item R4	0.85	0.67	1.00					
Item R13	0.76	0.67	0.50	1.00				
Item R14	0.83	0.60	0.80	0.48	1.00			
Item R18	0.85	0.75	0.66	0.64	0.60	1.00		
Item R19	0.62	0.42	0.50	0.27	0.49	0.45	1.00	
Item R20	0.75	0.52	0.70	0.37	0.63	0.58	0.52	1.00

*Cronbach Alpha

Table 4-6: Results of Analysis of Variance on Composite of Cohesiveness/Cooperation Items

SOURCE	DEGREES OF FREEDOM	MEAN SQUARES	F VALUE	PROBABILITY > F
MODEL	15	303.299	6.69	0.0001
ERROR	208	45.361		
		TYPE I SUM OF SQUARES		
CLASS	7	297.096	0.94	0.4807
GROUP	1	3897.273	85.92	0.0001
INTERACTION	7	355.117	1.12	0.3526
		TYPE IV SUM OF SQUARES		
CLASS	7	275.977	0.87	0.5329
GROUP	1	3970.930	87.54	0.0001
INTERACTION	7	355.117	1.12	0.3526

Based on all the results in this section, the hypothesis (1) that there would be no difference in group cohesiveness/willingness to cooperate between students in the PT^2 condition and those in the comparison condition is rejected.

Quantity of Peer Teaching

To determine whether there was any difference in the quantity of peer teaching which occurred in the PT^2 and comparison conditions a composite of three items on the questionnaire was analyzed. These items ask the students how frequently they engaged in certain activities which represent peer teaching. The activities were: (1) meeting with other students from their lab table outside of class to study Zoology, (2) receiving assistance from another student at their lab table in understanding a lab exercise and (3) discussing visual displays (in Phylum room) with other students from their lab table. The cronbach alpha for the composite of these items was 0.566. Although this is relatively low, it is still logical that all of these activities represent a form of peer teaching. The low cronbach alpha may be due to the students feeling that if they engaged in one of these activities there was no need to engage in the others.

The t-test on this composite indicates a significant difference at the 0.08 alpha level (see Table 4-7). The PT^2 students mean scores indicated more peer teaching for each of these items but the difference was not statistically significant. Correlations between this composite and the items in it are provided in Table 4-8.

Table 4-7: Results of Aspin-Welch T-Test on Composite of Quantity of Peer Teaching Items and Individual Questionnaire Items

COMPOSITE	N	MEAN	STD. DEV.	T	PROBABILITY 1t1
COMPARISON STUDENTS	122	3.54	1.05	1.77	0.08
PT^2 STUDENTS	138	3.33	0.86		
ITEMS					
Item 1 COMPARISON	122	3.64	1.35	1.08	0.29
PT^2	138	3.49	0.92		
Item 3 COMPARISON	122	3.31	1.39	1.15	0.25
PT^2	138	3.12	1.36		
Item 6 COMPARISON	122	3.66	1.48	1.60	0.11
PT^2	138	3.38	1.31		

Table 4-8: Correlations of Quantity of Peer Teaching Composite with the Items in the Composite.

Quantity of PT	1.	2.	3.	4.
1. Composite	*(0.57)			
2. Item 1	0.62	1.00		
3. Item 3	0.74	0.15	1.00	
4. Item 6	0.82	0.31	0.43	1.00

*Cronbach Alpha

In the analysis of variance on this quantity (amount) of peer teaching composite, both the interaction effect and the effect of being in a PT^2 or comparison group, indicated a significant difference (see Table 4-9). The results imply that the interaction of an instructor and the use of PT^2 most significantly affect the quantity of peer teaching which will occur. This may be due to varing skill levels of the instructors to administer the PT^2 process. Or it may be a reflection of compatability or incompatability of individual instructional style and requirements of the PT^2 process.

Table 4-9: Results of Analysis of Variance on Composite of Quantity of Peer Teaching Items

SOURCE	DEGREES OF FREEDOM	MEAN SQUARES	F VALUE	PROBABILITY > F
MODEL	15	2.186	2.63	0.0012
ERROR	212	0.831		
		TYPE I SUM OF SQUARES		
CLASS	7	7.042	1.21	0.2975
GROUP	1	4.167	5.02	0.0262
INTERACTION	7	21.575	3.71	0.0009
		TYPE IV SUM OF SQUARES		
CLASS	7	8.538	1.47	0.1792
GROUP	1	9.283	11.17	0.0010
INTERACTION	7	21.575	3.71	0.0009

Based on the results in this section there is conflicting evidence on the hypothesis (2) that there is no difference in the quantity of peer teaching which will occur among students in the PT^2 condition and those in the comparison condition. The conflicting evidence leaves the results of hypothesis testing on hypothesis 2 inconclusive.

Quality of Peer Teaching

To determine whether there was any difference in the quality of peer teaching which occurred in the PT^2 and comparison conditions a composite of the items which followed immediately the quantity of peer teaching items was analyzed. These items ask the students how helpful the: (1) outside meetings with other students from the lab table was in understanding the course material, (2) assistance and/or discussions with other students from their lab table were in learning the course material, and (3) discussions of the visual displays in the Phylum room were in understanding the course material. The cronbach alpha for this composite, again, was low, 0.565, probably related to the problem with the quantity of peer teaching composite.

The t-test on this composite indicates no significant difference (see Table 4-10). The analysis of variance on this quality composite indicates that the model

and therefore, neither of the main effects were not significant on the quality of peer teaching composite (see Table 4-12). Correlations between this composite and the items in it are provided in Table 4-11.

