DOCUMENT RESUME

ED 228 308 TM 830 230

AUTHOR	Fraser, Barry J.
TITLE	Use of Classroom Environment Instruments in Person-Environment Fit Research.
INSTITUTION	Western Australian Inst. of Tech., Perth.
SPONS AGENCY	Australian Education Research and Development Committee, Canberra.
REPORT NO	ISBN-0-909848-47-5
PUB DATE	Apr 83
NOTE	73p.
PUB TYPE	Reports - Research/Technical (143) -- Tests/Evaluation Instruments (160)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	*Academic Achievement; *Classroom Environment; Evaluation Methods; Foreign Countries; Junior High Schools; *Questionnaires; *Student Attitudes; Student Characteristics; *Student Reaction
IDENTIFIERS	Australia; *Classroom Environment Scale (Trickett and Moos); *Individualized Classroom Environment Questionnaire; Person Fit Measures

ABSTRACT

A comprehensive and rigorous investigation of the person-environment fit hypothesis that students achieve better in their preferred environment is described. The design of this study included four notable features. First, the student outcome domain included a comprehensive range of six affective and three cognitive outcomes. Second, classroom environment was measured with the five scales contained in the Individualized Classroom Environment Questionnaire (ICEQ) and the nine scales which make up an instrument called the Classroom Environment Scale (CES). Third, the sample size of 116 junior high school classes was large and permitted use of the class mean as the unit of statistical analysis where this was considered appropriate. Fourth, it provided a methodological improvement in that it made use of regression surface analysis to provide a powerful multivariate method of statistical analysis which enabled person-environment interactions to be represented as the products of continuous variables. Results confirmed that students achieved better where there was a greater similarity between the actual classroom environment and that preferred by students. To facilitate future research in the area of classroom environment, attention is given to describing the ICEQ and CES and reporting the impressive validation data obtained with the present sample of 116 classes. (Author/PN)

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Western Australian Institute of Technology
FACULTY OF EDUCATION

Use of Classroom Environment Instruments in Person-Environment Fit Research

Barry J. Fraser

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BARRY J. FRASER
Western Australian Institute of Technology, Perth, Australia

Report of Study Funded by
Education Research and Development Committee
April 1983

Inquiries about availability of this publication and requests for complimentary copies should be sent to:

Barry J. Fraser
Faculty of Education
Western Australian Institute of Technology
Bentley WA 6102
Australia

International Standard Book Number

ISBN 0 909848 47 5

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PREFACE

A previous study funded by the Education Research and Development Committee (Fraser, 1980a) reported the development and use of an instrument called the Individualized Classroom Environment Questionnaire (ICEQ). This classroom environment instrument is distinctive in that it measures dimensions salient in individualized settings and because it can be used to measure student perceptions, not only of actual classroom environment, but also a preferred classroom environment. The previous report provided validation data for the ICEQ for a sample of 766 junior high school students in 34 classes and reported several research applications of the ICEQ for a subsample consisting of 285 students in 15 classes. In particular, the previous research provided some promising tentative results suggesting, first, that the nature of the actual classroom environment affected student outcomes and, second, that students achieved better when there was a greater similarity between actual classroom environment and that preferred by students.

The major purpose of the present report is to describe a more comprehensive and rigorous investigation of the person-environment fit hypothesis that students achieve better in their preferred environment. The new study provided several major improvements over Fraser's (1980a) exploratory research. First, the student outcome domain was extended to include a comprehensive range of six affective and three cognitive outcomes. Second, classroom environment was measured, not only by the five scales contained in the ICEQ, but also with another nine scales which make up an instrument called the Classroom Environment Scale (CES). Third, the sample size of 116 junior high school classes was large and permitted use of the class mean as the unit of statistical analysis where this was considered appropriate. Fourth, it provided a methodological improvement in that it made use of regression surface analysis to provide a powerful multivariate method of statistical analysis which enabled person-environment interactions to be represented as the products of continuous variables.

In addition to its major purpose of reporting the person-environment fit study in Chapter 4, the present report achieves two other important purposes. First, in order to facilitate future research in the area of classroom environment, Chapter 2 is devoted to describing the ICEQ and CES and reporting the impressive validation data obtained with the present sample of 116 classes. Second, as the data available from the study enabled a detailed investigation of the effects of actual classroom environment on student learning, the results of analyses of outcome-environment relationships are reported in Chapter 3.

As this study has benefited greatly from collaboration with Darrell L. Fisher of the Tasmanian College of Advanced Education in Launceston, his valuable contribution is acknowledged here. Some of the research described in this report has been published jointly with Dr Fisher in several articles cited elsewhere in the report.

Barry J. Fraser
Perth
April 1983

CHAPTER 1

INTRODUCTION

For many decades, the study of persons and the study of environments have tended to remain as two substantively and methodologically distinct traditions in educational research. Certainly, there is considerable scope for researchers to follow Hunt's (1975) recommendation that a person-environment interactional framework be incorporated into a wide variety of studies in education. The area of classroom learning environment provides an example of a thriving area of research which has involved many promising studies of environmental variables but hitherto has not made use of a person-environment interactional perspective. Consequently, the present investigation makes a contribution to the fields of both classroom environment and person-environment fit because it made use of classroom environment scales which assess actual and preferred environment in a person-environment fit study. In particular, the strong prior research tradition involving investigation of associations between class learning and actual classroom environment was extended to a study of relationships between class achievement and the interaction between actual classroom environment and that preferred by students. The study, therefore, was based on the intuitively plausible person-environment fit hypothesis that student preferences for a particular classroom environment could mediate relationships between class achievement and the nature of the actual classroom environment.

The main aim of the present research was to use two instruments - the Individualized Classroom Environment Questionnaire (ICEQ) and the Classroom Envrionment Scale (CES) - in an investigation of whether students achieve better when in their preferred classroom environment. In order to provide some background information and to place this present person-environment fit study into context, the following section provides a brief review of research involving student perception of psychosocial characteristics of classroom learning environment.

REVIEW OF PREVIOUS RESEARCH

Classroom environment research is now an established field of study as evidenced by several books (Moos, 1979; Walberg, 1979; Fraser, 1981a), a guest-edited journal issue (Fraser, 1980b), and recent reviews (Walberg & Haertel, 1980; Fraser, 1981b; Fraser & Walberg, 1981). Much of this research has involved use of the Learing Environment Inventory (LEI) (Anderson & Walberg, 1974; Fraser, Anderson & Walberg, 1982), which measures dimensions including Difficulty, Speed, Cohesiveness and Democracy. Nevertheless, quite a few notable studies involving the ICEQ or CES have now been completed.

The most common use of the LEI has been in studies of associations between students' cognitive and affective outcomes and their perceptions of classroom environment. In fact, outcome-environment relationships have been established using the LEI in studies conducted in the U.S.A. (Walberg, 1972; Lawrenz, 1976; Cort, 1979), Israel (Hofstein, Gluzman, Ben-Zvi & Samuel, 1979), Canada (Walberg & Anderson, 1972) India (Walberg, Singh & Rasher, 1977) and Australia (Fraser, 1979a; Fraser & Fisher, 1982a). Much of this research has formed the basis for Haertel, Walberg and Haertel's (1981) meta-analysis which established that classroom environment perceptions contribute to a greater or lesser extent to accounting for variance in learning outcomes beyond that accounted for by general ability and pretest measures and that the signs and magnitudes of relationship are surprisingly constant across studies.

Numerous studies have used student perceptions on versions of the LEI as criterion variables. In particular, classroom environment variables have been found to provide useful process criteria in curriculum evaluations in which outcome measures have shown little sensitivity (Welch & Walberg, 1972; Fraser, 1979a; Levin, 1980). Other studies have established that the nature of the classroom environment varies with teacher personality (Walberg, 1968), class size (Walberg, 1969), grade level (Welch, 1979) and subject matter (Kuert, 1979).

The CES has been used in several studies. Associations between student outcomes or classroom environment perceptions were reported by Trickett and Moos (1974), Moos and Moos (1978) and Fraser, Pearse & Azmi (1982). Other studies have used the CES to investigate differences between students and teachers in their perceptions of actual and preferred classroom environment (Fisher & Fraser, 1983), relationships between subject matter and classroom environment (Hearn & Moos, 1978), and differences in the classroom environment of different types of schools (Trickett, 1978).

The ICEQ has been used for five purposes in research in Australia. First, studies have established associations between student attitudes and their perceptions of classroom environment (Rentoul & Fraser, 1980; Fraser, 1981c; Fraser & Butts, 1982). Second, two studies have revealed consistent differences between students' and teachers' perceptions of actual and preferred classroom environment (Fraser, 1982; Fisher & Fraser, 1983). Third, the ICEQ was found useful in evaluating an innovation aimed at promoting individualized learning approaches (Fraser, 1980a). Fourth, the actual and preferred forms of the ICEQ have been used successfully by teachers in practical attempts to improve classrooms by aligning the actual environment more closely with the environment preferred by students (Fraser, 1981d; Fraser, Seddon & Eagleson, 1982). Fifth, Fraser and Rentoul (1982) have reported interesting relationships between school-level and classroom-level environment.

OVERVIEW OF OTHER CHAPTERS

Since the main purpose of the present research was to investigate the person-environment fit hypothesis of whether students achieve better in their preferred environment, a comprehensive section of this report (namely, Chapter 4) is devoted to reporting this person-environment fit investigation. But, in addition, this report achieves two other purposes in Chapter 2 and 3. Because the present investigation involved use of the actual and preferred forms of the ICEQ and CES among a large sample of students, Chapter 2 reports the comprehensive validation data generated for these instruments. Because much prior research has focused on relationships between classroom environment and student outcomes, Chapter 3 reports use of the present data base in investigating associations between students' affective and cognitive outcomes and their perceptions of classroom environment.

CHAPTER 2

DESCRIPTIVE AND VALIDATION INFORMATION FOR ICEQ AND CES

The present study made use of both the actual and preferred forms of the ICEQ and CES, which have been used to a limited degree in prior research. In order to facilitate future research, this chapter provides a brief description of the nature and development of each instrument and presents validation data based on the sample of 116 junior high school classes. In fact, the present research provides the most comprehensive statistics hitherto available for the ICEQ, the first statistics reported for the CES for a sample outside the United States, and the first data reported for any sample for the preferred form of the CES.

DEVELOPMENT OF ICEQ AND CES

The ICEQ measures perceptions of classroom environment along dimensions which differentiate conventional classrooms from open or individualized ones (Rentoul & Fraser, 1979; Fraser, 1980a). ICEQ dimensions were chosen to characterize the classroom environment described in the literature of individualized education (including open and inquiry-based classrooms) and were considered salient by a group of educational researchers, practising teachers and high school students. Preliminary versions of scales were refined by application of item analysis techniques to data collected from several different samples. Also, the ICEQ's dimensions were chosen to include at least one scale classifiable as each of the three general categories proposed by Moos (1974) for conceptualizing the individual dimensions characterizing diverse psychosocial environments. These three categories are Relationship Dimensions (nature and intensity of personal relationships), Personal Development Dimensions (basic directions along which personal growth and self-enhancement tend to occur), and System Maintenance and System Change Dimensions (extent to which the environment is orderly, clear in expectation, maintains control, and is responsive to change).

