Hal Warren Pierce. THE LEARNING ENVIRONMENT IN HIGH SCHOOL PHYSICS CLASSES. (Under the direction of Robert L. Dough) Department of Science Education, August, 1972.

In order to learn more about the classroom environment in physics classes in North Carolina, the Learning Environment Inventory was administered to approximately forty physics classes. This instrument is designed to measure the social classroom climate as perceived by the pupils within it. The Learning Environment Inventory contains fifteen scales such as Satisfaction, Difficulty and Formality.

The main interest of this study was to compare the environment of students taking the Project Physics Course with that in the "traditional" physics courses. Computer programs were used to determine means for the scales and to compare data by use of the t test. It was found that Project Physics classes are considered to be less formal, less rushed, less goal directed, more disorganized, and less difficult than "traditional" physics classes in North Carolina.

THE LEARNING ENVIRONMENT IN HIGH SCHOOL PHYSICS CLASSES

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Hal Warren Pierce

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by

Hal Warren Pierce

APPROVED BY:

SUPERVISOR OF THESIS Robert L. Dough

Dr. Robert L. Dough

CHAIRMAN OF THE DEPARTMENT OF SCIENCE EDUCATION

Floyd E. Mattheis

Dr. Floyd E. Mattheis

DEAN OF THE GRADUATE SCHOOL

John M. Howell

Dr. John M. Howell

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TABLE OF CONTENTS

Page

APPENDICES

LIST OF TABLES

Chapter 1

INTRODUCTION

Rationale of this Study

The percentage of high school students enrolled in physics courses has declined steadily since about 1958. It is expected that this decline will continue for a few years, unless efforts are made to improve the teaching of physics.[1] The Project Physics Course was developed in order to attract a larger number of high school students to the study of physics. This course presents physics as a broadly based intellectual activity that has firm historical roots and that profoundly influences our whole culture. The purpose of this study is to compare the learning environment in Project Physics classrooms with the learning environment in "traditional" physics classrooms. The words "conventional" and "traditional" used in this study refer to classes which generally are taught mostly by lecture with little laboratory work. One would hope to find the environment in Project Physics classrooms more conducive to learning because of the multi-media and multi-level design of the course.

Results of this study should be useful to science educators in general and especially to those who are interested in improving the teaching of physics. By having a better understanding of how students

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[1] Newsletter 1, Harvard Project Physics, Fall, 1964, p. 2.

perceive their classes, high school educators might wish to revise the type of physics curriculum that they are now using. It is hoped that colleges and universities can also adjust their programs accordingly.

RESEARCH DESIGN

Statement of the Problem

This study will use the Learning Environment Inventory in evaluating the learning environment in physics classrooms. The following questions are to be answered:

1. How does the learning environment in Project Physics compare with the learning environment in a traditional course in North Carolina?
2. How does the classroom environment of first-year Project Physics teachers compare with the classroom environment of second-year Project Physics teachers in North Carolina?
3. How does the learning environment in Project Physics classrooms in North Carolina compare with the learning environment in Project Physics classrooms on the national level?
4. How does the learning environment in traditional classrooms of North Carolina compare with the learning environment in traditional classrooms in the United States?

Evaluation Tool

The Learning Environment Inventory (LEI) is designed to measure the social classroom climate as perceived by the students within it.[2] A copy of the LEI is given in Appendix A. The test contains one hundred and five statements which are grouped into fifteen scales. Each scale contains seven statements. The scale names, which are suggestive of the items within the scale, are Cohesiveness, Diversity, Formality, Speed, Environment, Friction, Goal Direction, Favoritism, Cliqueness, Satisfaction, Disorganization, Difficulty, Apathy, Democratic, and Competitiveness. The student indicates his agreement or disagreement with the statements on a four-point system. A choice of 1 indicates strong agreement; 2, agreement; 3, disagreement; 4, strong disagreement. Therefore, the maximum number of points possible for a scale is twenty-eight. A high score, such as 28, indicates a negative response to the scale. In scoring, the polarity is reversed on some statements so that a high score always indicates a negative response. The inventory has been constructed with the statements for all scales intermingled. The testing time is forty minutes.

The statements, listed together with the name of the scale to which they have been assigned, are as follows (an asterisk indicates that the polarity must be reversed in scoring the statements):

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[2] Gary J. Anderson, The Learning Environment Inventory Manual (Montreal: Centre for Learning and Development, McGill University, 1969), p. 3.

Cohesiveness

1. Members of the class do favors for one another.
18. A student has the chance to get to know all other students in the class.
32. Members of the class are personal friends.
56. All students know each other very well.
* 58. Students are not in close enough contact to develop likes or dislikes for one another.
* 71. The class is made up of individuals who do not know each other well.
91. Each student knows the other members of the class by their first names.

Diversity

4. The class has students with many different interests.
11. There does not appear to be a group of interests shared by all members of the class.
34. Some students are interested in completely different things than other students.
37. Class members tend to pursue different kinds of problems.
72. The class divides its efforts among several purposes.
86. The class is working toward many different goals.
95. Different students vary a great deal regarding which aspect of the class they are interested in.

Formality

7. Students who break the rules are penalized.
16. The class has rules to guide its activities.
48. Students are asked to follow a complicated set of rules.
* 59. The class is rather informal and few rules are imposed.
61. There is a recognized right and wrong way of going about class activities.
68. All classroom procedures are well-established.
81. There is a set of rules for the students to follow.

Speed

27. The pace of the class is rushed.
* 73. The class has plenty of time to cover the prescribed amount of work.
* 75. Students do not have to hurry to finish their work.
85. There is little time for day-dreaming.
87. The class members feel rushed to finish their work.
93. The class has difficulty keeping up with its assigned work.
102. Students do not have time to ask questions during class.

Environment

2. The books and equipment students need or want are easily available to them in the classroom.

12. A good collection of books and magazines is available in the classroom for students to use.
26. The students would be proud to show the classroom to a visitor.
36. The room is bright and comfortable.
55. There are displays around the room.
* 57. The classroom is too crowded.
90. There is enough room for both individual and group work.

Friction

8. There is constant bickering among class members.
30. Certain students have no respect for other students.
44. There are tensions among certain groups of students.
69. Certain students in the class are responsible for petty quarrels.
82. Certain students don't like other students.
88. Certain students are considered uncooperative.
103. There is an undercurrent of feeling among students that tends to pull the class apart.

Goal Direction

10. The class knows exactly what it has to get done.
* 23. The objectives of the class are not clearly recognized.
* 60. Students have little idea of what the class is attempting to accomplish.
67. Each student knows the goals of the course.
83. The class realizes exactly how much work it is required to do.
96. Each student in the class has a clear idea of the class goals.
105. The objectives of the class are specific.

Favoritism

9. The better students' questions are more sympathetically answered than those of the average students.
* 14. Every member of the class enjoys the same privileges.
22. The better students are granted special privileges.
24. Only the good students are given special projects.
49. The class is controlled by the actions of a few members who are favored.
74. Students who have past histories of being discipline problems are discriminated against.
98. Certain students are favored more than the rest.

Cliqueness

5. Certain students work only with their close friends.
* 20. Students cooperate equally with all class members.
28. Some students refuse to mix with the rest of the class.
31. Some groups of students work together regardless of what the rest of the class is doing.
76. Certain groups of friends tend to sit together.
* 97. Most students cooperate equally with other class members.
100. Certain students stick together in small groups.

Satisfaction

6. The students enjoy their class work.
17. Personal dissatisfaction with the class is too small to be a problem.
* 21. Many students are dissatisfied with much that the class does.
* 38. There is considerable dissatisfaction with the work of the class.
52. The members look forward to coming to class meetings.
63. After the class, the students have a sense of satisfaction.
79. Students are well-satisfied with the work of the class.

Disorganization

3. There are long periods during which the class does nothing.
19. The work of the class is frequently interrupted when some students have nothing to do.
* 33. The class is well organized.
40. The class is disorganized.
* 45. The class is well-organized and efficient.
70. Many class members are confused by what goes on in class.
94. There is a great deal of confusion during class meetings.

Difficulty

13. The class goes at a pace best suited for the smartest students.
46. Students are constantly challenged.
* 53. The subject studied requires no particular aptitude on the part of the students.
66. Students in the class tend to be much brighter than those in the rest of the school.
* 78. The subject presentation is too elementary for many students.
*101. Most students consider the subject-matter easy.
104. Many students in the school would have difficulty doing the advanced work of the class.

Apathy

39. Failure of the class would mean little to individual members.
50. Students don't care about the future of the class as a group.
54. Members of the class don't care what the class does.
* 84. Students share a common concern for the success of the class.
* 89. Most students sincerely want the class to be a success.
92. Failure of the class would mean nothing to most members.
* 99. Students have a great concern for the progress of the class.

Democratic

25. Class decisions tend to be made by all the students.
29. Decisions affecting the class tend to be made democratically.
* 35. Certain students have more influence on the class than others.
* 42. Certain students impose their wishes on the whole class.
51. Each member of the class has as much influence as any other member.

62. What the class does is determined by all the students.
* 80. A few members of the class have much greater influence than the other members.