Table 4-10: Results of Aspin-Welch T-Test on Composite of Quality of Peer Teaching Items and Individual Questionnaire Items

	N	MEAN	STD. DEV.	T	PROBABILITY > 1t1
COMPARISON STUDENTS	56	2.88	0.75	0.21	0.84
PT^2 STUDENTS	101	2.85	0.76		
ITEMS					
Item 2 COMPARISON	69	3.20	1.15	0.83	0.41
PT^2	106	3.07	0.93		
Item 4 COMPARISON	106	2.87	0.91	1.30	0.20
PT^2	116	2.71	0.94		
Item 7 COMPARISON	91	3.17	0.93	1.39	0.17
PT^2	114	2.99	0.96		

Table 4-11: Correlations of Quality of Peer Teaching Composite with the Items in the Composite

Quality PT	1.	2.	3.	4.
1. Composite	*(0.57)			
2. Item 2	0.81	1.00		
3. Item 4	0.79	0.41	1.00	
4. Item 7	0.84	0.51	0.58	1.00

*Cronbach Alpha

Table 4-12: Results of Analysis of Variance on Composite of Quality of Peer Teaching Items

SOURCE	DEGREE OF FREEDOM	MEAN SQUARES	F VALUE	PROBABILITY > F
MODEL	15	0.605	1.08	0.3799
ERROR	141	0.560		
		TYPE I SUM OF SQUARES		
CLASS	7	5.184	1.32	0.2429
GROUP	1	0.025	0.04	0.8340
INTERACTION	7	3.860	0.99	0.4550
		TYPE IV SUM OF SQUARES		
CLASS	7	5.973	1.52	0.1620
GROUP	1	0.605	1.08	0.3000
INTERACTION	7	3.860	0.99	0.4550

Based on the results in this section the hypothesis (3) that there will be no difference in the quality (helpfulness) of peer teaching which occurred in the PT^2 condition and that which occurred in the comparison condition is rejected. Additionally, both the effect of whether the students were in the PT^2 or comparison condition and the interaction effect were significant.

Improved Satisfaction

To determine any difference in satisfaction with the course between the PT^2 and comparison students a composite of items from the satisfaction scale items found in the "Job Diagnostic Survey" (Hackman, J. and Oldham, G., 1975) was included in the questionnaire. Certain of the individual items from this composite of items showed a significant difference (at the 0.05 level). PT^2 students indicated they were more satisfied with: (1) the people they talked to and worked with, (2) their feeling of worthwhile accomplishment, (3) the chance to get to know other people while working in class, and (4) the chance to help other people in class. The items for which there was no significant difference in satisfaction concerned the challenge of the course work and quality of instruction.

The alpha for this satisfaction composite was 0.8382 as compared with the 0.76 Hackman and Oldham (1975) computed while developing the "Job Diagnostic Survey". However, using this composite as a measure of overall satisfaction with the course indicated no significant difference between the PT^2 and comparison students (see Table 4-13). An analysis of variance on this satisfaction composite showed no significant difference due to the ANOVA model (see Table 4-15). Correlations of this composite and the items in it are provided in Table 4-14.

Table 4-13: Results of Aspin-Welch T-Test on Composite of Satisfaction with the Course Items and Individual Questionnaire Items in this Composite

COMPOSITE	N	MEAN	STD. DEV.	T	PROBABILITY > 1t1
COMPARISON STUDENTS	122	3.80	0.32	0.27	0.37
PT^2 STUDENTS	138	3.76	0.92		
ITEMS					
Item 31 COMPARISON	122	4.66	1.06	-1.90	0.058
PT^2	138	4.91	1.05		
Item 32 COMPARISON	122	4.97	1.02	-0.86	0.39
PT^2	138	5.09	1.06		
Item 33 COMPARISON	121	4.17	1.11	-2.08	0.04
PT^2	138	4.44	1.03		
Item 34 COMPARISON	122	4.38	1.10	-3.13	0.002
PT^2	138	4.78	0.97		
Item 35 COMPARISON	122	4.69	1.15	-0.97	0.33
PT^2	138	4.83	1.12		

Table 4-13: (Cont'd)

ITEMS	N	MEAN	STD. DEV.	T	PROBABILITY > 1t1
Item 36					
COMPARISON	121	4.29	0.88	-2.99	0.003
PT^2	138	4.62	0.87		
Item 37					
COMPARISON	120	4.58	1.12	-0.09	0.93
PT^2	138	4.59	1.14		
Item 38					
COMPARISON	120	4.60	1.29	-1.86	0.06
PT^2	138	4.88	1.14		

Table 4-14: Correlations of Satisfaction Composite with the Items in the Composite

Satisfaction	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Composite	*(0.84)								
2. Item 31	0.50	1.00							
3. Item 32	0.75	0.24	1.00						
4. Item 33	0.69	0.16	0.45	1.00					
5. Item 34	0.66	0.44	0.34	0.32	1.00				
6. Item 35	0.81	0.23	0.83	0.49	0.40	1.00			
7. Item 36	0.62	0.27	0.27	0.35	0.47	0.38	1.00		
8. Item 37	0.61	0.13	0.27	0.44	0.34	0.33	0.39	1.00	
9. Item 38	0.79	0.27	0.65	0.48	0.33	0.73	0.32	0.41	1.00

*Cronbach Alpha

Table 4-15: Results of Analysis of Variance on Composite of Satisfaction with the Course Items

SOURCE	DEGREE OF FREEDOM	MEAN SQUARES	F VALUE	PROBABILITY > F
MODEL	15	1.4886	1.65	0.0634
ERROR	212	0.0903		
		TYPE I SUM OF SQUARES		
CLASS	7	1.2271	1.94	0.0642
GROUP	1	0.1494	1.65	0.1997
INTERACTION	7	0.8663	1.35	0.2254
		TYPE IV SUM OF SQUARES		
CLASS	7	1.1604	1.84	0.0813
GROUP	1	0.2537	2.81	0.0952
INTERACTION	7	0.8663	1.35	0.2254

Based on the results in this section the hypothesis (4), that there will be no difference in overall satisfaction with course between students in the PT^2 condition and students in the comparison condition, fails to be rejected.

Improved Performance

The results of twelve mini-tests, the mid-term exam and the final exam were combined as a composite for determining if there was any difference in performance between PT^2 and comparison students. The scores on the twelve mini-tests (averaged), the mid-term, and the final are the factors examined separately in Table 4-16.