The final version of the ICEQ contains 50 items, with each of its five scales being assessed by 10 items. Each item is scored on a five-point scale with responses of Almost Never, Seldom, Sometimes, Often and Very Often. The scoring direction is reversed for many of the items. Table I clarifies the nature of the ICEQ by providing the classification according to Moos's three general categories, a scale description, and a sample item for each scale. Validation data for the ICEQ reported previously by Fraser (1980a) for a sample of 766 individual students in Australia revealed that internal consistency estimates (alpha coefficients) ranged from 0.61 to 0.79, discriminant validity indexes (mean magnitudes of the correlation of a scale with the other four scales) ranged from 0.07 to 0.28, and each scale differentiated significantly ($p<0.001$) between the perceptions of students in different classrooms.

TABLE I

Descriptive Information for each Scale in ICEQ and CES

Scale Name	Scale Description Extent to which ...	Sample Item
Individualized Classroom Environment Questionnaire (ICEQ)		
Personalization (R)	... there is emphasis on opportunities for individual students to interact with the teacher and on concern for the personal welfare and social growth of the individual	The teacher considers students' feelings. (a)
Participation (R)	... students are encouraged to participate rather than be passive listeners	The teacher lectures without students asking or answering questions. (b)
Independence (P)	... students are allowed to make decisions and have control over their own learning and behavior	Students choose their partners for group work. (a)
Investigation (P)	... there is emphasis on the skills and processes of inquiry and their use in problem-solving and investigation	Students find out the answers to questions and problems from the teacher rather than from investigations. (b)
Differentiation (S)	... there is emphasis on the selective treatment of students on the basis of ability, learning style, interests, and rate of working	Different students use different books, equipment, and materials. (a)
Classroom Environment Scale (CES)		
Involvement (R)	... students have attentive interest, participate in discussions, do additional work, and enjoy the class	Students daydream a lot in this class. (d)
Affiliation (R)	... students help each other, get to know each other easily, and enjoy working together	Students in this class get to know each other really well. (c)
Teacher Support (R)	... the teacher helps, befriends, trusts, and is interested in students	The teacher takes a personal interest in the students. (c)
Task Orientation (P)	... it is important to complete activities planned and to stay on the subject matter	The teacher often takes time out from the lesson plan to talk about other things. (d)
Competition (P)	... students compete with each other for grades and recognition	Some students always try to see who can answer questions first. (c)
Order and Organization (S)	... there is emphasis on students behaving in an orderly, quiet, and polite manner, and on the overall organization of classroom activities	Assignments are usually clear so everyone knows what to do. (c)
Rule Clarity (S)	... rules are clear, students know the consequence of breaking rules, and the teacher deals consistently with students who break rules	There is a clear set of rules for students to follow (c)
Teacher Control (S)	... rules are enforced and rule infractions are punished	Students don't always have to stick to the rules in this class. (d)
Innovation (S)	... the teacher plans new, unusual, and varying activities and techniques, and encourages students to contribute to classroom planning and to think creatively	New and different ways of teaching are not tried very often in this class. (d)

R Relationship Dimensions, P Personal Development Dimensions, S System Maintenance and System Change Dimensions. Items designated (a) were scored 1, 2, 3, 4, 5, respectively, for the responses Almost Never, Seldom, Sometimes, Often, and Very Often. Items designated (b) were scored in the reverse manner. Items designated (c) were scored 3 and 1, respectively, for the responses of True and False. Items designated (d) were scored in the reverse manner.

The initial development of the CES grew out of a comprehensive programme of research involving perceptual measures of a variety of human environments including psychiatric hospitals, prisons, university residences and work milieus (Moos, 1974). As part of the original development of the CES (Moos, 1979; Moos & Trickett, 1974; Trickett & Moos, 1973), preliminary versions of the CES were field tested and evaluated statistically according to whether they discriminated significantly between the perceptions of students in different classrooms and whether they correlated highly with their scale scores. The final version of the CES consists of 90 items of True-False response format, with 10 items measuring each of nine scales. The scoring direction is reversed for approximately half of the items, and all items are listed fully in Moos (1979). Table I provides for each CES scale the classification according to Moos's three general dimensions, a description of the dimension it measures, and a sample of one of its items. Validation data reported by Moos and Trickett (1974) indicate that class reliabilities for different scales (based on alpha coefficients adjusted for average within-class item variance) ranged from 0.74 to 0.86 for a sample of 465 secondary school students in 22 classes in a variety of subject areas in the United States. Discriminant validity indexes (mean correlations of a scale with the other eight scales) using the individual as the unit of analysis ranged from 0.20 to 0.31 for various CES scales for the same sample of 465 students. Also, each CES scale was found to differentiate significantly ($p<0.01$) between the perceptions of students in different classrooms.

SCORING THE ICEQ AND CES

A complete copy of the ICEQ is provided on five separate pages in Appendix A. The first page contains directions for answering the actual form, whereas the second page contains directions for answering the preferred form. The third and fourth pages contain a set of 50 items which are used in either the actual or preferred form. In order to reduce printing costs and to facilitate hand scoring, the ICEQ has a separate one-page Answer Sheet (see the fifth page in Appendix A). Appendix B provides detailed directions for hand scoring the ICEQ.

Appendix C contains a copy of the CES. The first page provides some instructions for answering the actual form; instructions for the preferred form of the CES are analogous to those for the actual form of the ICEQ. The second, third and fourth pages contain the set of items that are used to measure either actual or preferred environment. The fifth page of Appendix C contains a separate Answer Sheet for the CES. Appendix D provides directions for hand scoring the CES.

Application of item analysis techniqeus with our data led to the identification of three items in the CES, namely, Items 41, 63 and 86, whose removal resulted in a noticeable improvement in scale reliability. As these items also seemed to lack face validity, they were omitted from all analyses described in this report.

SAMPLE

The sample used in all analyses described in this report consisted of representative group of 116 year 8 and 9 science classes, each with a different teacher, in 33 different schools in Tasmania. Approximately equal numbers of schools were in country and suburban areas, and approximately equal number of boys and girls made up the sample. A random half of the students in each class responded to the actual form of these instruments while the remaining half responded simultaneously to the preferred form. The total number of students answering the actual form was 1,083 and answering the preferred form was 1,092. Although the sample was not randomly chosen, it was carefully selected to be as representative as possbile of the population of schools in Tasmania.

NORMATIVE INFORMATION

Table 2 reports tentative normative information for the ICEQ and CES for the sample of 116 classes of students. Information provided consists of scale means and standard deviations using both the individual student and the class mean as the unit of analysis. As expected, standard deviations are quite a bit smaller for class means than for individuals.

VALIDATION OF SCALES

The use of the ICEQ and the CES in the present study enabled the generation of the most comprehensive validation information hitherto available for either instrument. Also, the present study provided the first use of the CES in any study in Australia and the first time that validation statistics have been reported for the CES's preferred form for any sample. In particular, information was generated about each scale's internal consistency reliability (the extent to which items in the same scale tend to measure the same dimension), discriminant validity (the extent to which a scale measures a unique dimension not covered by other scales within an instrument), and ability to differentiate between the perceptions of students in different classrooms.

Internal Consistency Reliability

Tables 3 and 4 provide information about the internal consistency reliability of each scale in the ICEQ and CES, respectively. The alpha coefficient is used as the index of internal consistency and data are provided separately for the actual and preferred forms of the instruments. Also data are reported separately using individuals and class means as the units of analysis. Class estimates of internal consistency were obtained simply by using the variance of class means in conjunction with the conventional alpha formula. Data in Tables 3 and 4 generally suggest that each scale in the ICEQ and CES has acceptable internal consistency for use in either its actual or preferred form and with either the individual student or the class mean as the unit of analysis.

TABLE 2

Scale Means and Standard Deviations for each Scale for Two Units of Analysis

	Mean[a]		Standard Deviation for Individuals		Standard Deviation for Class Means	
	Student Actual	Student Preferred	Student Actual	Student Preferred	Student Actual	Student Preferred
ICEQ						
Personalization	33.0	36.8	6.5	6.2	3.7	3.1
Participation	34.0	36.5	5.2	5.1	2.7	2.7
Independence	28.2	29.2	5.3	5.7	3.1	2.9
Investigation	30.6	33.6	5.2	5.8	2.5	2.7
Differentiation	23.8	26.1	7.9	7.0	5.2	5.0
CES						
Involvement	20.6	23.1	5.0	5.2	2.7	2.7
Affiliation	23.8	25.1	4.0	3.9	1.9	1.8
Teacher Support	21.3	23.1	5.0	4.6	2.9	2.4
Task Orientation	24.8	23.7	3.6	3.7	1.8	1.6
Competition[b]	17.4	17.3	3.1	3.1	1.4	1.2
Order & Organization	21.7	23.2	5.2	4.9	3.3	2.8
Rule Clarity	23.4	24.3	4.3	4.1	2.1	1.8
Teacher Control	22.0	21.7	4.3	4.1	2.2	1.9
Innovation[c]	17.9	20.3	3.7	4.2	2.0	2.0

a Means were approximately the same for both the student and the class as the unit of analysis.
b Competition scale contains 8 items only.
c Innovation scale contains 9 items only.

Sample sizes were 1,083 students for student actual form, 1,092 students for student preferred form, and 116 classes for either form.

TABLE 3

Internal Consistency Reliability (Alpha Coefficient) and Discriminant Validity (Mean Correlation of a Scale with Other Four Scales) for Two Forms of ICEQ for Two Units of Analyses

Scale Name	Unit of Analysis	Alpha Reliability		Mean Correlation with Other Scales	
		Actual	Preferred	Actual	Preferred
Personalization	Individual	0.78	0.74	0.28	0.33
	Class	0.88	0.82	0.36	0.35
Participation	Individual	0.70	0.68	0.28	0.29
	Class	0.78	0.74	0.35	0.37
Independence	Individual	0.67	0.71	0.07	0.10
	Class	0.78	0.79	0.16	0.17
Investigation	Individual	0.70	0.75	0.29	0.29
	Class	0.74	0.83	0.32	0.37
Differentiation	Individual	0.79	0.76	0.15	0.16
	Class	0.92	0.88	0.29	0.18

The student actual form was responded to by 1,083 students in 116 classes and the student preferred form was responded to by 1,092 students in the same classes.

TABLE 4

Internal Consistency Reliability (Alpha Coefficient) and Discriminant Validity (Mean Correlation with Other Eight Scales) for Two Forms of CES for Two Units of Analysis

Scale	Unit of Analysis	Alpha Reliability		Mean Correlation with Other Scales	
		Actual	Preferred	Actual	Preferred
Involvement	Indiv.	0.70	0.75	0.40	0.39
	Class	0.81	0.84	0.42	0.43
Affiliation	Indiv.	0.60	0.63	0.24	0.32
	Class	0.71	0.70	0.29	0.39
Teacher Support	Indiv.	0.72	0.67	0.29	0.37
	Class	0.85	0.80	0.38	0.39
Task Orientation	Indiv.	0.58	0.58	0.32	0.22
	Class	0.72	0.65	0.31	0.24
Competition	Indiv.	0.51	0.50	0.09	0.08
	Class	0.60	0.60	0.08	0.16
Order and Organization	Indiv.	0.75	0.73	0.29	0.37
	Class	0.90	0.86	0.40	0.38
Rule Clarity	Indiv.	0.63	0.60	0.29	0.34
	Class	0.76	0.69	0.36	0.39
Teacher Control	Indiv.	0.60	0.55	0.16	0.18
	Class	0.71	0.67	0.23	0.32
Innovation	Indiv.	0.52	0.63	0.19	0.37
	Class	0.71	0.73	0.29	0.38

1,083 students in 116 classes respond to the actual form and 1,092 students in 116 classes respond to the preferred form.

All scales contained 10 items except for Competition (8 items) and Innovation (9 items).