Competitiveness
* 15. Students are seldom called upon to participate in the work of the class.
41. Much of the class time is spent on student activities and discussion.
* 43. Most of the course material is covered in lectures and demonstrations.
* 47. Students are required to follow the textbook closely.
64. Students often make presentations to the rest of the class.
65. Students are encouraged to find out many things for themselves.
* 77. Students have to memorize specific information.

Administration of Tests

In January 1972, letters were sent to approximately twenty principals requesting their permission and cooperation to test the physics classes in their school. These letters are in Appendix B. All the schools known to be teaching Project Physics were requested to participate in this evaluation and all did. Both Project Physics and traditional classes had been tested the previous year. The traditional classes surveyed were not a random sample but were those of a selected group of teachers who had attended an East Carolina University in-service institute in physics and physical science.

Test booklets, answer sheets and instructions were mailed to the schools in early February. Instructions are given in Appendix C. It was assumed that by letting the guidance counselors instead of the teachers administer the test, the students would be more honest in their answers. All tests were given by guidance counselors except for eight schools.

Scoring Procedure

All the data collected from students were on form 510 IBM answer sheets. These answer sheets were checked by hand for stray marks. The answer sheet contained five spaces for each statement; only the first four were needed because a student had only four choices. A few students had marked a five. This researcher assumed that they had meant to mark a four and corrected it as such. Two papers that lacked answers to approximately half the questions were discarded. There were approximately ten statements unanswered on all the other papers. Half of these were marked as threes and the remaining half as twos. This was necessary due to the scoring procedure.

Though the LEI does not have specific answers, the tests were scored by a Model 1231 optical mark page reader through the standard test grading program. The printout enabled the researcher to again check for omitted items, stray marks, incomplete erasures, and answers in column five. Some incomplete erasures were read as double answers. This extra check allows one to make the necessary corrections with ease since he knows exactly which statements to look for.

Another problem which presents itself is that many statements in the LEI are deliberately reversed so that students will not be tempted to consistently mark the positive position of the scale. Since some statements were reversed, a special program called SPOTS 5 was used which would read the answer to any statement that the programmer requested and would print the appropriate number on a card. All student responses in a class for scale 1 were taken first, then all the responses

for scale 2, and in a like manner for all the other scales. The data thus generated was submitted to another program, LEI, specifically designed to give the score for each scale. Thus there is a card for each student which contains a score for each scale.

Since there is no meaning in each student's individual score, the student data was separated into groups such as Project Physics and traditional classes. The data was then submitted to a standard program, REGRES, which gives the mean score and standard deviation for each scale in the group of students and the intercorrelation coefficients. A t test for correlated samples could not be used since there was a different number of students in each group. A t test for uncorrelated samples was used for testing the significance of the difference between the means of the scales in each group. This t value is defined by G. A. Ferguson in Statistical Analysis in Psychology and Education as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s^2}{N_1} + \frac{s^2}{N_2}}} \qquad s^2 = \frac{N_1 \sigma_1^2 + N_2 \sigma_2^2}{N_1 + N_2 - 2}$$

Chapter 2

A REVIEW OF THE LITERATURE

The social climate of a group is the psychological atmosphere in which the group works. The importance of studying group climate was first observed with industrial workers.[1] In recent years, educational literature has strongly emphasized this importance.

The climate is a fundamental part of any interpersonal experience. It is not so much dependent on the surroundings or setting of a school as it is upon what goes on within each individual class. The climate helps to determine the learning and the satisfaction of emotional needs of individuals in the class. The behavior of an individual is determined by his personality and his environment. Changes in behavior develop as a consequence of changes in environment. The class members' feelings about themselves, their teacher, and the course influence the kind and the amount of learning that will be accomplished. Classroom climate and learning are parts of an interrelated and unified experience. The climate is a fairly stable quality of each classroom.[2]

Each component of classroom climate is important in making the total climate positive. Classroom climate is the result of how each component is integrated and is working in relation to the others.

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[1] Mary A. Bany and Lois V. Johnson, Classroom Group Behavior (New York: The Macmillan Company, 1964), p. 227.

[2] Hugh V. Perkins, "Climate Influences Group Learning," The Journal of Educational Research, XLV (October, 1951), 117.

The significance of a positive social climate is now commonplace for most educators, but the concept of classroom social climate is used in a vague, abstract manner and little analysis of the components of classroom climate has been made. Schmuck (1971) says a "positive classroom climate is one in which the students share high amounts of potential influence -- both with one another and with the teacher; where high levels of attraction exist for the group as a whole and between classmates; where norms are supportive for getting academic work done, as well as for maximizing individual differences; where communication is open and featured by dialogue; and where the processes of working and developing together as a group are considered relevant in themselves for study."[3]

The first attempts to study the learning climate of a classroom were by careful observation of students' behavior in the classroom. Wrightstone (1933) found that this was not effective in systematically studying these effects because the students and teachers were aware of the observer and did not behave as naturally as they normally did.[4] This method of direct observation was expensive and slow, and the results were not accurate. Since students are good judges of their learning environment, researchers then tried to develop a method by

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[3] Richard A. Schmuck and Patricia A. Schmuck, Group Processes in the Classroom (Dubuque, Iowa: Wm. C. Brown Company Publishers, 1971), p. 18.

[4] J. Wayne Wrightstone, "Measuring the Social Climate of a Classroom," The Journal of Educational Research, XLIV (January, 1951), 341.

which the students could evaluate their classroom climate by responding to a written questionnaire.[5]

From the studies made of classroom climate, the general consensus is that a positive classroom climate is necessary for the optimal school adjustment of students. Studies have shown that students in a good climate are more productive, more positive about their feelings toward school, and have a higher self-esteem than students in a poor climate.[6]

The quality of teacher-pupil relations has been recognized to be a major determiner of classroom climate. In fact, it has been hypothesized that the teacher's behavior is the most important single factor in creating the climate in a classroom. Using the assumption that the teacher's verbal behavior is a representative sample of his total behavior, Withall (1949) developed an instrument to measure the social-emotional climate in learning situations by categorizing teachers' statements as supportive, reproving, encouraging, etc.[7] With this instrument, it was hard to tell how the students felt in response to the teachers' statements.

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[5] Gary J. Anderson, The Learning Environment Inventory Manual (Montreal: Centre for Learning and Development, McGill University, 1969), p. 2.

[6] Schmuck and Schmuck, op. cit., p. 17.

[7] John Withall, "The Development of a Technique for the Measurement of Social-Emotional Climate in Classrooms," The Journal of Experimental Education, XVII (March, 1949), 349.

From his research, Walberg (1968) found that the personality patterns of the teacher, his needs, values, and attitudes, predict the climate of his classes. If his needs are for dependence and power, he will foster a formal and dependent class. If his needs are to interact aggressively and closely with the students, his classes will tend to be controlled, goal-directed, and teacher-monopolized. The self-centered teacher will foster a climate of disorganization, constraint, and loose supervision of pupils' work.[8]

Schmuck (1966) found that the teachers with more positive classroom climates regarded teaching as twofold: that of academic learning, and that of the development and growth of personality. They also tended to see students as individuals with unique personality traits.[9] In comparable classes and teaching conditions, student achievement has been shown to be greater in the classes in which teachers accept students as worthwhile individuals and make the students conscious of this acceptance. They use a positive approach to students, use praise effectively, and explore the students' ideas to see what they already know and think.[10] When the teacher's behavior is directive, demanding, or disapproving, students respond with hostility, withdrawal, apathy, or aggression. When the teacher's behavior is generally student-supportive,

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[8] Herbert J. Walberg, "Teacher Personality and Classroom Climate," Psychology in the Schools, V (April, 1968), 168.

[9] Richard Schmuck, "Some Aspects of Classroom Social Climate," Psychology in the Schools, III (January, 1966), 63.

[10] Norma Furst and Marciene S. Mattleman, "Classroom Climate," NEA Journal, LVII (April, 1968), 24.

accepting, evaluative and problem-oriented, students respond with decreased anxiety and with increased effort.[11]

In a study of the teachers of four schools, Walker (1969) found that teacher personality is an important variable in the school environment. Two of the schools were regarded as "high creative" with an "open system" of education that permitted originality and initiative and accepted uniqueness in perception and thinking. The other two schools, designated as traditional schools, were included for purposes of comparison. The teachers in the "high creative" schools were found to be more flexible, adaptive, outgoing, permissive and less authoritarian.[12] Creative teachers are likely to stimulate creativeness in their students. They help to create a climate in which students feel comfortable in expressing new ideas without fear of being ridiculed.

Rothman, Welch, and Walberg (1969) studied physics teacher characteristics and student learning. They found that the teacher personality and value system is more strongly related to students' changes in physics achievement, attitudes toward physics, and interest in science than are the teacher's knowledge of physics, years of physics teaching, and preparation in physics, mathematics, and the history and philosophy of science. They also found that students of teachers who engage in social activities with the opposite sex and are regarded as attractive

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[11] Bany and Johnson, op. cit., p. 228.