A t-test on this performance composite indicated a statistically significant difference with PT^2 students out performing the comparison students (see Table 4-16). The analysis of variance on this composite indicated the model had a significant affect on performance with the effect of being in the PT^2 or comparison condition and the interaction effect of these groupings and the instructor being significant (see Table 4-18).

When the mini-tests, mid-term exam and final exam are viewed independent of each other the mean scores of PT^2 students were higher than the comparison students' mean

scores. However, the statistical significance was strongest for the quizzes (0.0264). The difference is significant for the mid-term exam at the 0.1171 level and significant for the final at the 0.3739 level. Correlations of this composite and the factors in it are provided in Table 4-17.

Table 4-16: Results of Aspin-Welch T-Test on Composite of Overall Performance in the Course and Individual Performance Factors

COMPOSITE	N	MEAN	STD. DEV.	T	PROBABILITY > 1t1
COMPARISON STUDENTS	139	67.71	15.38	-1.9485	0.05
PT^2 STUDENTS	149	70.88	12.12		
Mini-Tests COMPARISON	142	71.27	15.51	-2.24	0.03
PT^2	149	74.86	11.57		
Mid-Term COMPARISON	142	67.32	19.57	-1.57	0.12
PT^2	149	70.62	15.96		
Final COMPARISON	139	61.07	18.34	0.89	0.37
PT^2	149	62.87	15.76		

Table 4-17: Correlations of Overall Performance Composite with the Performance Factors in the Composite

	PERFORMANCE	1.	2.	3.	4.
1.	Composite	1.00			
2.	Mini-tests	0.83	1.00		
3.	Mid-term	0.92	0.65	1.00	
4.	Final	0.91	0.62	0.78	1.00

Table 4-18: Results of Analysis of Variance on Composite of Overall Performance in the Course

SOURCE	DEGREE OF FREEDOM	MEAN SQUARES	F VALUE	PROBABILITY > F
MODEL	15	412.1094	2.20	0.0070
ERROR	238	187.0238		
		TYPE I SUM OF SQUARES		
CLASS	7	1279.5703	0.98	0.4489
GROUP	1	692.9903	3.71	0.0554
INTERACTION	7	4209.0802	3.22	0.0029
		TYPE IV SUM OF SQUARES		
CLASS	7	1194.6760	0.91	0.4982
GROUP	1	968.3941	5.18	0.0238
INTERACTION	7	4209.0802	3.22	0.0029

Table 4-19: Correlations Between Primary Measures (Cronbach Alphas on Diagonal)

		1.	2.	3.	4.	5.	6.
1.	Cooperative Composite	*(0.89)					
2.	Cooperation Item	0.18					
3.	Quantity of PT	0.22	0.45	*(0.57)			
4.	Quality of PT	0.29	0.44	0.72	*(0.57)		
5.	Satisfaction Composite	0.11	0.28	-0.09	-0.14	*(0.84)	
6.	Performance Composite	0.21	-0.06	0.02	0.05	0.18	1.00

*Cronbach Alphas

Based on the results reported in this section the hypothesis (5) that there will be no difference in overall performance in the course between students in the PT^2 condition and students in the comparison condition is rejected.

Correlation between all of the primary measures are provided in Table 4-19. As would be expected there is a very strong correlation between quantity and quality of peer teaching. The only other notable correlations are between the general cooperation item with both quantity of peer teaching (0.45) and quality of peer teaching (0.44). These correlations confirm the findings in the "Group Dynamics" literature that group members who cooperate are more willing to help one another. A discussion of the results provided in this chapter and the general conclusions drawn from these results are presented in Chapter V.

CHAPTER V

GENERAL CONCLUSIONS AND DISCUSSION

The objectives of this study were to determine whether the application of PT^2 would result in greater group willingness to cooperate than in a comparable situation in which PT^2 was not applied. Further objectives were to determine whether the application of PT^2 effects the quantity and/or quality of peer teaching. Final objectives were to determine whether this process results in improved performance in the course and/or satisfaction with the course. An additional objective was to observe any differences in certain non-performance behaviors between students in the PT^2 situation and those in the comparison condition. These objectives were achieved to the various extents indicated in the following conclusions.

Conclusions

The conclusions in this section are based upon the results reported in the previous chapter and the methodology of this study reported in Chapter Three. For continuity the conclusions will be presented in the same order as the results were presented in Chapter Four.

Group Cohesiveness/Willingness to Cooperate

The statistical analysis of the questionnaire data indicated that the PT^2 groups were significantly more cohesive and coperative than were the students who worked together at lab tables in the comparison situation. Thus it appears that assigning students to permanent, heterogeneous project teams and treating them as teams leads to more cohesiveness and cooperation among the students. The result is very strong in light of the fact that the comparison students were assigned to lab tables as opposed to sitting in rows of desks as is typical in lecture type sections.

The analysis of variance test on the single general cooperation item indicates that the interaction effect of being in the PT^2 or comparison situation with a particular instructor significantly affected cooperation among the students. This result lends credibility to a conclusion

that the instructor who administers PT^2 may influence the extent of cooperation in the project teams, since the instructor is the only other main effects variable.

The evidence strongly supports a conclusion that PT^2 is capable of gaining significantly greater group cooperation from PT^2 students than comparison students in educational settings. Further the evidence supports a conclusion that the person administering PT^2 in interaction with PT^2 will modify the degree of cooperation obtained in the project teams.

Quantity of Peer Teaching

The statistical test for significant difference in the amount of peer teaching in the PT^2 condition revealed no significant difference. The descriptive statistics (means) of the composite on each of the items in the composite, however, indicated slightly more of the peer teaching activities occurred in the PT^2 condition. There are several issues in the methodology which may have clouded the results in testing this hypothesis. These issues include: (1) the lack of strong differentiation in the class setting between the PT^2 and comparison conditions, (2) the lack of a more sophisticated methodology for measuring the occurrence of peer teaching.