Discriminant Validity

Tables 3 and 4 also report data about each scale's discriminant validity (using the mean correlation of a scale with the other scales in the same instrument as a convenient index). Information is provided for the actual and preferred forms of the ICEQ and CES and for both the individual and the class mean as the unit of analysis. These values are small enough to suggest that each ICEQ scales has adequate discriminant validity in each of its forms for the two units of analysis. It appears, however, that the ICEQ and CES each measures distinct although somewhat overlapping aspects of classroom environment.

Ability to Differentiate Between Classrooms

Table 5 provides information about the ability of the actual form of each scale to differentiate between the perceptions of students in different classrooms. These results were obtained by performing for each scale a one-way ANOVA, using the individual as the unit of analysis and with class membership as the main effect. Results show that each of the 14 scales differentiated significantly ($p<0.001$) between the perceptions of students in different classrooms. The eta^2 statistic, which represents the proportion of variance explained by class membership, ranged from 0.18 to 0.43 for various scales.

CONCLUSION

In an attempt to assist other workers contemplating using classroom environment scales in their own research, this chapter has made the ICEQ and CES readily assessible and reported valuable normative and validation information based on a large sample of Australian students. Complete copies of each instrument, together with detailed scoring instructions, are included in this report's appendices. Data reported attested to the internal consistency reliability and discriminant validity of the actual and preferred forms of each ICEQ and CES scale when either the individual or the class mean was used as the unit of analysis. Also, it was found that the actual form of each scale differentiated significantly between the perceptions of students in different classrooms.

TABLE 5

ANOVA Results for Class Membership Differences in Student Perceptions on Actual Form of ICEQ and CES

Scale	MS Between	MS Within	df	F	Eta^2
ICEQ					
Personalization	139.3	31.1	115, 967	4.5*	0.35
Participation	57.6	23.6	115, 967	2.4*	0.22
Independence	61.3	20.5	115, 967	3.0*	0.26
Investigation	51.7	24.7	115, 967	2.1*	0.20
Differentiation	182.1	18.6	115, 967	9.8*	0.40
CES					
Involvement	63.8	18.9	115, 967	3.4*	0.29
Affiliation	30.2	13.9	115, 967	2.2*	0.21
Teacher Support	79.8	18.2	115, 967	4.4*	0.34
Task Orientation	29.6	10.5	115, 967	2.8*	0.25
Competition	17.0	9.1	115, 967	1.9*	0.18
Order and Organization	108.1	17.2	115, 967	6.3*	0.43
Rule Clarity	35.3	15.9	115, 967	2.2*	0.21
Teacher Control	46.8	15.2	115, 967	3.1*	0.27
Innovation	32.8	11.1	115, 967	3.0*	0.26

* $p<0.001$

Eta^2 is the ratio of between to total sums of squares and indicates the proportion of variance explained by class membership.

Sample size was 1083 students in 116 classes.

CHAPTER 3

PREDICTING STUDENT OUTCOMES FROM CLASSROOM ENVIRONMENT PERCEPTIONS

The strongest tradition in prior classroom environment research has involved investigation of the predictability of student cognitive and affective outcomes from their perceptions of classroom learning environment. In fact, a large number of studies in numerous countries has provided consistent and strong support for the predictive validity of students' classroom perceptions in accounting for appreciable amounts of learning outcome variance, often beyond that attributable to student entry characteristics such as pretest performance or general ability (Haertel, Walberg & Haertel, 1981). The research described in this chapter is consistent with this tradition in that it also investigated the predictive validity of students' classroom environment perceptions.

The present Tasmanian data base permitted a study of associations between students' outcomes and their perceptions of classroom psychosocial environment which was distinctive in four ways. First, it involved use of classroom environment instruments (the ICEQ and CES) which have been used a limited amount previously in this type of research. Second, in order to permit comparison with results from methodologically diverse past studies, the present data were analyzed in six different ways (namely, simple, multiple and canonical correlation analyses performed separately for raw posttest scores and residual posttest scores adjusted for corresponding pretest and general ability). Third, by including two classroom environment instruments within the one study, it was possible to estimate the unique and confounded contributions made by each instrument to the prediction of outcome variance. Fourth, the magnitudes of environment-outcome relationships were compared for two units of analysis, namely, the individual student and the class mean.

DESIGN AND MAIN ANALYSES

In order to permit investigation of relationships between classroom environment perceptions and learning outcomes in the present study, three cognitive and six affective measures were administered both at the beginning and end of the same school year, while the ICEQ and CES were administered at mid-year. The three cognitive outcomes were measured by the Test of Enquiry Skills (Fraser, 1979b) and consisted of ten-item, multiple choice scales called, respectively, Comprehension of Science Reading, Design of Experimental Procedures, and Conclusions and Generalizations. The KR-20 reliability figures for class means were found to be 0.81, 0.75 and 0.77, respectively, for the three scales for the present sample of 116 classes. The six attitude measures each consisted of ten items of Likert format selected from the Test of

Science-Related Attitudes (Fraser, 1981e). These scales are called Attitude to the Social Implications of Science, Enjoyment of Science Lessons, Attitude to the Normality of Scientists (i.e., the extent to which students view scientists as normal people rather than as the eccentrics sometimes depicted in the mass media), Attitude to Inquiry, Adoption of Scientific Attitudes (e.g., curiosity, open-mindedness) and Leisure Interest in Science. Class alpha reliabilities were found to range from 0.80 to 0.97 for these six attitude scales for the present sample. In addition to these cognitive and affective measures, information was gathered about the general ability of the students using a version of the Otis test.

The present study involved the use of the class mean as the unit of statistical analysis. Also, in order to permit easier comparison of the results of this study with prior research, data were analyzed in six different ways which reflect major methodological variations in past research. These six methods were a simple, multiple, and canonical correlational analysis involving raw scores and a simple, multiple, and canonical correlational analysis involving residual scores.

It has been common in prior research to perform a conservative test of outcome-environment relationships by controlling statistically certain student characteristics, especially corresponding pretest and general ability. That is, for reasons of simplicity, learning environment dimensions have been considered useful predictors of student learning outcomes only if they accounted for different variance from that attributable to well-established predictors like pretest and general ability (Walberg & Haertel, 1980). While conservative analyses in which student characteristics are controlled have the merit that they do not overestimate the variance component attributable to environment, they might well underestimate the importance of the environment component because any variance shared by environment and student characteristics is removed. For this reason, all analyses (simple, multiple, canonical correlation) were performed twice, once using raw posttest scores as the criterion variables and once using residual posttest scores adjusted for corresponding pretest and general ability.

Table 6 shows the results of the six types of analyses. The first pair of analyses are the least complex as they involve simple correlations between class means on the 14 environment scales and class means on each of the nine outcome posttests (using either raw scores or residual scores). A major advantage of these simple correlational analyses is that they furnish data to other workers interested in associations between particular environment variables and particular outcomes. For example, future workers wanting to conduct meta-analyses involving specific environment and outcome variables would require this sort of information. The results in Table 6 show that the number of significant outcome-environment correlations ($p<0.05$) was 39 out of a possible 126 for the analyses involving raw posttest scores (i.e., about six times that expected by chance) and 23 for the analyses using residual posttest scores (about four times that expected by chance). Furthermore, inspection of the signs of these correlations show that all significant outcome-environment relationships were positive except for six cases in which greater levels of perceived classroom Differentiation were associated with lower raw scores on three scales (Attitude to Normality of Scientists, Adoption of Scientific Attitudes, Conclusions and Generalizations), and greater levels of perceived Innovation were associated with lower raw outcome scores on three scales (Attitude to the Normality of Scientists, Design of Experimental Procedures, Conclusions and Generalizations).

TABLE 6

Simple, Multiple, and Canonical Correlations Between Classroom Environment Dimensions and Learning Outcomes (Using Raw Scores and Residual Scores Adjusted for Corresponding Pretest and General Ability)

Learning Outcome	Raw Scores/ Residuals[a]	Simple Correlation														Multiple Correlation	Beta Weights for Significant Individual Environment Predictors[b]
		Pers	Part	Indep	Inves	Diff	Invol	Affil	Teach Supp	Task Orien	Comp	Order & Org	Rule Clar	Teach Contr	Innov		
Social Implications	Raw Scores	.14	.30**	.05	.09	-.15	.22*	.16	.16	.25**	.20*	.30**	.24*	.02	.06	.50**	.26* (Part)
	Residuals	.15	.27**	.02	.05	-.12	.27**	.24*	.15	.25**	.14	.33**	.26**	.03	.09	.45*	.24* (Part); .34* (Order & Org)
Enjoyment of Science Lessons	Raw Scores	.29**	.32**	.11	.11	-.02	.42**	.20*	.27**	.17	.13	.45**	.25**	-.02	-.20*	.55**	.43* (Order & Org)
	Residuals	.16	.23*	.00	.05	-.13	.36**	.27**	.16	.22*	.02	.40**	.20*	.05	.03	.49**	.35* (Order & Org)
Attitude to Normality of Scientists	Raw Scores	.03	.20*	-.04	-.07	-.22*	.12	.10	.07	.23*	.03	.16	.10	.08	-.20*	.49**	-.34* (Innov)
	Residuals	.14	.15	-.09	-.07	-.16	.17	.11	.15	.07	-.04	.10	.18	.08	-.04	.44*	.36* (Invol)
Attitude to Inquiry	Raw Scores	-.03	.15	-.08	.08	-.17	.11	.18	.05	.18	.07	.10	.23*	.07	.03	.44*	.31 (Rule Clar)
	Residuals	-.03	.12	-.10	.07	-.15	.10	.18	.04	.13	.05	.09	.23*	.09	.01	.37	
Adoption of Scientific Attitudes	Raw Scores	.02	.33**	-.03	.11	-.35**	.07	.29**	.10	.25**	.14	.17	.06	-.04	-.13	.57**	.23* (Part); -.29* Diff; .21* (Affil); -.30** (Innov)
	Residuals	.18	.27**	-.05	.13	-.17	.16	.26**	.21*	.07	-.01	.18	.15	-.02	.06	.39	
Leisure Interest in Science	Raw Scores	.09	.22*	.10	.20*	-.03	.28**	.22*	.11	.25**	.08	.41**	.25**	.04	.20*	.54**	.56** (Order & Org); .35** (Innov)
	Residuals	.14	.09	.09	.21*	.15	.30**	.12	.11	.12	-.11	.35**	.21*	.00	.23*	.51**	.35* (Invol); .50** (Order & Org); .37** (Innov)
Comprehension of Science Reading	Raw Scores	.08	.13	.20*	.12	-.05	.02	.13	-.03	.15	.05	.13	-.05	-.04	-.13	.45*	.30* (Indep)
	Residuals	.10	.10	.07	.14	.14	.11	.13	.00	.03	.03	.17	.06	.06	.01	.35	
Design of Experimental Procedures	Raw Scores	-.18	.04	.00	.01	-.03	-.08	.03	-.06	.22*	.18	.11	.01	.05	-.20*	.47**	-.30* (Innov)
	Residuals	-.04	-.04	-.12	.00	.08	-.05	-.05	-.02	-.05	.09	.05	.09	.12	-.05	.34	
Conclusions and Generalizations	Raw Scores	-.04	.25**	.04	.14	-.26**	.08	.17	.06	.31**	.15	.22*	-.02	.04	-.20*	.61**	.26* (Part); -.23** (Diff); .43** (Teach Supp); -.41** (Innov)
	Residuals	.08	.17	-.10	.21*	-.15	.18	.12	.07	.14	.07	.26**	.07	.12	-.02	.45*	.33** (Inves); .36* (Order & Org)

Canonical Correlations — Raw Scores: .70**, .68**; Residuals: .65**

* $p < .05$, ** $p < .01$

[a] Residual scores have been adjusted for performance on the corresponding pretest and general ability.