[12] William J. Walker, "Teacher Personality in Creative School Environments," The Journal of Educational Research, LXII (February, 1969), 245.

are more likely to exhibit growth in the knowledge of the processes of science, the understanding of science, and physics achievement. These factors have an opposite effect on student growth in participation in science tinkering activities and an awareness of the beauty of the universe.[13]

The personality of the individual students of the classroom group are also important in creating classroom climate. Students of different personalities react differently to teachers with different personalities and values. There does not seem to have been as much research done in this area as in other areas.

Walberg (1969) used the Learning Environment Inventory to determine the relationship between class size and learning climate. Thomas and Fink (1963) had found that class size was positively correlated with the quality of performance and with productivity. As perceived by the students, class size did affect the learning climate. Small classes have more opportunity for interaction but they seem to inhibit expressions of disagreement and dissatisfaction by the members. Large classes are more organized but lead to clique formation and to less cohesiveness. Walberg found that class size was also positively correlated with formality and diversity; that is, the larger the class, the

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[13] A. I. Rothman, W. W. Welch, and H. J. Walberg, "Physics Teacher Characteristics and Student Learning," Journal of Research in Science Teaching, VI, 1 (1969), 63.

more formal and diverse, and was negatively correlated with cohesiveness and difficulty; the larger the class, the less cohesive and difficult.[14]

Thelen (1949) investigated the idea of small group learning in the classroom and found there were many problems. Many students felt the sub-group work was not important. There was a lack of direction toward the goals when students were not directly supervised by the teacher or an appointed member of the group, and there was a tendency to let one person do all the work. Within the classroom, there was hostility and competition among the groups. However, Thelen believed there was generally more student participation when the class was divided into small groups than there was when it was not.[15]

The type of leadership of the group is a component in determining the learning climate. Traditional classes with rigid authoritarian structures lead to tension, and tension leads to aggression or apathy. Learning occurs when experiences are meaningful to the learner and when they occur in a non-threatening situation. Relaxed and somewhat informal teachers can foster an atmosphere of freedom to explore ideas.

In classes with good climate, students interact more among themselves and with the teacher. The relationships are warm, friendly and

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[14] Herbert J. Walberg, "Class Size and the Social Environment of Learning," Human Relations, XXII (October, 1969), 472.

[15] Herbert A. Thelen, "Group Dynamics in Instruction: Principle of Least Group Size," The School Review, LVII (March, 1949), 141.

encouraging. This fosters the development of higher self-esteem and the fuller use of intellectual abilities. Students show more interest and enjoyment and become more involved in classroom tasks.

Studies of classroom climate have shown that the conventional school with its authoritarian structure may be hindering rather than promoting meaningful learning.[16] Students learn best that which they do themselves. Each individual has his own aims, goals, and desires. If he actively makes choices, chooses alternatives, and accomplishes the goals for himself, his learning becomes more meaningful. Since students seem to be naturally inquisitive, the teacher should provide a climate conducive to this. Students need an environment filled with learning opportunities and new materials to humanize education. These opportunities should allow for the uniqueness of each learner by offering a variety of types of experiences and levels of difficulty. They should also allow for increasing interaction between student and teacher and student and peers to improve the student's skill in relating with others and to improve his self-image.

Project Physics

Harvard Project Physics was established in 1964 as a new introductory physics course for nationwide use. Actually, the first feasibility study was done in 1962. Rutherford, Holton and Watson

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[16] Robert L. Wendel, "Developing Climates for Learning," Journal of Secondary Education, XLV (November, 1970), 329.

collaborated in testing the feasibility of designing a new physics course.[17] Support from the Carnegie Corporation in New York allowed them to test the materials in the course they developed. The success of these tests, together with the increasing national awareness that something needed to be done about decreasing high school physics enrollments, led to the formation of Harvard Project Physics. Financial support was obtained from the Carnegie Corporation of New York, the Ford Foundation, the National Science Foundation, the Alfred P. Sloan Foundation, the United States Office of Education, Harvard University, and from Project Physics Incorporated.[18] A final, commercial version of the Project Physics Course was published for school use in the fall of 1970 by Holt, Rinehart and Winston, Inc. Further revisions and improvements will be made as necessary. Project Physics has had a detailed and elaborate program of testing, revising and evaluating its materials. Starting in 1964, teachers who agreed to try the course have attended summer institutes to acquaint themselves with new materials and ways of presenting physics. Later editions were shaped through their responses.[19] Project Physics was designed as an introductory physics course for secondary schools. It was intended to appeal to a wide variety of students, from

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[17] About The Project Physics Course (New York: Holt, Rinehart and Winston, Inc., 1971), p. 3.

[18] Newsletter 7, Harvard Project Physics, Spring, 1968, p. 2.

[19] Newsletter 10, Harvard Project Physics, Spring, 1971, p. 4.

science-oriented to science-shy, and especially to the growing majority of students who are taking no physics course at all.

The Project Physics Course emphasizes that physics is for everyone. It is the study of what makes the world go. Therefore, an understanding of physics is as important as an understanding of history and literature. The future of the United States is tied to scientific and technological developments. Citizens need a general feel for science, its strengths, limitations, and possibilities, in order to decide on enormous expenditures and national courses of action.

The course introduces concepts and ideas that are the foundations of science. Project Physics attempts to show the developing of scientific thinking and helps students to see physics as the many-sided human activity that it really is. It presents the subject in historical and cultural perspective and shows how physics relates to other fields. Students are encouraged to explore the areas that interest them most. Each student can demonstrate his own best achievement in his own way: by mathematical treatment of physics, by laboratory experiments and projects, or through historical readings. Thus, he can have immediate rewarding experiences in science while gaining knowledge and skill that will be useful throughout life.

The course includes texts, student handbooks of laboratory and other activities, laboratory equipment, programmed instruction, film loops, and a series of paperback books of selected readings. These varied learning materials make it possible for the course to provide for individual and cultural differences. They permit the teacher to shape

the course to fit the diverse needs and interests of the students. The most important element in the learning process is interaction between student and teacher. In try-out schools, teachers almost unanimously agreed that the Project Physics approach allowed them to teach physics in an exciting way.[20]

Teacher preparation is an important part of the course. No matter how well prepared they may otherwise be, teachers need to learn two aspects of the Project Physics program: they must be trained for the new way of presenting physics, and they must become familiar with all parts of the materials in the multimedia approach in order to be able to direct students toward their chosen ways. This training is usually done in summer institutes.

Groups in Canada, Brazil, Italy, Egypt, India, Japan and other countries are now studying and working on adaptation of Project Physics Course materials. The Directors of Project Physics, Gerald Holton, Department of Physics, Harvard University; Fletcher G. Watson, Harvard Graduate School of Education; and F. James Rutherford, now in the Department of Science Education, New York University, have insisted from the beginning that other countries must preserve the spirit of the course. Therefore, original material should be modified to fit the instructional pattern, specific culture, science history, and resources of the particular country rather than simply being a straight translation.[21]

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[20] Newsletter 7, op. cit., p. 5.

[21] Newsletter 10, op. cit., p. 9.

The Learning Environment Inventory

Hemphill and Westie (1950) developed the Group Dimensions Description Questionnaire to measure general characteristics of groups.[22] The items were inappropriate for classroom use, but they did suggest a number of dimensions possibly related to learning. Using these dimensions and others believed to be related to learning, Walberg developed The Classroom Climate Questionnaire (1966) which consisted of eighteen scales considered meaningful for the description of classroom groups. Eighty items were written and distributed over the eighteen scales. The scales were Friction, Classroom Intimacy, Goal Direction, Social Heterogeneity, Interest Heterogeneity, Goal Diversity, Group Status, Democratic, Subservient, Satisfaction, Strict Control, Disorganization, Alienation, Personal Intimacy, Stratification, Egalitarian, Formality, and Speech Constraint. Students responded by expressing their degree of agreement on a five-point system. A choice of 1 indicated that the statement was definitely false; 2, mostly false; 3, undecided, don't know, doesn't apply; 4, mostly true; 5 definitely true. If a student marked 3, he was further requested to check one of the alternative meanings of the middle response.[23]

The Classroom Climate Questionnaire was administered to a national sample of high school students by Walberg. He found that the

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[22] John K. Hemphill and Charles M. Westie, "The Measurement of Group Dimensions," The Journal of Psychology, XXIX (April, 1950), 341.

[23] Herbert J. Walberg and Gary J. Anderson, "The Achievement-Creativity Dimension and Classroom Climate," The Journal of Creative Behavior, II (Fall, 1968), 286.

learning climate in classrooms was related to teacher personality. The Classroom Climate Questionnaire contained too few statements within each scale to make it consistent internally; therefore, Walberg and Anderson at Harvard University expanded and improved the test. In 1967, it evolved into the Learning Environment Inventory (LEI) and contained fourteen scales. The 1969 revision contains fifteen scales. Each scale contains seven statements. Previous experience had shown that these scales were concepts identified as good predictors of learning, concepts considered relevant to social psychological theory and research, concepts similar to useful theory and research in education, or concepts intuitively judged relevant to the social psychology of the classroom.[24]

The Learning Environment Inventory has been used in evaluation of physics courses, especially in studies of the Project Physics Course, and in research on the relationships of various variables to classroom climate. Some of the variables which have been studied are class size, personality characteristics of the class teacher, and a variety of teacher, student, and class characteristics.