Lack of differentiation. The comparison condition was the traditional method of teaching the Zoology lab sections. The traditional method consisted of assigning the students to a lab table and pairing them up with another student as a lab partner to share lab equipment and work together. This method contains some of the essence of the PT^2 permanent project teams and may encourage some degree of peer teaching. Additionally, the labs were taught, three in a simultaneous time slot in three identical rooms located next to each other. This situation made it easy for the comparison students to learn that some of the other labs were working in teams and may have encouraged them to work together more than they would have without this knowledge.

Instructor influence. The analysis of variance on the quantity of peer teaching composite revealed that interaction effect of instructor and condition (PT^2 or comparison) influenced the quantity of peer teaching.

This result is substantiated by the mean scores on the quantity of peer teaching items by section. The mean scores of PT^2 and comparison section of the same instructor were not much different, but usually indicated slightly more peer teaching in the PT^2 section. Yet, the mean scores between the sections of different instructors were varied. This strongly suggests that the way some instructors conduct

their class may encourage peer teaching, while the way other instructors conduct their class may discourage peer teaching. This researcher believes that most of this effect could be explained by the willingness of the instructors to use PT^2 to its fullest potential. The only support for this belief is observation by myself, Dr. Michaelsen and the course coordinator of the varied degrees of willingness to try PT^2 by the instructors.

Lack of sophisticated measures. This was a very early and admittedly primative attempt to measure occurance of peer teaching. There is a definite need to develop sophisticated measures of peer teaching. It is suggested that although the results of this study do not clearly indicate greater amounts of peer teaching in the PT^2 condition, the data did tend in that direction and certainly further research is merited. The opinion of this researcher is that PT^2 has great potential for encouraging peer teaching. However, an instructor using PT^2 to gain more peer teaching should not depend entirely on the PT^2 technique but must personally encourage peer teaching, provide plenty of opportunities for the occurrence of peer teaching, and communicate the benefits of peer teaching for all types of students.

An additional observation indicates that PT^2 students may have engaged in more peer teaching. Students in all the sections were invited to a one time voluntary review session for the final exam. The students signed in as they entered the review session and were identified as either a PT^2 or comparison student by different colored name tags. Although more of the comparison students (90 comparison to 70 PT^2) attended the review, observations revealed that more of the PT^2 students (52 PT^2 to 17 comparison) were working in groups.

Quality of Peer Teaching

The statistical test on the quality of peer teaching indicated no significant difference in the perceived helpfulness of assistance from the other students at their lab table between the students in the PT^2 condition and those in the comparison condition. Overall the students in the PT^2 condition perceived the assistance they received from other students at their lab table as being no more helpful than the degree of helpfulness reported by the comparison students on assistance they received from the other students at their lab table.

The analysis of variance on this quality of peer teaching composite indicated that neither the condition (PT^2

or comparison) nor a particular instructor interacting with the condition influenced the quality of peer teaching perceived by the students. However, on the mid-term questionnaire the comparison students, as well as the PT^2 students, reported that the assistance they received from others at their lab table was significantly more helpful than assistance they received from other students in the course but not assigned to their lab table. A final point applicable to this issue is that a t-test on a single item from the satisfaction scale indicates that the PT^2 students were significantly more satisfied than were the comparison students with the opportunities to help others in the class. It is logical to assume that if the opportunities to help were more satisfactory, this may very well affect the quality of the help.

Improved Satisfaction

The statistical tests on the satisfaction scale (composite) indicated no significant difference in satisfaction with the course between PT^2 students and comparison students. Some of the single items of satisfaction indicate significantly greater satisfaction among PT^2 students than among comparison students. None of the single items indicated more satisfaction among

comparison students, regardless of whether the differences were statistically significant. Yet, the tests for difference on the satisfaction scale (composite) indicates no significant statistical difference.

One of the most plausible explainations of this result is that the single items which indicated significant differences were countered by those which did not. It is interesting to note that the items which did not indicate significant differences concerned satisfaction with (1) degree of respect and fair treatment, and (2) amount of support and guidance, received from the instructor. It is highly probable that since each of eight instructors taught both a comparison and a PT^2 section that the students in both of these sections perceived of the instructor very similarly as far as the satisfaction items in the scale are concerned (this is a methodological problem which was identified too late). It seems reasonable that if the items concerning the instructor had not been asked, the statistical test may very well have indicated greater satisfaction on the part of the PT^2 students.

The tests of the satisfaction scale does reveal a very interesting result. While cohesiveness/cooperation and quality of peer teaching were influenced by the interaction of the instructor and the condition (PT^2 or comparison),

satisfaction was influenced by the instructor and the condition independently but not in interaction. This indicates that students may perceive satisfaction with the instructor and not with other aspects of the course or vice versa.

This reasoning was supported by the results on an end of semester course evaluation the students completed for the College of Arts and Sciences. In comparing PT^2 sections to the comparison section with the same instructor, the instructor was rated higher than other instructors the students had by the PT^2 students more substantially than by the comparison students for seven out of eight instructors (composite means: PT^2 = 2.09, comparison = 2.32; difference = 0.23). While the comparison of course with other university courses taken was rated more favorably by the PT^2 students in only six out of eight section comparisons and by a much less composite mean difference (composite means: PT^2 = 2.67, comparison = 2.74; difference = 0.07). Perhaps more legitimately comparable to the satisfaction items concerning the instructor was a rating of how effectively the instructor taught the course. In comparing this rating the PT^2 sections rated the instructor higher in eight out of eight comparisons (composite means: PT^2 = 1.57, comparison = 2.04; difference = 0.47).

Even though the hypothesis that there will be no significant difference in satisfaction with the course between PT^2 and comparison students failed to be rejected in this study, close examination of the measuring instrument and some conflicting results make this result suspect. After reexamination this researcher believes that at best the results of testing for differences in satisfaction in this study are inconclusive.

Improved Performance

The statistical tests indicated that the PT^2 students significantly outperformed the comparison students on quizzes and exams. While this three point difference was statistically significant, some may question its value from a practical point of view (because of overlaps in standard deviations). I consider this a valid observation; however, there were several factors which may have caused this difference to be even greater.