[b] Beta weights are shown for those individual predictors for which, first, the corresponding block of 14 environment scales had a significant multiple correlation and, second the b weight was significantly different from zero.

The second pair of analyses reported in Table 6 consisted of a multiple correlation analysis involving the set of 14 environment scales performed separately for each outcome using either raw or residual criterion scores. The multiple correlation provides a more parsimonious picture of the joint influence of correlated environment dimensions on outcomes, and reduces the Type I error rate associated with simple correlational analyses. These analyses are likely to be of particular relevance to people interested in particular outcome measures. Table 6 shows that the multiple correlation between raw outcome scores and the set of classroom environment scales ranged from 0.44 to 0.61 and was significantly greater than zero ($p<0.05$) for all nine outcomes. As expected, multiple correlations were smaller for analyses involving residual scores, but their magnitudes still ranged from 0.34 to 0.50 with five of these being statistically significant.

In order to interpret which individual classroom environment scales were making the largest contribution to explaining variance in learning outcomes, an examination was made of b and beta weights for those regression equations for which the multiple correlation for the whole block of 14 environment scales had been found to be significantly greater than zero ($p<0.05$). The right hand side of Table 6 lists the magnitude of the beta weight for those individual environment scales whose b weight was significantly different from zero ($p<0.05$) and for which the corresponding block of environment scales also had a significant multiple correlation. This requirement that the multiple correlation for the whole block of environment scales should meet the 0.05 significance criterion provides protection against an inflated experimentwise Type I error rate. This table shows that the number of significant relationships for individual environment variables was 16 for raw criterion scores and 9 for residual criterion scores.

The signs of the beta weights in Table 6 can be used to suggest the following interpretations for the 16 significant individual outcome-environment relationships using raw posttest scores: Social Implications of Science scores were higher in classes perceived as having greater Participation; Enjoyment of Science lessons scores were higher in classes perceived as having greater Order and Organization; Attitude to the Normality of Scientists scores were higher in classes perceived as having less Innovation; Attitude to Inquiry scores were higher in classes perceived as having greater Rule Clarity; Adoption of Scientific Attitude scores were higher in classes perceived as having greater Participation and Affiliation and less Differentiation and Innovation; Leisure Interest in Science scores were higher in classes perceived as having greater Order and Organization and Innovation; Comprehension of Science Reading scores were higher in classes perceived as having greater Independence; Design of Experimental Procedures scores were higher in classes perceived as having less Innovation; and Conclusions and Generalizations scores were higher in classes perceived as having greater Participation and Teacher Support and less Differentiation and Innovation. Examination of the signs of the beta weights for residual scores in Table 6 suggests the following interpretations of significant outcome-environment relationships when corresponding pretest and general ability were controlled: Social Implications of Science scores were higher in classes perceived as having greater Participation and Order and Organization; Enjoyment of Science Lessons scores were higher in classes perceived as having greater Order and Organization; Attitude to the Normality of Scientists scores were higher in classes perceived as having greater Involvement; Leisure

Interest in Science scores were greater in classes perceived as having greater Involvement, Order and Organization, and Innovation; and Conclusions and Generalizations scores were higher in classes perceived as having greater Investigation and Order and Organization.

Although use of multiple correlation analyses overcomes the problems of collinearity between environment scales, collinearity between outcome measures could still give rise to an inflated experimentwise Type I error rate. Canonical analysis, however, can provide a parsimonious picture of relationships between a domain of correlated learning outcomes and a domain of correlated environment dimensions. Consequently, two canonical analyses were conducted (one involving raw outcome scores and one involving residual scores) using the class mean as the unit of analysis. The bottom of Table 6 shows that both canonical analyses yielded at least one significant canonical correlation. Two significant canonical correlations of 0.70 ($p<0.01$) and 0.68 ($p<0.01$), respectively, were found between environment scales and raw posttest scores, while one significant canonical correlation of 0.65 ($p<0.01$) was found between environment scales and residual posttest scores.

In order to interpret the results of the canonical analyses, an examination was made of the magnitudes and signs of the structure coefficients (i.e., simple correlations of a canonical variate with its constituent variables) associated with each significant canonical variate. These substantive interpretations were based on structure coefficients in preference to canonical weights or loadings because the latter can be seriously misleading as they are partial regression coefficients subject to redundancy and suppression effects (Cohen & Cohen, 1975; Cooley & Lohnes, 1971). The interpretation of the first significant canonical correlation for the analysis involving raw scores was readily interpretable. It indicated that attitude scores on the Enjoyment of Science Lessons and Leisure Interest in Science scales were higher in classes perceived as having greater Order and Organization and Innovation. The interpretation of the second significant canonical correlation for the analysis of raw scores was less straightforward, but it suggested that cognitive outcome scores on the Conclusions and Generalizations scale tended to be higher in classes perceived as having more Participation and less Differentiation. The straightforward interpretation of the significant canonical correlation for residual scores was that, with corresponding pretest scores and general ability controlled, Enjoyment of Science Lessons and Leisure Interest in Science scores were greater in classrooms perceived as having greater Order and Organization and Involvement.

UNIQUE AND COMMON VARIANCE ASSOCIATED WITH ICEQ AND CES

The multiple and canonical correlation analyses reported previously in Table 6 provide information about relationships between learning outcome criteria and the whole set of 14 environment dimensions measured by the ICEQ and CES. These analyses, however, provide no information about the unique contributions to the prediction of learning outcome variance made separately by the ICEQ and CES. Nor do they identify the confounded contribution to criterion variance associated with the two separate instruments. This type of information is of potential relevance in future predictive validity research because it provides guidance about the extent to which the ICEQ and CES predict different outcome variance and, consequently, whether it is redundant to include both instruments in a given study.

Commonality analysis is widely endorsed as a method of estimating the unique and confounded components of variance explained in criteria by two or more sets of predictors (Cooley & Lohnes, 1976). For the case of a single criterion variable, the uniqueness for the ICEQ would be computed simply by subtracting the squared multiple correlation coefficient for a model containing the nine CES scales as predictors from a model containing all 14 environment variables measured by both the ICEQ and CES. Thus, the definition of uniqueness is the same as the definition of the squared semipartial multiple correlation of a dependent variable with one set of independent variables partialled on the other set of independent variables. Similarly, the uniqueness for the set of CES dimensions is computed using the values of R^2 for a model containing only ICEQ variables and another model containing both ICEQ and CES variables. The commonality, or the confounded contribution to criterion variance made by the two classroom environment instruments, is simply the variance explained by the full model containing ICEQ and CES scales minus the sum of the uniqueneses for the ICEQ and CES.

Cooley and Lohnes (1976) describe a way of extending the method of commonality analysis for a single criterion measure to the case of multiple criterion measures. When the criterion domain is multivariate, the criterion redundancy (Gleason, 1976; Miller, 1975) can be substituted for the R^2 statistic in all rules for partitioning variance. Also, just as R^2 represents the proportion of variance accounted for in a univariate criterion, the redundancy can be interpreted as the multivariate variance in a domain of criterion variables associated with a set of predictors. The redundancy can be calculated by multiplying the variance extracted from the criterion domain for each linear function fitted to the criterion variates by the squared canonical correlation for that function, and summing these products (assuming that there is more than one) (Stewart & Love, 1968).

Table 7 reports the results of commonality analyses which were performed for the present sample using the class mean as the unit of statistical analysis. In line with earlier analyses, these commonality analyses were conducted separately for raw criterion scores and for residual criterion scores (adjusted for corresponding pretest and general ability). Also the analyses reported include commonality analyses of the squared multiple correlation performed separately for each of the nine learning outcome criteria, together with commonality analayses of the canonical redundancy statistic performed for the set of nine outcome criteria as a whole.

The results in Table 7 for the 18 commonality analyses of the R^2 statistic show that the values of the uniqueness and the commonality for each outcome varied considerably. For the raw score analyses, the uniqueness for the CES ranged from 0.08 to 0.20 with a median of 0.13, the uniqueness for the ICEQ ranged from 0.03 to 0.15 with a median of 0.09, and the commonality ranged from 0.00 to 0.11 with a median of 0.02. For the residual scores analyses, the uniqueness for the CES ranged from 0.05 to 0.20 with a median of 0.09, the uniqueness for the ICEQ ranged from 0.02 to 0.10 with a median of 0.05, and the commonality ranged from 0.00 to 0.05 with a median of 0.03. Overall, these results

TABLE 7

Commonality Analysis of R^2 and Redundancy Statistic for ICEQ and CES Using Raw and Residual Criterion Scores

Outcome	R^2 for Raw Scores			R^2 for Residuals		
	Uniqueness		Commonality	Uniqueness		Commonality
	CES	ICEQ		CES	ICEQ	
Social Implications of Science	0.14	0.11	0.00	0.11	0.05	0.05
Enjoyment of Science Lessons	0.17	0.06	0.08	0.17	0.05	0.03
Attitude to Normality of Scientists	0.13	0.09	0.02	0.09	0.10	0.01
Attitude to Inquiry	0.13	0.05	0.02	0.08	0.05	0.00
Adoption of Scientific Attitudes	0.08	0.13	0.11	0.05	0.06	0.04
Leisure Interest in Science	0.20	0.03	0.07	0.20	0.02	0.04
Comprehension of Science Reading	0.09	0.11	0.00	0.06	0.05	0.01
Design of Experimental Procedures	0.13	0.08	0.01	0.08	0.04	0.00
Conclusions and Generalizations	0.17	0.15	0.05	0.10	0.06	0.04
Redundancy for Raw Scores:	0.11	0.10	0.05			
Redundancy for Residuals:				0.06	0.06	0.06

Based on a sample of 116 class means.

for individual learning outcome criteria generally suggest that the CES and the ICEQ each accounted for a sizable amount of outcome variance which is unique of that associated with the other instrument and which is larger than the commonality.

A more parsimonious picture of the unique and common contributions made by the ICEQ and CES in explaining learning outcome variance is provided by the results of the commonality analyses of the redundancy statistic reported at the bottom of Table 7 for the set of nine learning outcomes as a whole. These results indicate that, for the raw score analysis, the uniqueness for the CES was 0.11, the uniqueness for the ICEQ was 0.10 and the commonality was 0.05. In other words, the proportion of the multivariate variance in raw scores on the criterion battery was comparable for the CES and ICEQ and was approximately double the magnitude of the common variance. For residual scores, Table 7 shows that the uniqueness was 0.06 for the CES and 0.06 for the ICEQ, and the commonality was 0.06. That is, the proportion of the multivariate variance in residual scores on the criterion battery accounted for uniquely by the scales in the CES was comparable to that uniquely accounted for by the scales in the ICEQ and comparable to the common variance.

COMPARISON OF TWO UNITS OF ANALYSIS

The two most commonly used units of statistical analysis in prior classroom environment research have been the individual student and the class mean. The choice of unit of anlaysis is of key importance because it is possible that relationships obtained using one unit of analysis could differ in magnitude and even in sign from those obtained using another unit (Robinson, 1950), and because the use of certain units can violate the requirement of independence of observations and call into question the results of any statistical significance tests. Moveover, the use of different units of analysis involves the testing of conceptually different hypotheses (Cronbach, 1976). For example, use of the individual as the unit of analysis involves substantive questions about whether students who score higher on environment measures also score higher on outcome measures when class membership is disregarded, whereas use of the class mean as the unit of analysis asks whether classes higher than average on environment scores also achieve higher than average on outcome measures.