Discussion of Scales

1. Cohesiveness.

Cohesiveness implies that students know each other well and work together. When students work together for a period of time, they develop a feeling of cohesiveness. This feeling separates members of the group

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[24] Anderson, op. cit., p. 4.

from non-members. Members are strongly motivated to become involved in group activities. Cohesive groups have more time for work because their unity enables them to resist external conflict with more success. Highly cohesive groups can have a work norm for either high or low productivity.[25] According to Walberg (1969), small classes are more cohesive than large classes.[26]

2. Diversity.

Diversity implies that class members tend to pursue different kinds of problems. This scale is used to evaluate the Project Physics Course philosophy in that the course provides for individual diversity. In his research on the relation of class size and the social climate of learning, Walberg (1969) found that class size was positively correlated with Diversity; that is, large classes are more diverse than small classes.[27] Research by Anderson, Walberg, and Welch (1969) showed that experimental physics course classes were perceived as having more diversity of interests and activities than those of traditional courses.[28]

3. Formality.

When there is a set of rules for students to follow, the classroom climate is perceived as being formal. Walberg (1969) found that

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[25] Barry and Johnson, op. cit., p. 57.

[26] Walberg, "Class Size and the Social Environment of Learning," op. cit., p. 472.

[27] Ibid.

[28] Anderson, op. cit., p. 8.

class size is positively correlated with Formality. Large classes are usually seen as being more formal. Formal classes lead to less cohesiveness, less diversity in class goals, and to more self-concern and competition.[29]

4. Speed.

Speed implies that class members feel rushed to finish their work. The rate of performance or progress of the class influences how the student feels about himself in comparison with the other students. The perception of Speed by the class should tell the researcher how well the teacher is communicating with and adapting to the needs of the class. Speed is negatively correlated with the mean IQ score; that is, the class is less rushed when the mean IQ score is high. Anderson (1970) found that Speed does not relate significantly to pupil learning.[30]

5. Environment.

Environment suggests there is enough room and enough materials for both individual and group work. Although the entire test is concerned with the classroom learning environment, this scale deals with the physical setting. Even though the physical environment is important in influencing the structure of the group, it is not as important as the psychological conditions that exist within the group.[31] Research

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[29] Wrightstone, op. cit., p. 342.

[30] Anderson, op. cit., p. 9.

[31] D. V. Connor, "Behavior in Class Groups of Contrasting Climate," The British Journal of Educational Psychology, XXX (November, 1960), 248.

by Anderson, Walberg, and Welch (1969) proved that Project Physics produced high Environment ratings because of the number and variety of materials included with the course. Anderson (1970) found that Environment was positively correlated with measures of pupil learning.[32]

6. Friction.

Friction results when there is constant bickering among class members. Learning is hindered by the emotional upset resulting from continued or widespread conflict. In early studies by Anderson and Walberg (1968), Friction had high negative correlations with measures of learning for individuals and for groups. Later studies by Anderson (1970) showed that these relationships were more complex such that high friction was advantageous for certain combinations of pupil sex, IQ, and learning measures.[33] Walberg and Anderson (1968) found that in the creative class there were diverse interests and friction among members.[34] Anderson (1970) found that high friction was favorable for learning. Friction is highly related to the individual personality characteristics of the pupils within the class. It is higher when the class contains a large number of boys.[35]

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[32] Anderson, op. cit., p. 10.

[33] Ibid.

[34] Walberg and Anderson, op. cit., p. 289.

[35] Anderson, op. cit., p. 10.

7. Goal Direction.

Goal Direction implies that each student knows the goals of the course. Group goals are important in letting students know what they are expected to accomplish. Walberg (1968) found that Goal Direction was positively correlated with Satisfaction and negatively correlated with Apathy.[36] When group behavior is directed toward a goal, there is more interaction and satisfaction. Walberg and Welch (1969) found that scores on Goal Direction were higher in traditional courses than in the Project Physics Course which has more individually determined goals.[37] If the assumptions underlying the behavioral objective movement are correct, students in highly goal directed classes can be expected to reach the goal more often than students in classes where the goals are less specified.

8. Favoritism.

Favoritism suggests that certain students are granted special privileges. Its relationship with other learning variables has been inconsistent. Walberg (1968) found that favoritism leads to internal friction and to decreased cohesiveness.[38]

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[36] Herbert J. Walberg, "Structural and Affective Aspects of Classroom Climate," Psychology in the Schools, V (July, 1968), 250.

[37] Anderson, op. cit., p. 11.

[38] Walberg, "Structural and Affective Aspects of Classroom Climate," op. cit., p. 252.

9. Difficulty.

Difficulty implies that the class is best suited for the smartest students. This scale was included specifically to compare the perceived difficulty levels associated with various physics courses and proved that the Project Physics Course is successful in its attempt to make physics appear less difficult to students. Walberg (1969) found that class size was negatively correlated with Difficulty.[39]

10. Apathy.

Apathy implies that members of the class do not care what the class does. This scale complements the Cohesiveness scale and shows whether the class members feel a lack of interest or concern with class activities. Apathy can be an expression of hostility, embarrassment, or lack of understanding of what is required or how to behave. Apathy seems to be passive but it is actually a direct expression of the student's feelings.

11. Democratic.

In a democratic class, each member of the class has as much influence as any other member. Wrightstone (1951) found that a democratic atmosphere leads to group concern and cooperation.[40] Walberg (1968) found that internal friction is negatively correlated with Democratic.[41]

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[39] Walberg, "Class Size and the Social Environment of Learning," op. cit., p. 472.

[40] Wrightstone, op. cit., p. 342.

[41] Walberg, "Structural and Affective Aspects of Classroom Climate," op. cit., p. 250.

Anderson (1969) feels that this scale has been highly overrated in the past and that it does not relate significantly to pupil learning.[42]

12. Cliqueness.

Cliqueness results when certain students stick together in small groups. Cliques are formed by three or more persons who choose one another exclusively. These subgroups within the class can lead to internal friction in the classroom. Research by Anderson, Walberg, and Welch (1969) showed that Cliqueness was higher in traditional courses than in the Project Physics Course.[43]

13. Satisfaction.

Satisfaction implies that students like their class work. Learning is greatly affected by whether or not the students like their class. Frustrations that result from dislike of classmates, the subject, or the teacher hinder the process of learning. Walberg (1968) found that Goal Direction was positively correlated with Satisfaction.[44] Anderson (1970) found that Satisfaction is negatively correlated to class size.[45] Satisfaction with school is a goal of educators. The relationships between this scale and the composition of the class may help determine the

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[42] Anderson, op. cit., p. 13.

[43] Ibid.

[44] Walberg, "Structural and Affective Aspects of Classroom Climate," op. cit., p. 250.

[45] Anderson, op. cit., p. 14.

effects of the practices of homogeneous and heterogeneous grouping, sexual and racial integration, and others..

14. Disorganization.

Disorganization results when there is a great deal of confusion during class meetings. Disorganization as perceived by students is somewhat dependent on the subject being studied. For example, Anderson (1970) found that Disorganization is highest in mathematics classes. According to Anderson and Walberg (1968), high Disorganization leads to a reduction in student learning. Walberg (1968) found that Disorganization leads to apathy, dissatisfaction, and conflict between members. In another study in the same year, he again found that internal friction was positively correlated with Disorganization.[46]

15. Competitiveness.

Competitiveness implies that much class time is spent on student activities and discussions which encourage the student to try to do better than others in the class. Intragroup competitiveness tends to decrease cohesiveness of a group. Competitiveness is less desirable to group members than a cooperative relationship. It produces greater personal anxiety through the individual's expectations of hostility from others. This fear and anxiety in members tends to inhibit communication. There has been little available evidence that Competitiveness is related to the course being studied.[47]

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[46] Walberg, "Structural and Affective Aspects of Classroom Climate," op. cit., p. 250.

[47] Anderson, op. cit., p. 15.

Chapter 3

RESULTS

The Learning Environment Inventory was administered to the students at approximately midway during the school year. This test was not designed to be given as a pre-post test since the student's overall learning environment in a particular class is expected to remain stable.

The first results to be discussed will be mean scores of the fifteen scales. Means from this test are given for seven different groups of classes in Table 1. The scale for competitiveness has been added since the national survey was taken. Table 1 allows one to compare the means of each scale in one group to the corresponding means of each scale in another group. It must be remembered that a low score indicates strong agreement with the scale and a high score indicates strong disagreement.

Before discussing the differences that are indicated by Table 1, it is necessary to test the differences to see if they are statistically significant. This was done using the t test. Table 2 shows the t values for each scale in various groups. The t values indicate that there are significant differences at the .05 level of confidence in some groups for some particular scales.