First, three of the comparison students who received a grade in the course failed to take the final exam. If the performance calculations had considered these as zeros instead of missing data the difference would have been increased by one half of a point. Second, eleven of the comparison students dropped the course prior to mid-term

because of grade difficulties in the course, compared to only two PT^2 students who exercised this option for the same reason. It is not unreasonable to predict that had all of these students remained in the course, the difference could have been increased. Finally, it is reasonable to suggest that several of the PT^2 students who did not perform well on the quizzes and exams may have dropped the course if it had not been for the PT^2 grading system. This system included team performance on mini-tests, team performance on lab reports, and peer evaluations among team members in the course grade. It is very possible that had these students not have had these team factors to bring their potential course grade up, they would have dropped the course prior to mid-term. If these students had dropped the course prior to mid-term their scores on quizzes and exams would not have been calculated in with the other PT^2 students and very likely would have increased the difference in performance even more in favor of the PT^2 students. It appears to this researcher that the above factors are realistic in that they could have had a substantial impact on the performance outcome which would have favored the PT^2 students.

Another factor which may have helped the PT^2 students performance was the additional practice they received by completing the mini-tests and mid-term in groups

after completing them individually. This practice effect was not controlled for but may be considered a part of the PT^2 technique.

Frequency distributions of all primary measures are provided in Appendices V through X. These distributions may be helpful to readers attempting to ascertain practical or useful differences attained when using PT^2 by comparing overlaps in the distributions of the comparison and PT^2 students. This researchers opinion is that the interpretation of overlaps will agree with the findings of statistical significant differences. However, the amount of overlap in both the performance and satisfaction with the course measures suggest that a decision to adopt PT^2 primarily to improve performance or satisfaction may be disappointing, since, the evidence in this study is not strong enough to make a recommendation to use PT^2 primarily for these purposes.

Non-Performance Behaviors

Certain non-performance behaviors other than satisfaction were expected to be modified by PT^2. Since differences in these behaviors were not specifically tested, they were not reported in Chapter IV but are reported here

instead. The reports here are based upon the instructors' records and observations.

Rate of withdrawal from the course. Students at the university where the study was conducted are allowed to withdraw from courses during the first three weeks of class without the instructor's permission; therefore, the instructors' records reported here reflect withdrawals after the third week of classes. The instructors' records report six PT^2 students withdrew after the third week of class compared to twelve withdrawals by comparison students. This is a two to one ratio. Probably the most important aspect of withdrawal behavior is that it is more critical to have small numbers of withdrawals in PT^2 situations where they can be very disruptive of team efforts.

Rate of absenteeism. The instructors' records of attendance at regular class meetings indicate eighty-eight absences among comparison students opposed to seventy-three among the PT^2 students. In terms of total attendance this represents 95% attendance by comparison students and 96% attendance by the PT^2 students. Both records are very good probably due mostly to the fact that quizzes were given at all class meetings. The slightly better record by PT^2 students is assumed to be due to feelings of responsibility to their team as indicated by responses to an item on the

questionnaire which asked what contributed to class attendance.

Interaction and involvement. Observations by the instructors indicated that their PT^2 students were more vocal and appeared to get more involved in the lab exercises than their comparison students did. The PT^2 students appeared to interact more with other students and with the instructor. These observations are supported by and in turn support the results which indicated greater cohesiveness/cooperation among the PT^2 students than among the comparison students.

Suggested Further Research

Since this study was exploratory research there are numerous research projects which should follow. The suggestions here will be addressed primarily to the weaknesses in this study.

First, a very obvious need is better measure of the occurrence of peer teaching for determining differences in the amount of peer teaching. The lack of such a measure was probably the main cause of inconclusive evidence of any difference in the quantity of peer teaching in this study. Due to this result it is impossible to say whether greater

amounts of peer teaching contribute to improved performance or satisfaction with the course.

Second, testing under conditions where it is possible to more strongly differentiate between the treatment (PT^2) and comparison subjects would be very interesting to compare with the results of this study. The fact that the comparison students were "grouped" around lab tables to share equipment and were assigned lab partners probably encouraged more peer teaching of greater quality than would be found in situations where students typically sit at rows of desks and are not assigned a partner. This lack of differentiation in this probably had a profound effect on the test for significant difference, particularly in the test on quantity and quality of peer teaching. However, this lack of differentiation can be viewed as an advantage in that it provided a very strong test of the capabilities of PT^2.

Third, the development of an instrument which can more clearly distinguish between the effects of PT^2 and the effects of a particular instructor would be very revealing. By distinguishing these effects more clearly, a more precise identification of the advantages and disadvantages of PT^2 would be possible. This may, also, be a helpful step in identifying the best approach to administering PT^2 and in

identifying the skills of instructors which are important to gaining the best results from the use of PT^2. It would be useful to have control over matching PT^2 to comparison groups by skill and ability levels.

In general, there is a need to test PT^2 in a great variety of settings. The applicability of PT^2 may be different for courses in the social sciences from those in the "hard" sciences. There may be a difference in applicability in mathematical courses or those with a quantitative orientation from those with a conceptual orientation. Additionally, testing PT^2 in various industrial training settings may prove useful.

Summary

Based upon the results and conclusions of this exploratory research, it seems that PT^2 holds great promise and potential as an educational technique capable of gaining student involvement at little or no additional costs. For example, this study was conducted at no expense to the university. More is yet to be learned concerning PT^2 and its applicability but the potential it has demonstrated in this study is sufficient justification for investing resources and time in further research, as well as, taking

advantage of the potential costs savings in delivery of education.

In general the conceptual model of the effects of PT^2 were given some support. That is, greater willingness to cooperate seems to relate to some additional amounts of peer teaching and improve its quality (as indicated by correlations). PT^2 seems to have some effect on performance and to a lesser extent satisfaction with the course. This effect is proposed because there were no other major differences between the PT^2 condition and the comparison condition which offer any other plausible alternative explanations.