As the main substantive hypotheses involved in the present study were considered to involve relationships between class means on learning outcome measures and class means on classroom environment scales, results so far have been reported for the class mean as the unit of statistical analysis. Table 8, however, provides a comparison of the magnitudes of relationships between learning outcomes and classroom environment when the individual and the class mean were used as the units of analysis. These results are provided here to permit comparison with prior research involving the student as the unit of analysis, to furnish information to researchers interested in substantive hypotheses concerning association between individual student perceptions and individual student learning outcomes, and to enable a comparison of effect sizes when two different units of analysis are employed.

TABLE 8

Comparison of Multiple Correlations Between Outcome and Environment Measures for Two Units of Analysis

Learning Outcome	Multiple Correlation for Raw Scores		Multiple Correlation for Residuals	
	Student	Class	Student	Class
Social Implications of Science	0.40	0.50	0.37	0.45
Enjoyment of Science Lessons	0.40	0.55	0.36	0.49
Attitude to Normality of Scientists	0.38	0.49	0.36	0.44
Attitude to Inquiry	0.25	0.44	0.23	0.37
Adoption of Scientific Attitudes	0.38	0.57	0.27	0.39
Leisure Interest in Science	0.47	0.54	0.41	0.51
Comprehension of Science Reading	0.24	0.45	0.17	0.35
Design of Experimental Procedures	0.21	0.47	0.18	0.34
Conclusions and Generalizations	0.31	0.61	0.20	0.45

The data in Table 8 are the multiple correlations between each of the nine learning outcomes and the set of 14 environment variables measured by the ICEQ and the CES together. These results are reported separately for raw criterion scores and for residual criterion scores. The sample size for all analyses involving class means was 116, whereas the samples for analyses involving individual students ranged from 700 to 758 for different learning outcomes (since different random fractions of the students in each class responded simultaneously to different parts of the outcome battery to economize on testing time). Significance tests are not reported in Table 8 because, since classes were the primary sampling units in the present research, inflated significance levels would arise for the student analyses because of nonindependence of observations. Furthermore, it was not possible to conduct any canonical analyses involving criterion and environment variables using the individual as the unit of analysis because each student in the sample responded to only one third of the total number of measures in the criterion battery.

The results in Table 8 show that the magnitudes of the outcome-environment relationships tended to be appreciably larger when the class was used as the unit of analysis than when the student was used. In fact, multiple correlations for raw scores ranged from 0.21 to 0.47 with a median of 0.38 for the student as the unit of analysis, and from 0.44 to 0.61 with a median of 0.50 for the class as the unit of analysis. For residuals scores, multiple correlations ranged from 0.17 to 0.41 with a median of 0.27 with the student as the unit of analysis, and from 0.34 to 0.51 with a median of 0.44 with the class as the unit of analysis. The finding that outcome-environment relationships were larger when the class was used as the unit of analysis than when the student was used in consistent with Haertel, Walberg, and Haertel's (1981) meta-analysis and Walberg's (1972) study.

DISCUSSION

This chapter has described a study of associations between students' learning outcomes and their perceptions of classroom environment as measured by the ICEQ and CES. Relationships between a set of nine learning outcomes (six affective and three cognitive) and the set of 14 classroom environment scales were explored using the class mean as the unit of analysis and six different data analytic techniques. Three of these were a simple correlational analysis between raw scores on outcome posttests and environment scales, a multiple correlational analysis involving the prediction of raw scores on each outcome posttest from the set of 14 environment scales, and a canonical analysis involving raw scores on the set of nine outcome posttests and the set of 14 environment scales. The other three analyses were anologous except that, instead of employing raw posttest scores as criteria, use was made of residual posttest scores adjusted for corresponding pretest and general ability. Overall, these results replicated prior research by furnishing evidence of sizable relationships between students' outcomes and perceptions of classroom environment.

Further analyses involved commonality partitioning of the R^2 and canonical redundancy statistic in order to estimate the unique and common contributions made by the ICEQ and CES in explaining variance in learning outcomes. It was found that the ICEQ and CES each made an important unique contribution to criterion variance, thus attesting to the usefulness of including both instruments within the same study. Also, by estimating the strength of environment-outcome relationships for two different units of statistical analysis, it was shown that effect sizes were greater when the class was employed as the unit of analysis than when the individual was used.

The separate methods of analysis yielded consistent support for the existence of overall relationships between learning outcomes and classroom environment and led to no major conflicts when explicating the specific form of such relationships in terms of particular outcomes and environment dimensions. However, as expected, the interpretation for individual variables varied somewhat with the presence or absence of control for student background characteristics (i.e., the raw scores vs. residuals analyses) and with the extent to which collinearity among variables was allowed for (i.e., simple, multiple, or canonical correlational analyses). Nevertheless, the present study still has some important tentative implications for educators wishing to enhance science students' achievement of particular outcomes by creating classroom environments found empirically to be conducive to achievement. Many practitioners are likely to find the results of the multiple regression analyses for residuals particularly useful for this purpose because they provide separate information for a range of different outcome variables, they overcome the problem of collinearity between environment scales, and they rule out the major rival hypothesis that observed outcomes could be attributed to differences in student background characteristics found in classes with different environments. Examples of specific findings from the multiple regression analyses for residuals are that attitudes to the Social Implications of Science are likely to be promoted in classes with greater Participation and Order and Organization, Leisure Interest in Science is likely to be enhanced in classes with greater Involvement, Order and Organization, and Innovation, and skill at drawing Conclusions and Generalizations is likely to be fostered in classes characterized by greater Investigation and Order and Organization.

CHAPTER 4

PERSON-ENVIRONMENT FIT STUDY

Despite a long-standing tradition for researchers to concentrate either on persons or situations, there is strong encouragement for educational psychologists and researchers to direct more attention to the study of person-environment interaction as a key determinant of students' classroom functioning and achievement (Hunt, 1975). The research reported in this chapter is consistent with Hunt's recommendation in that it investigated relationships between student outcomes and person-environment fit defined in terms of the congruence between the actual classroom environment and that preferred by students. Consequently, the present study makes an original contribution to the two previously distinct fields of person-environment fit research and classroom environment research because it applied ideas, methods and measuring instruments originating in the field of classroom environment in investigating person-environment fit hypotheses.

BACKGROUND

In an early but seminal works in psychology, Lewin (1936) and Murray (1938) have presented theoretical points of view which clearly recognize both the environment and its interaction with personal characteristics of the individual as potent determinants of human behaviour. Drawing on Murray's work, Stern (1970) has formulated a theory of person-environment congruence in which complementary combinatations of personal needs and environmental press enhance student outcomes. Mitchell (1969) has stressed the critical importance of person-environment interaction for understanding and predicting human behaviour, while Hunt (1975) has admonished researchers for their apparent reluctance to incorporate a person-environment interactional perspective into their invesitgations.

An earlier but widely known person-environment fit study, Grimes and Allinsmith (1961) found that achievement increased with increasing compulsivity under structured teaching, but compulsivity made no difference under unstructured teaching, and, in contrast, anxiety made no difference under structured teaching, but achievement decreased with increasing anxiety in unstructured settings. Nielsen and Moos (1978) found, for an overall satisfaction and a classroom adaptation outcome, there was no relationship between outcome and exploration preference in classrooms low in actual exploration; but there was a positive relationship in classrooms high in actual exploration. Rich and Bush (1978) reported a study which incorporates a person-environment interactional perspective in investigating the effects of a dichotomous teacher style variable and the student personal characteristic of social-emotional development. Congruent groups were formed by matching teachers having a natural direct style with students high in social-emotional development and matching indirect teachers with students low in social-emotional development, whereas incongruent groups were obtained by matching direct teachers with students low in social-emotional development and matching indirect teachers with students high in social-emotional development. It was found that congruent person-environment groups outperformed incongruent groups on several outcomes. Furthermore the teacher style variable was not significantly related to any outcome, suggesting that person-environment fit in this case was more important for enhancing student outcomes than teacher style per se.

DESIGN CONSIDERATIONS

Although studies reviewed above provide good examples of person-environment fit research, they also reflect some common shortcomings. As the present study represented a new direction in person-environment fit research, it was considered important to pay particular attention to the methodological issues discussed below.

Characterization of Environment in Continuous, Multidimensional Terms Although Cooley and Lohnes (1976) have emphasized that instructional treatments or educational environments consist of sets of continuous variables, prior person-environment fit research almost exclusively has represented an educational environment as a single dichotomous variable (e.g., structured vs. unstructured). In the present study, however, use of the actual form of the ICEQ and CES enabled the environment to be assessed in terms of sets of continuous variables.

Commensurability of Personal and Environmental Dimensions For research following a person-environment interactive approach, it is considered desirable that the person and the environment be described as commensurate or compatible dimensions (Graham, 1976; Bem, 1979). Yet prior person-environment fit studies seldom have attempted to employ commensurate dimensions for conceptualizing and measuring person and environment. The use of the preferred form of the ICEQ and CES in the present study permitted the assessment of personal characteristics (namely, student perceptions of dimensions of preferred classroom environment) along dimensions which were commensurate with those used for assessing (actual) environment.

Use of Regression Surface Analysis to Maximize Power A third criticism of past studies is that the presence of person-environment interaction seldom has been tested using the most powerful statistical tools available. Statistical power often has been diminished considerably by reducing continuous data on personal and environmental variables to two or three levels in order that convenient analysis of variance routines can be employed for testing interactions. Consequently, the present research made use of multiple regression analysis to provide a powerful multivariate method of statistical analysis which enabled each two-way person-environment interaction to be represented as the product of continuous variables (see Cohen and Cohen, 1975).

Interactions between categorical variable detected through analysis of variance techniques can be represented and interpreted readily through the use of two dimensional plots. The present study's use of interactions between continuous variables necessitated that interpretations of person-environment interactions be based on three-dimensional plots which enabled all three types of variables (outcome, actual environment, preferred environment) to be represented as continuous variables. Therefore the regression surface analyses described later were used in the present investigation.

Control for Background Characteristics and Actual Environment In prior studies of associations between student learning outcomes and actual classroom environment, it has been common to use hierarchical regression analyses in which environment variables are entered into regression equations after student background characteristics (especially corresponding pretest performance and general ability). That is, for reasons of simplicity, classroom environment dimensions have been considered useful predictors of learning outcomes only if they accounted for criterion variance which was unique of that attributable to well-established background variables (Walberg & Haertel, (1980). As the present study of person-environment interaction broke new ground, it was considered desirable that the detection of these interactions should involve conservative statistical procedures in which the only interactions interpreted were those which were found to be significantly related to learning outcomes after the effects of pretest performance, general ability and actual environment had been removed.

Control of Overall Type I Error Rate Because the ICEQ and CES contain numerous separate scales, there were numerous (two-way) person-environment interactions to be tested for each learning outcome. In order to reduce the overall Type I error rate associated with the testing of each of these individual hypotheses, person-environment fit for a particular outcome was only examined for any of the individual environment scales if the interactions for all scales in an instrument together were found to account for a significant amount of criterion variance ($p<0.05$). When this requirement was combined with the previously described condition that actual-preferred interactions would be investigated whilst controlling for pretest, general ability and actual environment, it was necessary to perform hierarchical multiple regression analyses in order to estimate the increment in criterion variance attributable to a block of interactions beyond that attributable to student background characteristics and to the block of actual-environment variables.