Table 1

Class Means and Standard Deviations for the LEI Scales

SCALE	NORTH CAROLINA (1972 Data)			NORTH CAROLINA (1971 Data)		NATIONAL NORMS (1967 Data)	
	1st yr. PP Teachers (13 classes)	2nd yr. PP Teachers (5 classes)	Both 1st & 2nd yr. PP Teachers (18 classes)	PP (4 classes)	Traditional (16 classes)	PP (47 classes)	Traditional (37 classes)
Mean Class Size	16.8	19.6	17.6	23	15.1	24.3	24.3
Cohesiveness	12.28 3.2	11.76 2.7	12.12 3.0	12.62 3.1	12.55 3.1	15.12 2.03	13.93 1.96
Diversity	15.36 2.2	14.82 2.4	15.19 2.3	14.78 2.0	14.96 2.2	15.05 0.84	15.54 0.84
Formality	19.05 2.7	16.56 3.1	18.28 3.0	16.72 2.5	17.41 2.7	17.43 1.40	17.22 1.33
Speed	19.41 3.4	18.89 3.5	19.25 3.4	18.79 2.4	17.64 3.7	18.62 1.40	18.13 2.03
Environment	15.32 3.2	14.07 3.4	14.93 3.3	14.21 3.0	15.13 3.0	14.07 1.33	15.12 1.26
Friction	19.84 3.8	21.01 3.7	20.20 3.8	20.34 3.3	20.35 3.4	20.02 1.89	19.81 2.10
Goal Direction	17.61 4.5	14.78 3.9	16.73 4.5	15.33 3.5	15.91 4.0	17.36 1.89	16.03 1.68
Favoritism	21.23 3.7	22.67 3.3	21.68 3.7	22.16 3.0	21.75 3.6	22.40 1.33	22.12 1.40

Table 1 (Continued)

SCALE	NORTH CAROLINA (1972 Data)			NORTH CAROLINA (1971 Data)		NATIONAL NORMS (1967 Data)	
	1st yr. PP Teachers (13 classes)	2nd Yr. PP Teachers (5 classes)	Both 1st & 2nd yr. PP Teachers (18 classes)	PP (4 classes)	Traditional (16 classes)	PP (47 classes)	Traditional (37 classes)
Mean Class Size	16.8	19.6	17.6	23	15.1	24.3	24.3
Cliqueness	16.61 3.8	17.81 3.4	16.98 3.7	18.30 3.6	17.11 3.1	17.08 1.54	16.73 2.03
Satisfaction	17.67 4.4	15.33 3.7	16.95 4.3	15.00 3.7	16.38 3.9	16.38 1.75	15.96 1.54
Disorganization	17.81 4.5	21.18 3.5	18.85 4.5	21.48 3.7	20.23 4.2	20.16 1.89	20.65 2.03
Difficulty	15.19 3.2	13.72 2.4	14.73 3.1	14.65 2.2	13.75 2.7	15.75 1.40	14.63 1.47
Apathy	19.01 4.1	20.63 4.1	19.51 4.2	21.05 3.4	19.89 3.8	19.67 1.68	19.88 1.89
Democratic	16.97 3.2	15.21 3.3	16.43 3.3	16.37 3.1	16.88 3.4	16.80 1.33	17.15 1.40
Competitiveness	15.64 2.5	14.70 2.5	15.35 2.6	15.90 2.7	15.39 2.2	- -	- -

Note: National norms obtained by Anderson, Walberg and Welch for 1967 were based on 47 Project Physics classes and 37 traditional physics classes in the United States.

Table 2

Results of t Tests of Significance

SCALE	PP			TRAD	TRAD & PP
	Nat. (1967) and N.C. (1972)	1st yr. N.C. (1972) and 2nd yr. N.C. (1972)	1st yr. N.C. (1971) and * 2nd yr. N.C. (1972)	Nat. (1967) and N.C. (1971)	N.C. Trad. (1971) PP (1972)
Cohesiveness	20.674	1.441	2.069	8.449	1.625
Diversity	1.709	1.972	0.102	6.437	1.196
Formality	7.131	7.302	0.381	1.535	3.517
Speed	4.909	1.260	0.216	2.729	5.316
Environment	6.999	3.150	0.290	0.077	0.728
Friction	1.158	2.531	1.312	3.045	0.459
Goal Direction	3.700	5.415	1.016	0.703	2.259
Favoritism	5.476	3.292	1.105	2.468	0.229
Cliqueness	0.717	2.687	0.984	2.278	0.444
Satisfaction	3.530	4.590	0.608	2.575	1.588
Disorganization	7.693	6.562	0.560	2.198	3.692
Difficulty	8.478	4.007	2.711	6.760	3.967
Apathy	1.032	3.254	0.766	0.057	1.114
Democratic	3.006	4.493	2.460	1.860	1.579
Competitiveness	-	3.017	3.427	-	0.201

* Same teachers tested in 1971 and 1972

t = 1.960 for significance at the .05 level of confidence
t = 2.576 for significance at the .01 level of confidence

In comparing the scores on the Learning Environment Inventory of North Carolina students taking Project Physics in 1972 with the scores of students in the United States taking Project Physics in 1967, it was found that classrooms in North Carolina show the following properties:

1. They are more cohesive
2. They are less formal
3. They are less rushed
4. The physical environment is less favorable
5. There is more goal direction
6. There is more favoritism on the part of teachers
7. There is less satisfaction among students
8. There is more disorganization
9. They are more difficult
10. The classes are more democratic.

The learning environment in North Carolina Project Physics classes appears to be less favorable than that of Project Physics classes in the United States. All the North Carolina Project Physics teachers were trained to teach the course. Since Project Physics has been used in North Carolina for only two years, these teachers are probably not as experienced as those on the national level.

In comparing the scores of North Carolina students of first-year teachers of Project Physics with the scores of the students of second-year teachers of Project Physics, it was found that the classrooms of second-year teachers show the following properties:

1. They are more diverse

2. They are more formal
3. The physical environment is more favorable
4. They have less friction
5. They are more goal directed
6. There is less favoritism on the part of teachers
7. There is less cliqueness
8. The students are more satisfied
9. There is less disorganization
10. They are more difficult
11. There is less apathy
12. The classes are more democratic
13. There is more competitiveness.

It appears that the second-year Project Physics teachers provide a better classroom climate in many respects. This is probably due to their increased familiarity with the course and its components. However, they could improve their classes by making physics appear less difficult.

The scores of the students of first-year teachers of Project Physics in North Carolina were compared with the scores of the students of these teachers the second year they taught Project Physics in North Carolina. The classrooms of these teachers in their second year of teaching show the following properties:

1. They are more cohesive
2. They are more difficult
3. The classes are more democratic
4. There is more competitiveness.

These teachers did not appear to change very much during their second year of teaching Project Physics. This was probably due to the fact that they were already good teachers.

In comparing the scores of North Carolina students taking traditional physics in 1971 with the scores of students in the United States taking traditional physics in 1967, it was found that classrooms in North Carolina show the following properties:

1. They are more cohesive
2. They are more diverse
3. They are more rushed
4. They have less friction
5. There is more favoritism on the part of teachers
6. There is less cliqueness
7. There is less satisfaction among students
8. There is more disorganization
9. They are more difficult.

Since the students in North Carolina traditional classes are less satisfied and see physics as being more difficult than students on the national level, some improvements need to be made. The researcher believes that implementation of the Project Physics Course would be the solution to this problem.

In comparing the scores of North Carolina students taking Project Physics with the scores of North Carolina students taking traditional physics, it was found that Project Physics classrooms show the following properties:

1. They are less formal

2. The students are less rushed

3. There is less goal direction

4. There is more disorganization

5. They are less difficult.

The environment in Project Physics classrooms was found to be more conducive to learning than the environment in traditional classrooms. One of the goals of Project Physics is that of making physics appear less difficult to students. Project Physics is successful in this attempt. In traditional courses, it has been consistently demonstrated that high disorganization leads to a reduction in pupil learning. The Project Physics Course was designed to be somewhat disorganized so that students could choose their own goals; therefore, this disorganization should lead to an increase in student learning.

This researcher was interested in seeing how the various scales were intercorrelated in the classes studied. Table 3 shows the intercorrelations of the scales on the LEI for various groups. The highly correlated scales are lished in Table 4. It can be concluded that several of these highly correlated scales are common to all the groups:

1. Cliqueness is positively correlated to Friction

2. Satisfaction is positively correlated to Goal Direction

3. Democratic is negatively correlated to Favoritism

4. Disorganization is negatively correlated to Goal Direction and Satisfaction

5. Apathy is positively correlated to Disorganization and negatively correlated to Goal Direction and Satisfaction.

Table 3a

Intercorrelations for 1st Year PP Teachers in N. C. (1972 Data)

	Scale	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1.	Cohesiveness	-														
2.	Diversity	-14	-													
3.	Formality	-04	-07	-												
4.	Speed	-25	-02	17	-											
5.	Environment	22	-06	23	23	-										
6.	Friction	-33	31	-15	06	-32	-									
7.	Goal Direction	11	-12	51	-12	55	-32	-								
8.	Favoritism	-44	09	-07	28	-39	39	-34	-							
9.	Cliqueness	-30	24	-23	-06	-27	65	-31	30	-						
10.	Satisfaction	22	-11	40	-15	57	-38	73	-36	-35	-					
11.	Disorganization	-15	17	-52	-01	-45	42	-73	34	38	-69	-				
12.	Difficulty	05	02	23	38	20	-17	16	-01	-13	15	-20	-			
13.	Apathy	-32	26	-33	17	-40	35	-57	23	33	-54	51	-09	-		
14.	Democratic	27	-16	23	-26	24	-32	38	-59	-35	36	-41	-04	-27	-	
15.	Competitiveness	32	02	10	-22	41	-25	34	-35	-23	39	-30	05	-26	21	-

Note: Correlations are based on 13 classes. Decimals have been omitted. Read correlations in hundredths.