PT^2 holds the greatest potential to those instructors who want all of their students to become more involved in the course, even if this means that the student becomes more vocal and possibly more hostile as indicated by the "Group Dynamics" literature. PT^2 can be extremely valuable in courses which require or are supposed to develop interpersonal skills, because it strongly encourages students to learn how to work together cooperatively. Developing these interpersonal skills may prove valuable to all students who later must function within an organization, for at various times they will have to interact with others to completely accomplish their assigned tasks or to present

the merits of their accomplishments. Finally, PT^2 may hold great potential for those very organizations that need members who possess highly developed interpersonal skills, because the use of PT^2 in their various training programs may prove very effective and efficient in developing the desired interpersonal skills.

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Appendix I

Zoology 1121 Section Composition (Spring 1981)

Section	Time	Teaching Assistants	Section* Code	Size
001	Tuesday, 1:30	1) Groeger	01	25 (C)
		2) Shaprio	02	25 (C)
		3) Lodes	10	25 (E)
002	Wednesday 8:30	1) Carroll	03	13 (C)
003	Wednesday 1:30	1) Carroll	11	22 (E)
		2) Shapiro	12	22 (E)
		3) Gage	13	22 (E)
004	Thursday 1:30	1) Cramer	14	20 (E)
		2) Groeger	15	20 (E)
		3) Lodes	04	20 (C)
005	Friday 8:30	1) Milstead	05	25 (C)
		2) Martin	06	25 (C)
		3) Watt	16	25 (E)
006	Friday 1:30	1) Milstead	17	18 (E)
		2) Martin	18	18 (E)
900	Monday 6:30	1) Gage	07	30 (C)
901	Tuesday 6:30	1) Peck	08	23 (C)
902	Thursday 6:30	1) Cramer	09	10 (C)

* (C) Comparison = 1-9 Section Codes
(E) Experimental = 10-18 Section Codes

APPENDIX II

Grading Policy in Zoology 1121, Experimental (PT^2) Sections

You will be graded in three major areas:

1) Individual Performance
2) Group Performance
3) Peer Evaluation

Each of these areas must count for at least 10% of your final grade. The remaining of your grade will be determined by the entire class on the first day of classes. The class will be divided into groups and the groups will also decide on the relative weights of the mini-tests, the mid-term exam and the final exam for individual performances.

1. Groups will be assigned by the T.A.
2. Each group will decide how it wants the class grades to be weighted.
3. Each group will select a representative to met with other group representatives and the T.A.
4. Representatives will assemble at the front of the classroom and discuss desired grade weights. A class consensus must be determined.

I. General Grading Criteria

AREA	MINIMUM %	TOTAL %
A. Individual Performance	10	____
B. Group Performance	10	____
C. Peer Evaluations	10	____
TOTALS	30%	100%

II. Criteria Within Each Area

A. Individual Performance

1. Mini-tests	0-50	____
2. Final Exam*	25-50	____
3. Mid-term Exam*	25-50	____
(*These two must be weighted equally)		
	100%	____

B. Group Performance

1. Mini-tests	30	
2. Lab Reports	30	
3. Mid-term Exam	30	
4. Average Final Exam Score	10	
	100%	____

C. Peer Evaluation

Each individual will assign a total of 50 points to the other members of their group.

	100
100%	____

APPENDIX III

GRADE WEIGHTS FOR ZOOLOGY LABORATORY 1121, COMPARISON SECTIONS

AREA		MINIMUM %	TOTAL %
1. Final Exam (100 pts)		15%	____
2. Mid-term Exam (100 pts)		15%	____
3. Mini-tests (100 pts)		10%	____
4. Lab Reports (100 pts)		15%	____
5. T.A. Points (50 pts)		5%	____
TOTALS	450 pts	60%	100%

APPENDIX IV

RESULTS OF GRADE WEIGHTING BY SECTION

SEC. COMP.	MINI-TESTS	MID-TERM	FINAL
01	42	29	29
02	40	33	27
03	14	43	43
04	50	25	25
05	42	29	29
06	46	27	27
07	38	31	31
08	52	26	22
09	57	21	22
SEC. EXPR.			
10	50	25	25
11	50	25	25
12	50	25	25
13	50	25	25
14	50	25	25
15	45	28	27
16	50	25	25
17	50	25	25
18	30	35	35

APPENDIX V

FREQUENCY DISTRIBUTIONS OF QUANTITY OF PEER TEACHING

PERCENTAGE BAR CHART COMPARISON STUDENTS

MIDPOINT V1_3_6		FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0		0	0	0.00	0.00
1	*****	3	3	2.38	2.38
2	**********	21	24	16.67	19.05
3	**********	36	60	28.57	47.62
4	**********	42	102	33.33	80.95
5	**********	24	126	19.0	100.00

2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32

PERCENTAGE

PERCENTAGE BAR CHART PT^2 STUDENTS

MIDPOINT V1_3_6		FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0		0	0	0.00	0.00
1	*	1	1	0.72	0.72
2	**********	24	25	17.29	18.12
3	**********	54	79	39.13	57.25
4	**********	46	125	33.33	90.58
5	**********	13	138	9.42	100.00

2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38

PERCENTAGE

APPENDIX VI

FREQUENCY DISTRIBUTIONS OF QUALITY OF PEER TEACHING

PERCENTAGE BAR CHART COMPARISON STUDENTS

MIDPOINT V2_4_7		FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0		0	0	0.00	0.00
1	******	4	4	3.17	3.17
2	**************************	17	21	13.49	16.67
3	**	41	62	32.54	49.21
4	**	51	113	40.48	89.68
5	**********************	13	126	10.32	100.00

2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40

PERCENTAGE

PERCENTAGE BAR CHART PT^2 STUDENTS

MIDPOINT V2_4_7		FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0		0	0	0.00	0.00
1	******	6	6	4.35	4.35
2	**************************	27	33	19.57	23.91
3	**	68	101	49.28	73.19
4	********************************	32	133	23.19	96.38
5	*****	5	138	3.62	100.00