METHOD

Student achievement was measured both at the beginning of the school year and again at the end of the same school year using the six affective and three cognitive outcome measures described in the previous chapter. The ICEQ and CES were administered at mid-year to obtain students' perceptions of 14 dimensions of actual classroom environment and of 14 dimensions of preferred classroom environment. As preferred classroom environment per se was not of interest in the present investigation, data obtained from the ICEQ and CES were used to provide 14 actual environment variables and to generate 14 new variables indicating the congruence or interaction between actual and preferred environment. In addition, the student background characteristic of general ability was measured using a version of the Otis test. The basic design of the study, then, involved the prediction of posttest achievement from pretest performance, general ability, the actual environment variables, and the variables indicating actual-preferred interaction.

The sample consisted of the previously described group of 116 science classes in Tasmania. Since the intact class and not the individual student was the primary sampling unit, the class mean was used as the unit of analysis (Sirotnik, 1980). All analyses were performed separately for the ICEQ and CES.

ANALYSES AND RESULTS FOR ICEQ

The first set of analyses involved performing for each outcome posttest a hierarchical regression analysis involving sets of student background characteristics, actual environment variables and actual-preferred interactions. These analyses provided a conservative test of person-environment fit interactions by first removing the variance attributable to background characteristics and actual environment, and reduced the Type I error rate by checking whether blocks of interaction variables accounted for significant increments in criterion variance prior to examining interaction effects for individual variables. Table 9 shows the results of these analyses when the class mean was used as the unit of statistical analysis.

Table 9 indicates that the amount of posttest variance accounted for by the two student background characteristics of corresponding pretest and general ability ranged from 13.0 to 67.0 per cent for different outcomes; these increments were statistically significant ($p<0.05$) for eight of the nine outcomes. The second column of figures indicates that the increment in posttest variance attributable to continuous scores on the block of five actual individualization variables measured by the ICEQ (beyond that attributable to pretest and general ability) ranged from 1.6 to 7.4 per cent for different outcomes, and was statistically significant for four outcomes. The last column of figures in Table 9 shows that the increment in posttest variance accounted for by the block of five two-way actual-preferred interactions (beyond that attributable to student background characteristics and the five actual environment variables) ranged from 1.9 to 10.9 per cent for different outcomes, and was statistically significant for four of the nine learning criteria.

As the block of interactions had accounted for a significant increment in posttest variance for four of the outcome measures (namely, Social Implications of Science, Enjoyment of Science Lessons, Adoption of Scientific Attitudes and Comprehension of Science Reading), 20 further regression analyses were performed, one for each outcome for each of the five individual interaction terms. In order to satisfy the requirement that student background characteristics should be controlled, each of these analyses was carried out using residual posttest criterion scores which had been adjusted for corresponding pretest and general ability. Also, in order to meet the condition that an interaction term should account for a significant increment in criterion variance over and above that explainable by the corresponding actual environment variable, each regression equation included an actual environment term in addition to an actual-preferred interaction. Consequently, the form of each of the 20 regression equations was:

$$Y_{res} = a + b_1 A_i + b_2 (A_i X P_i)$$

where Y_{res} represents residual outcome scores (adjusted for corresponding pretest and general ability), a is the regression constant, b_1 is the raw regression coefficient for the ith continuous actual environment variable, and b_2 is the raw regression coefficient for the interaction formed by taking the product of the ith continuous actual environment variable and the ith continuous preferred variable.

TABLE 9

Increment in Percentage of Criterion Variance Associated with Student Characteristics, Actual Environment and Actual-Preferred Interactions

Criterion Variable	Increment in Percentage of Variance Accounted For		
	Pretest & Gen. Ability	Block of 5 Actual Env. Scales	Block of 5 Actual x Pref Interactions
Social Implications of Science	30.3**	7.1*	10.9**
Enjoyment of Science Lessons	46.7**	4.1	6.6**
Normality of Scientists	25.9*	7.4*	1.9
Attitude to Inquiry	13.0	5.0	2.4
Adoption of Scientific Attitudes	48.0**	6.0*	4.8*
Leisure Interest in Science	43.1**	3.0	2.5
Comprehension of Science Reading	53.7**	1.8	4.7*
Design of Experimental Procedures	55.7**	1.6	2.4
Conclusions and Generalizations	67.0**	3.6*	2.4

* $p < 0.05$ ** $p < 0.01$

Table 10 shows the results obtained for these regression analyses for the six cases in which the actual-preferred interaction was found to account for a significant increment ($p<0.05$) in residual posttest scores beyond that attributable to the corresponding actual environment scale. The information in this table includes for each significant interaction the magnitude of the increment in explained variance and the values of the constant and coefficients associated with each regression equation.

Since actual-preferred interactions had been formed by taking the products of continuous actual and preferred scores (in order to enhance statistical power), the two-dimensional plots conventionally used with analysis of variance results were inappropriate. Instead, the interpretations of the six significant interactions were based upon three-dimensional regression surfaces which permitted actual and preferred scores to be represented as continuous variables. In each of these plots, the vertical axis represented residual posttest scores, one horizontal axis represented continuous scores on an actual environment scale, and the other horizontal axis represented continuous scores on the corresponding preferred environment scale. Each regression surface was plotted using values ranging from a minimum of two standard deviations (for class means) below the mean for the actual and preferred scales, to a maximum of two standard deviations above the mean. Figure 1 shows two of the regression surfaces obtained (namely, Personalization and Social Implications of Science and Differentiation and Comprehension of Science Reading).

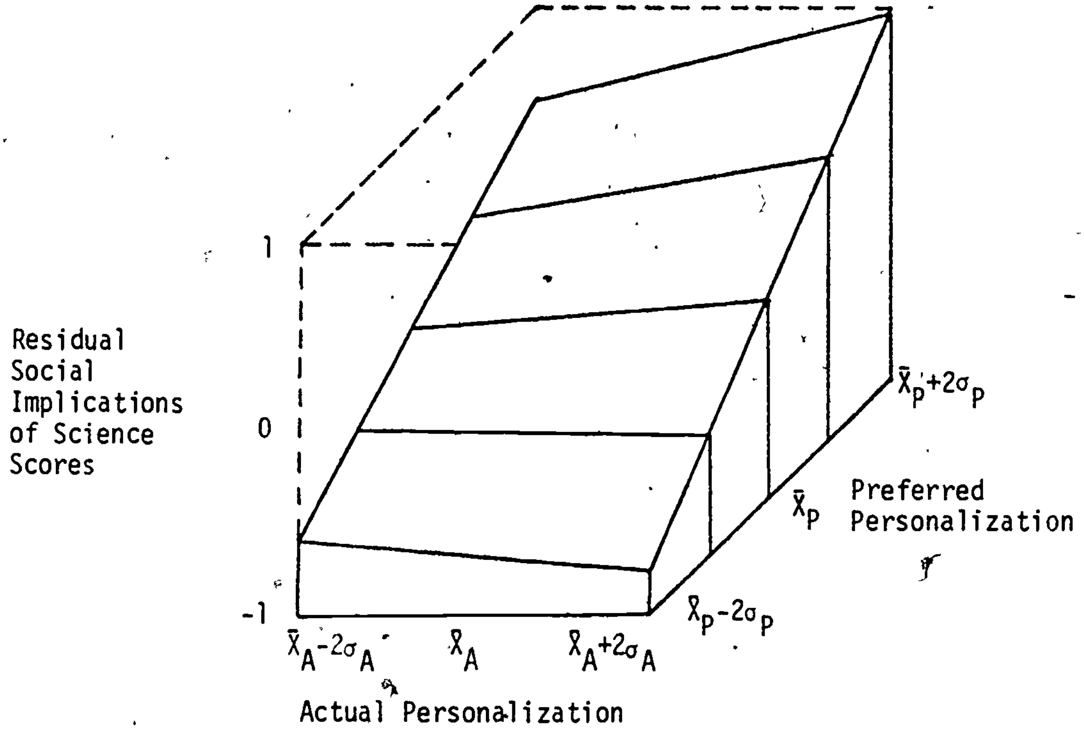
Inspection of each of the six regression surfaces indicated that the hypothesized person-environment interaction had emerged in every case. That is, relationships between residual posttest scores and actual environment scores on a certain scale were more positive for classes with higher preferred scores on that scale than for classes with lower preferred scores. For example, Figure 1 shows that the interpretation of the actual-preferred interaction for Personalization and Social Implications of Science was that the relationship between residual Social Implications scores and actual Personalization was negative for classes with preferred Personalization scores two standard deviations below the mean, was approximately zero for classes with preferred Personalization scores one standard deviation below the mean, and was positive for classes with preferred Personalization scores at or above the mean. That is, residual Social Implications scores increased with increasing amounts of actual Personalization for classes preferring high levels of actual Personalization, but decreased with increasing actual Personalization for classes preferring low levels of actual Personalization. In the case of the interaction for Differentiation and Comprehension of Science Reading, Figure 1 shows that the relationship between residual Comprehension scores and actual Differentiation scores was negative at all levels of preferred Differentiation, but that the strength of this negative relationship become progressively weaker as one moves from classes two standard deviations below the mean on preferred Differentiation to classes two standard deviations above the mean. 6

TABLE 10

Increment in Percentage of Variance and Regression Equation Associated with Each Significant Individual Actual-Preferred Interaction

Residual Outcome	Environment Scale	ΔR^2 Associated with Interaction	Regression Equation
Social Implications of Science	Personalization	11.5**	$Y_{res} = -0.3150 - 0.1171A + 0.0035(AxP)$
	Differentiation	4.4*	$Y_{res} = 1.7006 - 0.1399A + 0.0025(AxP)$
Enjoyment of Science Lessons	Personalization	3.9*	$Y_{res} = -0.8182 - 0.0494A + 0.0020(AxP)$
	Differentiation	6.9**	$Y_{res} = 2.0573 - 0.1728A + 0.0032(AxP)$
Adoption of Scientific Attitudes	Investigation	3.6*	$Y_{res} = -1.2919 - 0.0230A + 0.0020(AxP)$
Comprehension of Science Reading	Differentiation	3.7*	$Y_{res} = 0.5343 - 0.0772A + 0.0020(AxP)$

* $p < 0.05$ ** $p < 0.01$



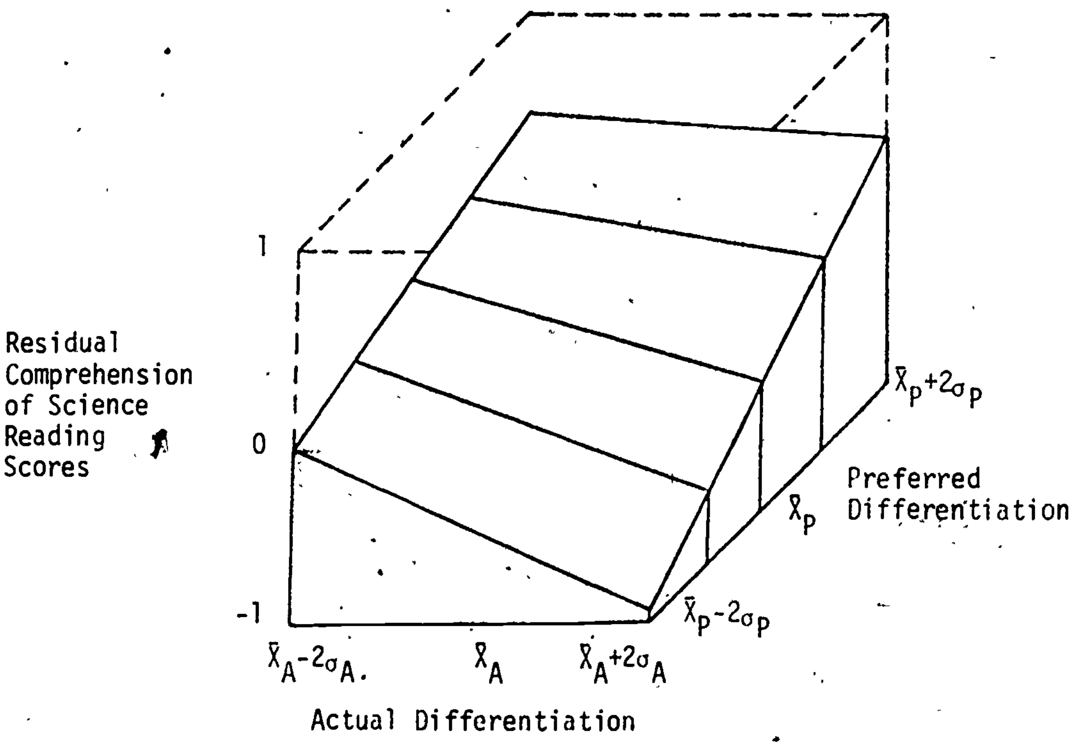


FIGURE 1

REGRESSION SURFACES FOR TWO ACTUAL-PREFERRED INTERACTIONS

ANALYSES AND RESULTS FOR CES

Analyses analogous to those described previously for the ICEQ were used when investigating person-environment interactions for the dimensions contained in the CES. In fact, the only difference between the two sets of analyses was that class means on the set of nine CES scales were used instead of the set of class means for the five ICEQ scales.