Table 3b

Intercorrelations for 2nd Year PP Teachers in N. C. (1972 Data)

	Scale	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1.	Cohesiveness	-														
2.	Diversity	09	-													
3.	Formality	26	05	-												
4.	Speed	-32	-04	-37	-											
5.	Environment	46	-11	37	-32	-										
6.	Friction	-43	09	-07	24	-22	-									
7.	Goal Direction	44	00	57	-55	57	-32	-								
8.	Favoritism	-34	-13	-22	43	-30	45	-51	-							
9.	Cliqueness	-32	30	-22	12	-31	56	-21	35	-						
10.	Satisfaction	44	-04	32	-69	48	-38	71	-47	-22	-					
11.	Disorganization	-41	08	-49	62	-42	39	-72	45	29	-74	-				
12.	Difficulty	16	11	04	25	13	12	-02	14	10	-15	08	-			
13.	Apathy	-63	-04	-34	40	-44	46	-74	44	33	-67	61	-01	-		
14.	Democratic	33	01	33	-43	23	-41	47	-67	-50	43	-38	-12	-50	-	
15.	Competitiveness	38	08	-11	-19	19	-38	29	-27	-11	39	-32	11	-36	16	-

Note: Correlations are based on 5 classes. Decimals have been omitted. Read correlations in hundredths.

Table 3c

Intercorrelations for Combined 1st & 2nd Year PP Teachers in N. C. (1972 Data)

	Scale	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1.	Cohesiveness	-														
2.	Diversity	-06	-													
3.	Formality	08	02	-												
4.	Speed	-26	-02	01	-											
5.	Environment	30	-06	32	-24	-										
6.	Friction	-36	22	-17	10	-30	-									
7.	Goal Direction	21	-05	57	-21	57	-34	-								
8.	Favoritism	-42	01	-18	31	-38	42	-41	-							
9.	Cliqueness	-32	24	-26	-02	-30	63	-31	33	-						
10.	Satisfaction	28	-06	43	-27	56	-40	75	-42	-34	-					
11.	Disorganization	-23	10	-57	12	-46	43	-76	40	38	-72	-				
12.	Difficulty	09	06	24	35	21	-12	18	-01	-10	13	-21	-			
13.	Apathy	-41	14	-37	22	-43	39	-63	32	35	-59	56	-11	-		
14.	Democratic	30	-07	33	-29	27	-37	45	-63	-41	42	-45	00	-37	-	
15.	Competitiveness	34	06	09	-20	36	-31	35	-35	-21	41	-34	10	-31	23	-

Note: Correlations are based on 18 classes. Decimals have been omitted. Read correlations in hundredths.

Table 3d

Intercorrelations for PP Teachers (1971 Data)

	Scale	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1.	Cohesiveness	-														
2.	Diversity	06	-													
3.	Formality	04	01	-												
4.	Speed	-20	19	-17	-											
5.	Environment	21	-13	25	-26	-										
6.	Friction	-38	21	-22	31	-49	-									
7.	Goal Direction	24	-08	43	-41	62	-45	-								
8.	Favoritism	-41	19	-10	31	-44	48	-52	-							
9.	Cliqueness	-42	34	02	15	-41	50	-30	58	-						
10.	Satisfaction	39	-14	22	-45	62	-51	75	-58	-42	-					
11.	Disorganization	-36	23	-35	47	-63	58	-70	64	42	-74	-				
12.	Difficulty	19	01	06	10	14	-28	03	-01	-15	01	-10	-			
13.	Apathy	-38	08	-23	34	-64	53	-65	51	46	-64	63	-05	-		
14.	Democratic	54	-20	16	-46	53	-42	48	-56	-48	64	-58	-07	-51	-	
15.	Competitiveness	34	09	-22	-18	15	-14	13	-24	-16	23	-09	05	-30	17	-

Note: Correlations are based on 4 classes. Decimals have been omitted. Read correlations in hundredths.

Table 3e

Intercorrelations for Traditional Teachers (1971 Data)

	Scale	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1.	Cohesiveness	-														
2.	Diversity	-16	-													
3.	Formality	01	04	-												
4.	Speed	-18	12	-08	-											
5.	Environment	37	04	16	-24	-										
6.	Friction	-39	33	-11	19	-23	-									
7.	Goal Direction	28	-01	45	-18	44	-33	-								
8.	Favoritism	-39	15	-11	33	-27	52	-38	-							
9.	Cliqueness	-38	27	-15	25	23	58	-31	44	-						
10.	Satisfaction	36	-17	36	-23	39	-38	66	-34	-46	-					
11.	Disorganization	-31	06	-50	13	-42	-42	-68	34	35	-73	-				
12.	Difficulty	04	12	02	42	07	06	10	18	19	01	-17	-			
13.	Apathy	-32	10	-41	10	-24	39	-60	39	46	-68	61	-01	-		
14.	Democratic	35	-18	20	-43	27	-48	37	-68	-49	39	-34	-23	-40	-	
15.	Competitiveness	25	08	00	-09	34	-28	46	-26	-23	41	-36	13	-35	27	-

Note: Correlations are based on 16 classes. Decimals have been omitted. Read correlations in hundredths.

Table 4a

Highly Intercorrelated Scales

GROUP	POSITIVE Correlation Coefficient Range (.5) - (1)		NEGATIVE Correlation Coefficient Range (-1) - (-.5)	
1st yr. PP Teachers (1972 Data)	goal direction	formality	disorganization	formality
	goal direction	environment	disorganization	goal direction
	cliqueness	friction	disorganization	satisfaction
	satisfaction	environment	apathy	goal direction
	satisfaction	goal direction	apathy	satisfaction
	apathy	disorganization	democratic	favoritism
2nd yr. PP Teachers (1972 Data)	goal direction	formality	goal direction	speed
	goal direction	environment	favoritism	goal direction
	cliqueness	friction	satisfaction	speed
	satisfaction	goal direction	disorganization	goal direction
	disorganization	speed	disorganization	satisfaction
	apathy	disorganization	apathy	cohesiveness
			apathy	goal direction
			apathy	satisfaction
			democratic	favoritism
			democratic	cliqueness
			democratic	apathy
Combined 1st & 2nd yr. PP Teachers (1972 Data)	goal direction	formality	disorganization	formality
	goal direction	environment	disorganization	goal direction
	cliqueness	friction	disorganization	satisfaction
	satisfaction	environment	apathy	goal direction
	satisfaction	goal direction	apathy	satisfaction
	apathy	disorganization	democratic	favoritism

Table 4b

Highly Intercorrelated Scales

GROUP	POSITIVE Correlation Coefficient Range (.5) - (1)		NEGATIVE Correlation Coefficient Range (-1) - (-.5)	
PP (1971 Data)	goal direction	environment	favoritism	goal direction
	cliqueness	friction	satisfaction	friction
	cliqueness	favoritism	satisfaction	favoritism
	satisfaction	environment	disorganization	environment
	satisfaction	goal direction	disorganization	goal direction
	disorganization	friction	disorganization	satisfaction
	disorganization	favoritism	apathy	environment
	apathy	friction	apathy	goal direction
	apathy	favoritism	apathy	satisfaction
	apathy	disorganization	democratic	favortism
	democratic	cohesiveness	democratic	disorganization
	democratic	environment	democratic	apathy
	democratic	satisfaction		
Traditional (1971 Data)	favoritism	friction	disorganization	formality
	cliqueness	friction	disorganization	goal direction
	satisfaction	goal direction	disorganization	satisfaction
	apathy	disorganization	apathy	goal direction
			apathy	satisfaction
			democratic	favoritism

Chapter 4

SUMMARY AND RECOMMENDATIONS

Summary of Procedures

The purpose of this study was to learn about the learning environment in some physics classrooms in the secondary schools of North Carolina. The sample consisted of about forty physics classes. These classes were divided according to their curriculum, Project Physics or traditional physics. In attempting to learn about the environment of the classrooms, only one test was administered, the Learning Environment Inventory. Computer programs were used to score the tests and to make statistical analyses.