3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48

PERCENTAGE

APPENDIX VII

FREQUENCY DISTRIBUTIONS OF GENERAL COOPERATION ITEM

PERCENTAGE BAR CHART COMPARISON STUDENTS

V8		FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
1	**********	28	28	22.22	22.22
2	**********	47	75	37.30	59.52
3	**********	29	104	23.02	82.54
4	**********	18	122	14.29	95.83
5	***	2	124	1.59	98.41
6	***	2	126	1.59	100.00

2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36

PERCENTAGE

PERCENTAGE BAR CHART PT^2 STUDENTS

V8		FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
1	**********	50	50	36.23	36.23
2	**********	45	95	32.61	68.84
3	**********	26	121	18.84	87.68
4	**********	14	135	10.14	97.83
5	****	3	138	2.17	100.00

2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36

PERCENTAGE

APPENDIX VIII

FREQUENCY DISTRIBUTIONS OF WILLINGNESS TO COOPERATE COMPOSITE

PERCENTAGE BAR CHART COMPARISON STUDENTS

MIDPOINT FINAL_R		FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
5	**********	106	106	85.48	85.48
15	**********	17	123	13.71	99.19
25	*	1	124	0.81	100.00
35		0	124	0.00	100.00
45		0	124	0.00	100.00
55		0	124	0.00	100.00
65		0	124	0.00	100.00
75		0	124	0.00	100.00
85		0	124	0.00	100.00
95		0	124	0.00	100.00

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

PERCENTAGE

PERCENTAGE BAR CHART PT^2 STUDENTS

MIDPOINT FINAL_R		FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
5	**********	51	51	37.23	37.23
15	**********	54	105	39.42	76.64
25	**********	28	133	20.44	97.08
35	******	4	137	2.92	100.00
45		0	137	0.00	100.00
55		0	137	0.00	100.00
65		0	137	0.00	100.00
75		0	137	0.00	100.00
85		0	137	0.00	100.00
95		0	137	0.00	100.00

2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38

PERCENTAGE

APPENDIX IX

FREQUENCY DISTRIBUTIONS OF SATISFACTION SCALE

PERCENTAGE BAR CHART COMPARISON STUDENTS

MIDPOINT V31_38		FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0		0	0	0.00	0.00
1		0	0	0.00	0.00
2	*	1	1	0.79	0.79
3	**********	10	11	7.94	8.73
4	**********	42	53	33.33	42.06
5	**********	73	126	57.94	100.00

3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57

PERCENTAGE

PERCENTAGE BAR CHART PT^2 STUDENTS

MIDPOINT V31_38		FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0		0	0	0.00	0.00
1	*	1	1	0.72	0.72
2	**	3	4	2.17	2.90
3	*****	7	11	5.07	7.97
4	**********	25	36	18.12	26.09
5	**********	102	138	73.91	100.00

5 10 15 20 25 30 35 40 45 50 55 60 65 70

PERCENTAGE

APPENDIX X

FREQUENCY DISTRIBUTIONS OF OVERALL PERFORMANCE COMPOSITE

PERCENTAGE BAR CHART COMPARISON STUDENTS

MIDPOINT SCORE		FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
5		0	0	0.00	0.00
15		0	0	0.00	0.00
25	***	2	2	1.42	1.42
35	**********	9	11	6.38	7.80
45	**********	10	21	7.09	14.89
55	**************************	18	39	12.77	27.66
65	**	29	68	20.57	48.23
75	**	44	112	31.21	79.43
85	**********************************	24	136	17.02	96.45
95	*****	5	141	3.55	100.00

2 4 6 8 10 12 14 16 18 20 22 24 26 28 30

PERCENTAGE

PERCENTAGE BAR CHART PT^2 STUDENTS

MIDPOINT SCORE		FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
5		0	0	0.00	0.00
15		0	0	0.00	0.00
25	*	1	1	0.66	0.66
35		0	1	0.00	0.66
45	******************	13	14	8.61	9.27
55	******************************	22	36	14.57	23.84
65	**	41	77	27.15	50.99
75	**	37	114	24.50	75.50
85	**	32	146	21.19	96.69
95	*******	5	151	3.31	100.00

2 4 6 8 10 12 14 16 18 20 22 24 26

PERCENTAGE

APPENDIX XI

CONFIDENTIAL QUESTIONNAIRE

On the following pages you will find several different kinds of questions about this class. Specific instructions are given at the start of each section. Please read them carefully. It should take no more than 25 minutes to complete the entire questionnaire. Please move through it quickly.

The questions are designed to obtain your perceptions of this class and your reactions to it.

There are no "tricky" questions. Your individual answers will be kept completely confidential. Please answer each item as honestly and frankly as possible on the accompanying answer sheet.

Thank you for your cooperation.

Please select the response which most nearly agrees with your beliefs/ feelings and darken in the corresponding response on the answer sheet.

1. How often do students that work at your lab table meet to study Zoology 1121 outside of class (including attending Phylum room with another students(s)?

1	2	3	4	5
Several times a week	Once a week	Three to five times this semester	Once or twice this semester	Never

2. How helpful have these meetings been in understanding the course material?

1	2	3	4	5	6
Extremely helpful	Very helpful	Helpful	Not too helpful	Not at all helpful	Harmful

3. How often do you receive assistance from another student(s) at your lab table in understanding a lab exercise?

1	2	3	4	5	6
Several times per lab meeting	At least once every lab meeting	Almost every lab meeting	Frequently (example, once every 2nd or 3rd lab meeting)	Very rarely (example, once or twice that you remember)	Never

4. How helpful is the assistance and/or discussions with other students from your lab table in learning the course material?