The first series of analyses involved the use of class means in performing separately for each of the nine outcome posttests a hierarchical regression analyses involving sets of student background characteristics, actual environment variables, and actual-preferred interactions. In each analysis, the student background characteristics consisted of corresponding pretest performance and general ability, actual environment variables were the nine scales in the actual form of the CES, and actual-preferred interactions consisted of the set of nine interactions formed by taking products of continuous scores on corresponding actual and preferred forms of each CES scale.

The results of the hierarchical regression analyses for sets shown in Table 11 indicate that background characteristics accounted for a significant amount of criterion variance for eight outcomes, that actual environment variables accounted for an additional significant increment in criterion variance for four outcomes, and that actual-preferred interactions were associated with a further significant increment in criterion variance for four outcomes ($p<0.05$). Since the increment in criterion variance associated with the block of interactions was non-significant for five outcome measures, no further attempts to examine individual interactions was attempted for those outcomes.

As the block of nine interactions accounted for a significant increment in posttest variance for Social Implications of Science, Normality of Scientists, Adoption of Scientific Attitudes and Design of Experimental Procedures, a further multiple regression analysis with the class as the unit of analysis was performed for each of the nine individual interaction terms for each of these outcomes. Table 12 shows the results of these analyses for the seven cases in which the actual-preferred interaction was found to account for a significant increment in residual posttest scores beyond that attributable to the corresponding actual environment scale. As with the previous analyses involving the ICEQ, significant interactions were interpreted by plotting regression surfaces using values ranging from a minimum of two standard deviations (for class means) below the mean on the actual and preferred scales, to a maximum of two standard deviations above the mean.

TABLE 11

Increment in Percentage of Criterion Variance Associated with Student Characteristics, Actual Environment and Actual-Preferred Interactions

Criterion Variable	Increment in Percentage of Variance Accounted For		
	Pretest & General Ability	Block of 9 Actual Env. Scales	Block of 9 Actual x Pref. Interactions
Social Implications of Science	30.3**	10.7*	9.5*
Enjoyment of Science Lessons	46.7**	10.9*	3.0
Normality of Scientists	25.9*	7.1	10.9*
Attitude to Inquiry	13.0	7.1	9.6
Adoption of Scientific Attitudes	48.0**	4.9	7.5*
Leisure Interest in Science	43.1**	14.4**	4.1
Comprehension of Science Reading	53.7**	3.5	1.7
Design of Experimental Procedures	55.7**	3.5	6.4*
Conclusions and Generalizations	67.0**	4.8*	1.8

* P<0.05 ** p<0.01

TABLE 12

Increment in Percentage of Variance and Regression Equation Associated with each Significant Individual Actual-Preferred Interaction

Residual Outcome	Environment Scale	ΔR^2 Associated with Interaction	Regression Equation
Social Implications of Science	Teacher Support	3.3*	$Y_{res} = -0.3840 - 0.0747A + 0.0040\,(AxP)$
	Competition	4.4*	$Y_{res} = -1.0579 - 0.1216A + 0.0106\,(AxP)$
	Rule Clarity	3.2*	$Y_{res} = -2.0079 - 0.0287A + 0.0047\,(AxP)$
	Innovation	3.8*	$Y_{res} = -0.5202 - 0.0849A + 0.0056\,(AxP)$
Normality of Scientists	Affiliation	3.3*	$Y_{res} = -0.6953 - 0.0816A + 0.0044\,(AxP)$
Adoption of Scientific Attitudes	Rule Clarity	3.3*	$Y_{res} = -0.7161 - 0.0850A + 0.0048\,(AxP)$
Design of Experimental Procedures	Teacher Support	3.4**	$Y_{res} = -0.8508 - 0.1339A + 0.0041\,(AxP)$

* $p<0.05$ ** $p<0.01$

Figure 2 depicts two of the regression surfaces for significant individual interactions. These two surfaces (namely, Teacher Support and Design of Experimental Procedures and Innovation and Social Implications of Science) are typical of the results obtained for other surfaces. In fact, inspection of all surfaces clearly indicated that the hypothesized person-environment interaction had emerged in every case. That is, relationships between residual posttest scores and actual environment scores on a certain scale were more positive for classes with higher preferred means on that scale than for classes with lower preferred means.

Figure 2 shows that the interpretation of the actual-preferred interaction for Teacher Support and Design of Experimental Procedures was that, with corresponding pretest and general ability controlled, the relationship between Design scores and actual Teacher Support was negative at all levels of preferred Teacher Support, but that the strength of this negative relationship became progressively weaker as one moves from classes two standard deviations below the mean on preferred Teacher Support to classes two standard deviations above the mean. For the interaction for Social Implications of Science and Innovation, Figure 2 shows that, with corresponding pretest and general ability controlled, the relationship between Social Implications means and actual Innovation means was positive at all levels of preferred Innovation, but that the strength of this relationship increased with increasing levels of mean preferred Innovation.

CONCLUSION

This study is distinctive in that it involved the use of instruments measuring student perceptions of actual and preferred classroom environment in a person-environment fit study of whether classes achieve affective and cognitive outcomes better when the actual classroom environment matches that preferred by the class. Also the study provided several methodological improvements over most prior research in that it employed the class mean as the unit of analysis, it measured the person and the environment as sets of commensurate and continuous variables, it provided control for student background characteristics and actual environment when studying the effect of actual-preferred interaction, it reduced the experimentwise Type I error rate by ensuring that individual interactions were interpreted only in cases where the block of all interactions was associated with a significant amount of criterion variance, and it made use of regression surface analysis to provide a powerful method of analysis which enabled person-environment interactions to be represented as the products of continuous variables.

The substantive hypotheses tested in this study using class means as the units of analysis should be clearly distinguished from those that would be involved in an alternative analytic unit were employed. Clearly the analyses reported in this chapter explored whether the relationship between class mean achievement and class mean actual environment scores depended on the class mean of students' environment preferences. Consequently, use of the class mean as the unit of analysis leads to conclusions about whether matching the level of an environment dimension actually present in a classroom to the average level preferred by a class of students is likely to enhance average class achievement. In contrast, adoption of the individual student as the unit of analysis would yield information about whether the individual student's achievement

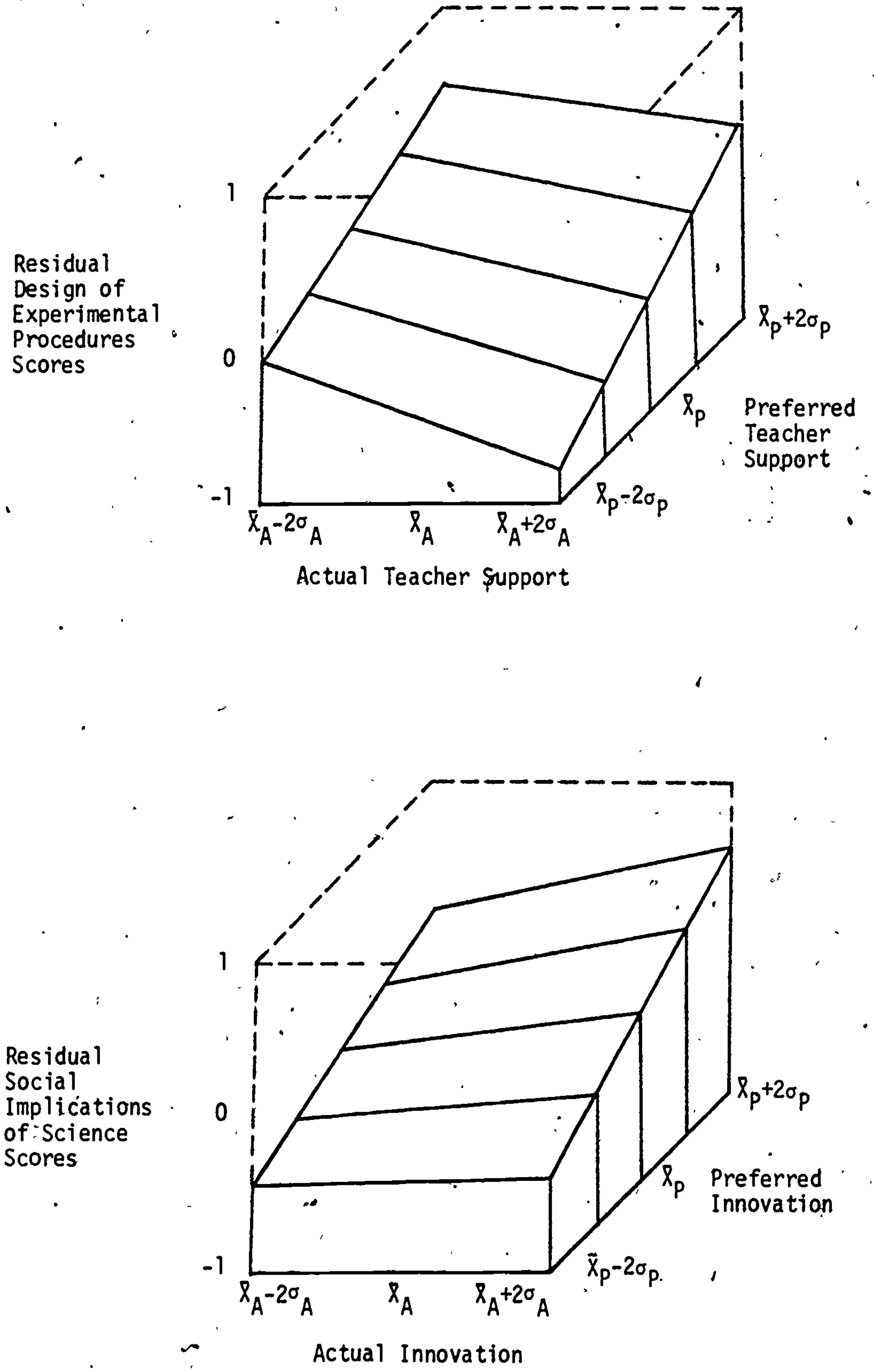


FIGURE 2

REGRESSION SURFACES FOR TWO ACTUAL-PREFERRED INTERACTIONS depends on the congruence between the individual's preferred environment and his or her own perception of actual environment. Results of analyses conducted separately for the ICEQ and CES indicated that a block of actual-preferred interactions accounted for a significant increment in criterion variance (beyond that attributable to corresponding pretest, general ability, and actual environment variables) for several learning criteria. Examination of regression surfaces for the significant actual-preferred interactions for individual classroom environment variables revealed the presence of the hypothesized person-environment interaction in every case. In fact, relationships between residual criterion scores and an actual classroom environment dimension were more positive for classes with a higher mean preference for that dimension than for classes with a lower preference for that dimension. Overall, the present promising findings suggest that actual-preferred congruence (or person-environment fit) at the class level could be as important as the nature of the actual classroom environment in predicting class achievement of important cognitive and affective aims.