Summary of Conclusions

1. Compared to traditional classrooms in North Carolina, Project Physics classrooms in North Carolina are less formal, less goal directed, less difficult, less rushed, and are more disorganized. These results indicate that the classroom environment in Project Physics classes is more favorable than that in the traditional classrooms. This comparison was the main interest of the researcher.
2. The more experienced Project Physics teachers obtained better ratings on environment due to the wealth of materials such as books and apparatus provided with the course. Their students are more satisfied than are the students of less

experienced Project Physics teachers. According to Anderson, environment is positively correlated to pupil learning.[1]

3. Compared with the national level, physics classes in general in North Carolina are more cohesive, more disorganized, more difficult, show more favoritism on the part of teachers, and students are less satisfied. From these LEI indications, it is concluded that the learning environment in North Carolina secondary school physics classes needs to be improved.

4. In physics classrooms in North Carolina, Satisfaction and Goal Direction are the most positively correlated scales. Disorganization is most negatively correlated to Goal Direction and Satisfaction.

Recommendations for Scoring

During this study, several problems arose with regard to scoring the individual answer sheets. Suggestions on ways to avoid these problems will be discussed in this section.

1. Identification numbers should be established on every student's answer sheet. This is time consuming but it allows the researcher to readily identify schools for comparison.

2. When the test is administered, it should be stressed that all statements are to be answered, erasures should be complete, and stray marks should be avoided. The student's pencil

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[1] Gary J. Anderson, The Learning Environment Inventory Manual (Montreal: Centre for Learning and Development, McGill University, 1969), p. 10.

point should not touch the answer sheet unless he intends to mark an answer.

3. If the researcher uses form 510 IBM answer sheets, all students should be instructed not to mark column 5 when they really intend to mark column 4 on their answer sheets.
4. The standard computer test grading procedure will help locate all stray marks, double answers, and column 5 answers.
5. If the scores in the Learning Environment Inventory manual by Anderson are used, the response columns 1, 2, 3, 4 should be reversed when comparing the scores with this researcher's results. Particular attention should be paid to the meaning of columns 1, 2, 3, and 4. The relationship between these two scoring procedures is found in Appendix E.

Recommendations for Future Studies

Using the LEI and other tests, the following topics for future research studies would be worthwhile.

1. Probably the most valuable research will be a study to compare the LEI scale results obtained in this study with the scores on the Physics Achievement Test (PAT) and the Test On Understanding Science (TOUS) which were also obtained this year.
2. An evaluation of the learning environment in other science classes such as chemistry and biology would be worthwhile.
3. A study to determine what correlations exist between the LEI scores, students' sex, and teachers' sex.

4. A researcher might investigate all IQ levels (low, medium, and high) and how they relate to the scales on the LEI.
5. How do scores on the LEI scales compare with attitude scores and personality scores of the teacher as measured by the Minnesota Teacher Attitude Inventory and the Allport - Vernon - Lindzey Study of Values?

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APPENDICES

APPENDIX A

Learning Environment Inventory Test

LEARNING ENVIRONMENT INVENTORY

This test was developed for research purposes at Harvard University by Herbert J. Walberg and Gary J. Anderson.

LEARNING ENVIRONMENT INVENTORY

Directions

The purpose of the questions in this booklet is to find out what your class is like. This is not a "test." You are asked to give your honest, frank opinions about the class which you are now attending.

Record your answer to each of the questions on the separate answer sheet provided. Please make no marks on the booklet itself. Answer every question.

In answering each question go through the following steps:

1. Read the statement carefully.
2. Think about how well the statement describes your class (the one you are now in).
3. Find the number on the answer sheet that corresponds to the statement you are considering.
4. Blacken the space on the answer sheet according to the following instructions:

   If you strongly agree with the statement, blacken space 1.
   If you agree with the statement, blacken space 2.
   If you disagree with the statement, blacken space 3.
   If you strongly disagree with the statement, blacken space 4.

5. You will have approximately 40 minutes to complete the 105 questions in the booklet. Be sure the number on the answer sheet corresponds to the number of the statement being answered in the booklet.

		Strongly agree	Agree	Disagree	Strongly disagree
1.	Members of the class do favors for one another.	1	2	3	4
2.	The books and equipment students need or want are easily available to them in the classroom.	1	2	3	4
3.	There are long periods during which the class does nothing.	1	2	3	4
4.	The class has students with many different interests.	1	2	3	4
5.	Certain students work only with their close friends.	1	2	3	4
6.	The students enjoy their class work.	1	2	3	4
7.	Students who break the rules are penalized.	1	2	3	4
8.	There is constant bickering among class members.	1	2	3	4
9.	The better students' questions are more sympathetically answered than those of the average students.	1	2	3	4
10.	The class knows exactly what it has to get done.	1	2	3	4
11.	There does not appear to be a group of interests shared by all members of the class.	1	2	3	4
12.	A good collection of books and magazines is available in the classroom for students to use.	1	2	3	4
13.	The class goes at a pace best suited for the smartest students.	1	2	3	4
14.	Every member of the class enjoys the same privileges.	1	2	3	4
15.	Students are seldom called upon to participate in the work of the class.	1	2	3	4
16.	The class has rules to guide its activities.	1	2	3	4
17.	Personal dissatisfaction with the class is too small to be a problem.	1	2	3	4
18.	A student has the chance to get to know all other students in the class.	1	2	3	4
19.	The work of the class is frequently interrupted when some students have nothing to do.	1	2	3	4
20.	Students cooperate equally with all class members.	1	2	3	4
21.	Many students are dissatisfied with much that the class does.	1	2	3	4
22.	The better students are granted special privileges.	1	2	3	4
23.	The objectives of the class are not clearly recognized.	1	2	3	4
24.	Only the good students are given special projects.	1	2	3	4
25.	Class decisions tend to be made by all the students.	1	2	3	4
26.	The students would be proud to show the classroom to a visitor.	1	2	3	4
27.	The pace of the class is rushed.	1	2	3	4

		Strongly agree	Agree	Disagree	Strongly disagree
28.	Some students refuse to mix with the rest of the class.	1	2	3	4
29.	Decisions affecting the class tend to be made democratically.	1	2	3	4
30.	Certain students have no respect for other students.	1	2	3	4
31.	Some groups of students work together regardless of what the rest of the class is doing.	1	2	3	4
32.	Members of the class are personal friends.	1	2	3	4
33.	The class is well organized.	1	2	3	4
34.	Some students are interested in completely different things than other students.	1	2	3	4
35.	Certain students have more influence on the class than others.	1	2	3	4
36.	The room is bright and comfortable.	1	2	3	4
37.	Class members tend to pursue different kinds of problems.	1	2	3	4
38.	There is considerable dissatisfaction with the work of the class.	1	2	3	4
39.	Failure of the class would mean little to individual members.	1	2	3	4
40.	The class is disorganized.	1	2	3	4
41.	Much of the class time is spent on student activities and discussion.	1	2	3	4
42.	Certain students impose their wishes on the whole class.	1	2	3	4
43.	Most of the course material is covered in lectures and demonstrations.	1	2	3	4
44.	There are tensions among certain groups of students that tend to interfere with class activities.	1	2	3	4
45.	The class is well-organized and efficient.	1	2	3	4
46.	Students are constantly challenged.	1	2	3	4
47.	Students are required to follow the textbook closely.	1	2	3	4
48.	Students are asked to follow a complicated set of rules.	1	2	3	4
49.	The class is controlled by the actions of a few members who are favored.	1	2	3	4
50.	Students don't care about the future of the class as a group.	1	2	3	4

		Strongly agree	Agree	Disagree	Strongly disagree
51.	Each member of the class has as much influence as any other member.	1	2	3	4
52.	The members look forward to coming to class meetings.	1	2	3	4
53.	The subject studied requires no particular aptitude on the part of the students.	1	2	3	4
54.	Members of the class don't care what the class does.	1	2	3	4
55.	There are displays around the room.	1	2	3	4
56.	All students know each other very well.	1	2	3	4
57.	The classroom is too crowded.	1	2	3	4
58.	Students are not in close enough contact to develop likes or dislikes for one another.	1	2	3	4
59.	The class is rather informal and few rules are imposed.	1	2	3	4
60.	Students have little idea of what the class is attempting to accomplish.	1	2	3	4
61.	There is a recognized right and wrong way of going about class activities.	1	2	3	4
62.	What the class does is determined by all the students.	1	2	3	4
63.	After the class, the students have a sense of satisfaction.	1	2	3	4
64.	Students often make presentations to the rest of the class.	1	2	3	4
65.	Students are encouraged to find out many things for themselves.	1	2	3	4
66.	Students in the class tend to be much brighter than those in the rest of the school.	1	2	3	4
67.	Each student knows the goals of the course.	1	2	3	4
68.	All classroom procedures are well-established.	1	2	3	4
69.	Certain students in the class are responsible for petty quarrels.	1	2	3	4
70.	Many class members are confused by what goes on in class.	1	2	3	4
71.	The class is made up of individuals who do not know each other well.	1	2	3	4
72.	The class divides its efforts among several purposes.	1	2	3	4