1	2	3	4	5	6
Extremely helpful	Very helpful	Helpful	Not too helpful	Not at all helpful	Harmful

5. Is this assistance:

1	2	3	4	5	6
Always asked for by you	Usually asked for by you	Frequently asked for by you	Frequently volunteered by other(s)	Usually volunteered by other(s)	Always volunteered by other(s)

6. How often do you discuss the Phylum room displays with the other student(s) from your table?

1	2	3	4	5	6
Several times per lab meeting	At least once every lab meeting	Almost every lab meeting	Frequently (example, once every 2nd or 3rd lab meeting)	Very rarely (example, once or twice that you remember)	Never

7. How helpful have these discussions been in understanding the course material?

1	2	3	4	5	6
Extremely helpful	Very helpful	Helpful	Not too helpful	Not at all helpful	Harmful

8. In general, how cooperatively do the students at your lab table work together?

1	2	3	4	5	6
Extremely well	Very well	Well	Fair	Not too well	Not well at all

Now please indicate how you personally feel about your class work.

Each of the statements below is something that a person might say about his or her class work. You are to indicate your own, personal feelings about your class work by marking how much you agree with each of the statements.

Please select the response which most nearly agrees with your beliefs/feelings and darken in the corresponding response on the answer sheet.

How much do you agree with the statement?

1	2	3	4	5	6
Disagree Strongly	Disagree	Disagree Slightly	Agree Slightly	Agree	Agree Strongly

_____ 9. It's hard, in this class for me to care very much about whether or not the work gets done right.

_____ 10. My opinion of myself goes up when I do the class work.

_____ 11. Generally speaking, I am very satisfied with this class.

_____ 12. Most of the things I have to do in this class seem useless or trivial.

_____ 13. I usually know whether or not my work is satisfactory in this class.

_____ 14. I feel a great sense of personal satisfaction when I do my class work well.

_____ 15. The work I do in this class is very meaningful to me.

_____ 16. I feel a very high degree of personal responsibility for the work I do in this class.

_____ 17. I frequently think of withdrawing from this class.

_____ 18. I feel bad and unhappy when I discover that I have performed poorly in this class.

_____ 19. I often have trouble figuring out whether I'm doing well or poorly in this class.

_____ 20. I feel I should personally take the credit or blame for the results of my work in this class.

_____ 21. I am generally satisfied with the kind of work I do in this class.

_____ 22. My own feelings generally are not affected much one way or the other by how well I do in this class.

Now please think of the other people in your class

Please think about how accurately each of the statement describes the feelings of those people about this class.

It is quite all right if your answers here are different from when you described your own reactions to the class. Often different people feel quite differently about the same class.

How much do you agree with the statement?

1	2	3	4	5	6
Disagree Strongly	Disagree	Disagree Slightly	Agree Slightly	Agree	Agree Strongly

_____ 23. Most people in this class feel a great sense of personal satisfaction when they do the work well.

_____ 24. Most people in this class are very satisfied with the class.

_____ 25. Most people in this class feel that the work is useless or trivial.

_____ 26. Most people in this class feel a great deal of personal responsibility for the work they do.

_____ 27. Most people in this class have a pretty good idea of how well they are performing their work.

_____ 28. Most people in this class find the work very meaningful.

_____ 29. People in this class often think of withdrawing.

_____ 30. Most people in this class have trouble figuring out whether they are doing a good or a bad job.

Now please indicate how satisfied you are with each aspect of this class listed below. Once again, write the appropriate number in the blank beside each statement.

How satisfied are you with this aspect of this class?

1	2	3	4	5	6
Extremely Dissatisfied	Dissatisfied	Slightly Dissatisfied	Slightly Satisfied	Satisfied	Extremely Satisfied

_____ 31. The people I talk to and work with.

_____ 32. The degree of respect and fair treatment I receive from my Teaching Assistant.

_____ 33. The feeling of worthwhile accomplishment I get from doing my class work.

_____ 34. The chance to get to know other people while working in class.

_____ 35. The amount of support and guidance I receive from my Teaching Assistant.

_____ 36. The chance to help other people.

_____ 37. The amount of challenge in my class work.

_____ 38. The overall quality of instruction I receive in class.

On each of the objectives listed below, rate the progress you have made in this course compared with that made in other courses you have taken at this college or university. In this course my progress was:

1 - Low (lowest 10 per cent of courses I have taken here)
2 - Low Average (next 20 per cent of courses)
3 - Average (middle 40 per cent of courses)
4 - High Average (next 20 per cent of courses)
5 - High (highest 10 per cent of courses)

_____ 39. Gaining factual knowledge (terminology, classifications, methods, trends).

_____ 40. Developing specific skills, competencies and points of view needed by professionals in the field most closely related to this course.

_____ 41. Developing a sense of personal responsibility (self-reliance, self-discipline).

_____ 42. Developing a skill in expressing myself orally or in writing.

I.D. #_____

On the next four questions please estimate as closely as you can the percentages of 100 percent. (The sum of your percentages should equal 100% for each question)

About what percent did each of the following contribute to the determination of whether or not you studied the reading assignments.

1. The class/material was interesting _____
2. The instructor expected it _____
3. Feelings of responsibility for others at your lab table _____
4. Expectations of the students at your lab table _____
5. To help earn a better grade _____

Total 100%

About what percent did each of the following contribute to the determination of how much effort you put into the course?

1. The class/material was interesting _____
2. The instructor expected it _____
3. Feelings of responsibility for others at your lab table _____
4. Expectations of the students at your lab table _____
5. To help earn a better grade _____

Total 100%

About what percent did each of the following contribute to the determination of whether or not you attended class, particularly on days when you had (or could have had) a good reason not to?

1. The class/material was interesting _____
2. The instructor expected it _____
3. Feelings of responsibility for others at your lab table _____
4. Expectations of the students at your lab table _____
5. To help earn a better grade _____

Total 100%

About what percent did each of the following contribute to your performance on quizzes and exams.

1. The class/material was interesting _____
2. The instructor expected high performance _____
3. Feelings of responsibility for the other students at your lab table _____
4. Help received from the other students at my lab table _____
4. The students at my lab table expected high performance _____
5. My drive to earn a high grade _____

Total 100%