		Strongly agree	Agree	Disagree	Strongly disagree
73.	The class has plenty of time to cover the prescribed amount of work.	1	2	3	4
74.	Students who have past histories of being discipline problems are discriminated against.	1	2	3	4
75.	Students do not have to hurry to finish their work.	1	2	3	4
76.	Certain groups of friends tend to sit together.	1	2	3	4
77.	Students have to memorize specific information.	1	2	3	4
78.	The subject presentation is too elementary for many students.	1	2	3	4
79.	Students are well-satisfied with the work of the class.	1	2	3	4
80.	A few members of the class have much greater influence than the other members.	1	2	3	4
81.	There is a set of rules for the students to follow.	1	2	3	4
82.	Certain students don't like other students.	1	2	3	4
83.	The class realizes exactly how much work it is required to do.	1	2	3	4
84.	Students share a common concern for the success of the class.	1	2	3	4
85.	There is little time for day-dreaming.	1	2	3	4
86.	The class is working toward many different goals.	1	2	3	4
87.	The class members feel rushed to finish their work.	1	2	3	4
88.	Certain students are considered uncooperative.	1	2	3	4
89.	Most students sincerely want the class to be a success.	1	2	3	4
90.	There is enough room for both individual and group work.	1	2	3	4
91.	Each student knows the other members of the class by their first names.	1	2	3	4
92.	Failure of the class would mean nothing to most members.	1	2	3	4
93.	The class has difficulty keeping up with its assigned work.	1	2	3	4
94.	There is a great deal of confusion during class meetings.	1	2	3	4
95.	Different students vary a great deal regarding which aspect of the class they are interested in.	1	2	3	4

		1. Strongly agree	2. Agree	3. Disagree	4. Strongly disagree
96.	Each student in the class has a clear idea of the class goals.	1	2	3	4
97.	Most students cooperate equally with other class members.	1	2	3	4
98.	Certain students are favored more than the rest.	1	2	3	4
99.	Students have a great concern for the progress of the class.	1	2	3	4
100.	Certain students stick together in small groups.	1	2	3	4
101.	Most students consider the subject-matter easy.	1	2	3	4
102.	Students do not have time to ask questions during class.	1	2	3	4
103.	There is an undercurrent of feeling among students that tends to pull the class apart.	1	2	3	4
104.	Many students in the school would have difficulty doing the advanced work of the class.	1	2	3	4
105.	The objectives of the class are specific.	1	2	3	4

APPENDIX B

Letter to Principals

January 31, 1972

Principal
County or City, North Carolina

During the past two summers, The Department of Science Education at East Carolina University has offered institutes to prepare teachers to implement the Project Physics Course. As a result, there are now twenty-three schools which are presenting the Course using textbooks, apparatus, and supplementary materials.

In order to evaluate the effectiveness of the Course and the institute program, it is necessary that we study Project Physics students. Therefore, we would like your permission to give three tests to your students according to the plan on the attached sheet. The total testing time will require two class periods. To insure uniformity of procedures, it is quite desirable that a guidance counselor administer the tests.

You are assured that (1) the results from your school will not be singled out in written or oral reports unless we receive permission from you, (2) you and the teacher will receive a report of our findings, and (3) test results for individual classes will be made available to teachers who request them.

The evaluation will be carried out under my direction as part of a master's thesis by Mr. Hal Pierce, who has taught physics in high school and attended our 1971 summer institute. This project is a continuation of work which was initiated last year by Mr. Stephen Bierma.

We look forward to receiving approval from you soon. Call me collect if you have questions.

Sincerely,

Robert L. Dough
Associate Professor

Enclosures

APPENDIX B (Continued)

January 31, 1972

Tests To Be Administered

1. The following test is to be given to all members of a class preferably during the week of February 21 - 25. Testing time will be 40 minutes.

Learning Environment Inventory

The purpose of this test is to find out what the classroom climate is like from the standpoint of satisfaction, goal diversity, goal direction, disorganization, etc. There are 105 questions which are to be grouped into 15 dimensions (four are given in the previous sentence). The questions are answered on an agree-disagree basis using a 4 point scale. Comparisons can be made with national and local norms.

2. The following two tests are to be administered at the same time, preferably during the week of May 15 - 19. Testing time will be 40 minutes. Half of the class will take the TOUS and the other half the PAT.

Test On Understanding Science (TOUS)

This is a test on the general nature of science, scientists, and the ways in which scientists work. There are 60 four-option multiple-choice items. National and local norms will be used for comparisons.

Physics Achievement Test (PAT)

This is subject-matter test with more emphasis on historical, philosophical, and interdisciplinary items than are found on other national tests. It was developed specifically for Project Physics students. There are 40 five-option multiple-choice items.

APPENDIX B (Continued)

Dr. Robert L. Dough
Department of Science Education
East Carolina University
Greenville, N. C.

Dear Dr. Dough:

We authorize you to test our Project Physics class(es) in the manner you have indicated in your letter of January 31, 1972. The person who will administer the tests is indicated below.

(signature) _____

(school) _____

person who will administer the tests: _____

additional comments:

APPENDIX C

Instructions for Guidance Counselors

To: Schools in Project Physics Evaluation Program
From: Dr. Robert L. Dough
Subject: Mid-year test

For the first part of our 1971-72 evaluation study, you are requested to administer the Learning Environment Inventory (LEI) to the Project Physics students. The tests should be given during the week of February 21 - 25 if possible. The testing time is 40 minutes. The final phase of our study will take place in late April or early May.

Thank you for your cooperation. If you have any questions, call me collect at 758-6736.

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please return this sheet to the address given below (an address label and stamps are enclosed).

to: Dr. Robert L. Dough
Department of Science Education
East Carolina University
P. O. Box 2792
Greenville, N. C. 27834

number of tests enclosed _____; returned _____

Person administering test _____
date test was administered _____
school _____

number in class _____; number present _____

comments on the class (during testing period) _____
_____
_____

other comments _____
_____
_____

Please treat these tests as confidential.

APPENDIX C (Continued)

PROCEDURE FOR ADMINISTERING THE
LEARNING ENVIRONMENT INVENTORY

For this testing period, the LEI will be given (40 minutes). The order in which you should proceed in giving these tests is listed below.

1. No special seating arrangements are necessary

2. Hand out the IBM red answer sheets that have answers listed as 1, 2, 3, 4, 5. Give just one answer sheet to each person.

3. All marks that are made on the answer sheet must be made with a #2 pencil. Number 3 pencils will not work. All tests will be scored by an optical reader and a computer.

4. On the answer sheet, the students should be instructed to fill in all the information requested. eg. name, date...
   For name of test, put LEI.
   Do not fill in the Identification Number.

5. While the students are working on item 4, the person administering the tests can proceed to hand out the tests.

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6. Read directions inside test booklet clearly. Be sure that the students understand that this is an opinion-type test, there are no correct answers.

7. Point out that the choices are only 1, 2, 3, or 4. Column 5 on the answer sheet should not be used.

8. Ask if there are any questions: Remind the students to answer honestly so as to insure meaningful results. Note your time and allow 40 minutes for students to complete test.

APPENDIX D

Reliability of Scales

The Cronbach alpha reliability coefficient is a measure of internal consistency and indicates the extent to which an individual responds similarly for each item on the scale. The Fisher intraclass correlation coefficient indicates the extent to which pupils within the same class respond similarly and the extent to which the scale discriminates among classes. In the table below, the 1967 data are based on a random sample of 29 Project Physics classes which consisted of 464 students. The 1969 data include 64 classes in a variety of subject areas and 1048 students. These coefficients were obtained by Anderson and can be found in The Learning Environment Inventory Manual.

Alpha and Intraclass Coefficients

Scale	Alpha		Intraclass	
	1967	1969	1967	1969
*	20	13	65	49
Cohesiveness	78	69	82	85
Diversity	58	54	43	31
Formality	64	76	82	92
Speed	77	70	71	81
Environment	65	56	76	81
Friction	78	72	77	83
Goal Direction	86	85	71	75
Favoritism	77	78	53	76
Cliqueness	74	65	77	71
Satisfaction	80	79	74	84
Disorganization	81	82	82	92
Difficulty	66	64	84	78
Apathy	83	82	79	74
Democratic	67	67	54	67
Competitiveness	78	78	-	56

* Correlation Coefficient for .01 level of confidence

Note: Decimals have been omitted. Read correlations in hundredths.

APPENDIX E

Score Conversion

Due to the different constructions of the test, it is sometimes necessary to use a conversion before comparing means. Two different methods of responding to the statements are sometimes used.

Method A: 1. Strongly agree; 2. Agree; 3. Disagree; 4. Strongly disagree.
Method B: 1. Strongly disagree; 2. Disagree; 3. Agree; 4. Strongly agree.

Since there are seven statements in each scale and four possible choices for each statement, the maximum score is twenty-eight. The score of a student for a particular scale is obtained by adding the seven responses. If all ones are marked, the score for the scale will be 7; all twos will give a score of 14; all threes, a score of 21; and all fours, a score of 28. Careful attention needs to be paid to the meaning of the choices. A score of 28 using Method A indicates strong disagreement while a score of 28 using Method B indicates strong agreement. A score of 7 for Method A will be the same as a score of 28 for Method B since both scores indicate strong agreement.

Method A	7	14	21	28
Method B	28	21	14	7

The equation expressing the relationship between Method A and Method B was found from the graph below to be $y = 35 - x$.