The practical implication of these findings for teachers in that class achievement of certain outcomes might be enhanced by attempting to change the actual classroom environment (perhaps using methods suggested by Fraser, 1981d) in ways which make it more congruent with that preferred by the class. In contrast, it cannot be inferred from the present class-level results that an individual's achievement might be improved by moving him or her to a class whose actual environment more closely matches his or her preferred environment. Finally, although the reader is cautioned against generalizing the present finding from the class-level to the individual level, it is noteworthy that a previous study (Fraser & Rentoul, 1980) involving the use of the individual as the unit of analysis has suggested that the effects of classroom openness on individual student cognitive achievement was mediated by individual student preferences for classroom openness.

CHAPTER 5

SUMMARY AND CONCLUSION

The main aim of the research described in this report was to use results from administration of the Individualized Classroom Environment Questionnaire (ICEQ) and the Classroom Environment Scale (CES) to explore several research questions. These were a person-environment fit study of whether students achieve better in their preferred classroom environment, the generation of validation data for those two instruments, and an investigation of the effects of classroom environment on student achievement of affective and cognitive outcomes. The sample for all analyses consisted of 116 junior high school science classes.

Chapter 2 makes the ICEQ and CES assessible to others by describing these instruments and their scoring procedures and by reporting normative and validation statistics. In particular, data supported the internal consistency reliability and discriminant validity of the actual and preferred forms of each scale with either the individual or the class mean as the unit of analysis. Other analyses attested to the ability of the actual form of each scale to differentiate between the perceptions of students in different classrooms.

In chapter 3, a description is given of a study of associations between students' achievement of six affective and three cognitive outcomes and their perceptions of classroom psychosocial environment as measured by the ICEQ and CES. The six different types of analysis used were a simple, multiple and canonical correlation analysis using raw outcome scores and a simple, multiple and canonical analysis using residual outcome scores adjusted for pretest performance and general ability. Overall, results replicated prior research by furnishing evidence of appreciable relationships between students' outcomes and their perceptions of classroom environment. Commonality analyses indicated that the ICEQ and CES each made an important unique contribution to criterion variance, thus attesting to the usefulness of including both instruments in the same study. Also it was shown that the magnitudes of outcome-environment relationships were larger when the class was used as the unit of analysis than when the individual was used. These results have implications about how to enhance student outcomes by creating classroom environments found conducive to learning.

Chapter 4 broke new ground by describing the use of actual and preferred classroom environment scales in a person-environment fit study of whether students achieve better in their preferred classroom environment. The study incorporated numerous methodological refinements including the use of regression surface analyses which allowed person-environment interactions to be represented as the products of continuous variables. Numerous statistically significant interactions emerged and, in each case, results supported the person-environment fit hypothesis. That is, the relationship between residual outcome scores and actual classroom environment were more positive for classes with a higher mean preference for that dimension than for classes with a lower preference on that dimension. The practical implication of these findings is that class achievement of certain outcomes might be enhanced by attempting to change the actual classroom environment in ways which make it more congruent with that preferred by the class.

The previous paragraphs in this chapter summarize the main aspects of a major study sponsored by the ERDC. In addition to this, however, the ERDC's sponsorship has enabled a number of other minor investigations to be carried out using either the data base of this study or analogous data collected from other samples. Since this research is peripheral to the main purpose of this report, it is summarized only briefly below.

In the initial proposal to ERDC, it was hoped that the sample for the study might cover more than one Australian state and, even, some overseas students. Because of the large number of variables involved in the research (including pretests and posttests of nine outcomes and actual and preferred forms of 14 classroom environment scales), it did not prove possible to secure cooperation for such a large data-gathering exercise in another state or country. Nevertheless, it was possible to arrange for subsets of the instruments to be administered to a sample of 712 students in 23 classes in New South Wales and a sample of 373 Indonesian students in 18 classes in Padang. The study in New South Wales (Fraser, 1981c; Fraser & Butts, 1982) provided further data to support the validity of the ICEQ's actual form and confirmed the existence of relationships between student attitudes and the nature of the classroom's psychosocial environment. The study in Indonesia (Fraser, Pearse & Azmi, 1982) involved a translated version of the ICEQ and CES, supported the cross-cultural validity of these instruments for use in Indonesia, and replicated the findings of association between attitudes and environment emerging in other cultures.

The sample of 116 classes involved in the main study also provided their responses on one occasion to an anxiety scale developed by Docking and Thornton (1979). As pretest anxiety data were not available, the anxiety outcome was not included in the main analyses. Nevertheless, because the same sample had answered the anxiety measures, classroom environment instruments and various student outcome measures, it was possible to conduct interesting analyses which suggested that the nature of the classroom environment affects student anxiety levels (Fraser, Nash & Fisher, in press) and that student anxiety impedes student achievement of desired educational outcomes (Fraser & Fisher, 1982b).

The Tasmanian student data base, together with some data collected from the teachers of some of the students in this sample, permitted a comparison of actual and preferred classroom environments as perceived by students and teachers (Fisher & Fraser, 1983). It was found generally that students preferred a more favourable classroom environment than was perceived as being actually present and that teachers perceived the environments of their classes more favourably than did their students in the same classrooms.

The same data base from 116 classes has been used to develop and validate a more economical short form of both the actual and preferred forms of the ICEQ and CES (Fraser & Fisher, in press). The short form of the ICEQ consists of five five-item scales measuring the original dimensions, whereas the short form of the CES consists of six four-item scales measuring six of the CES's original nine dimensions. The reliability of the short version of scales was found typically to be no more than 0.1 smaller than the corresponding long form of the scales. The short forms, therefore, have adequate reliability for applications involving the class mean as the unit of analysis. It is hoped that the availability of these economical short forms will facilitate and encourage the use of classroom environment assessments for a variety of research purposes.

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APPENDIX A

INDIVIDUALIZED CLASSROOM ENVIRONMENT QUESTIONNAIRE

ACTUAL LONG FORM

DIRECTIONS

This questionnaire contains statements about practices which could take place in this classroom. You will be asked how often each practice actually takes place.

There are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Please do not write on this questionnaire. All answers should be given on the separate Answer Sheet.

Think about how well each statement describes what your actual classroom is like. Draw a circle around

1 if the practice actually takes place ALMOST NEVER
2 if the practice actually takes place SELDOM
3 if the practice actually takes place SOMETIMES
4 if the practice actually takes place OFTEN
5 if the practice actually takes place VERY OFTEN

Be sure to give an answer for all questions. If you change your mind about an answer, just cross it out and circle another.

Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Simply give your opinion about all statements.

INDIVIDUALIZED CLASSROOM ENVIRONMENT QUESTIONNAIRE

PREFERRED LONG FORM

DIRECTIONS

This questionnaire contains statements about practices which could take place in this classroom. You will be asked how often you would like or prefer each practice to take place.

There are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Please do not write on this questionnaire. All answers should be given on the separate Answer Sheet.

Think about how well each statement describes what your preferred classroom is like. Draw a circle around

1 if you'd prefer the practice to take place ALMOST NEVER
2 if you'd prefer the practice to take place SELDOM
3 if you'd prefer the practice to take place SOMETIMES
4 if you'd prefer the practice to take place OFTEN
5 if you'd prefer the practice to take place VERY OFTEN

Be sure to give an answer for all questions. If you change your mind about an answer, just cross it out and circle another.

Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Simply give your opinion about all statements.

LONG FORM (ACTUAL OR PREFERRED)

1. The teacher considers students' feelings.
2. Students discuss their work in class.
3. The teacher decides where students sit.
4. Students find out the answers to questions from textbooks rather than from investigations.
5. Students work at their own speed.

6. The teacher talks with each student.
7. The teacher talks rather than listens.
8. Students choose their partners for group work.
9. Students draw conclusions from information.
10. All students in the class use the same textbooks.

11. The teacher takes a personal interest in each student.
12. Most students take part in discussions.
13. Students are told exactly how to do their work.
14. Students carry out investigations to test ideas.
15. All students in the class do the same work at the same time.

16. The teacher goes out of his/her way to help each student.
17. Students give their opinions during discussion.
18. Students are told how to behave in the classroom.
19. Students find out the answers to questions and problems from the teacher rather than from investigations.
20. Different students do different work.

21. The teacher is unfriendly to students.
22. The teacher lectures without students asking or answering questions.
23. The teacher decides when students are to be tested.
24. Students are asked to think about the evidence behind statements.
25. Different students use different tests.

26. The teacher helps each student who is having trouble with the work.
27. Students are asked questions.
28. Students are punished if they behave badly in class.
29. Students carry out investigations to answer questions coming from class discussions.
30. Students who have finished their work wait for the others to catch up.
31. The teacher remains at the front of the class rather than moving about and talking with students.
32. Students sit and listen to the teacher.
33. The teacher decides which students should work together.
34. Students explain the meaning of statements, diagrams and graphs.
35. Different students use different books, equipment and materials.
36. Students are encouraged to be considerate of other people's ideas and feelings.
37. Students' ideas and suggestions are used during classroom discussions.
38. Students are told what will happen if they break any rules.
39. Students carry out investigations to answer questions which puzzle them.
40. Students who work faster than others move on to the next topic.
41. The teacher tries to find out what each student wants to learn about.
42. Students ask the teacher questions.
43. Students who break the rules get into trouble.
44. Investigations are used to answer the teacher's questions.
45. The same teaching aid (e.g., blackboard or overhead projector) is used for all students in the class.
46. The teacher uses tests to find out where each student needs help.
47. There is classroom discussion.
48. The teacher decides how much movement and talk there should be in the classroom.
49. Students solve problems by obtaining information from the library.
50. All students are expected to do the same amount of work in the lesson.

INDIVIDUALIZED CLASSROOM ENVIRONMENT QUESTIONNAIRE

ACTUAL LONG FORM

A N S W E R   S H E E T

NAME ______________________ SCHOOL ______________________ CLASS/GRADE ______________

	ALMOST NEVER / SELDOM / SOMETIMES / OFTEN / VERY OFTEN		ALMOST NEVER / SELDOM / SOMETIMES / OFTEN / VERY OFTEN		ALMOST NEVER / SELDOM / SOMETIMES / OFTEN / VERY OFTEN		ALMOST NEVER / SELDOM / SOMETIMES / OFTEN / VERY OFTEN		ALMOST NEVER / SELDOM / SOMETIMES / OFTEN / VERY OFTEN	Teacher Use Only
				Remember you are rating your <u>actual</u> classroom						
1.	1 2 3 4 5	11.	1 2 3 4 5	21.	1 2 3 4 5	31.	1 2 3 4 5	41.	1 2 3 4 5	Pe ___
2.	1 2 3 4 5	12.	1 2 3 4 5	22.	1 2 3 4 5	32.	1 2 3 4 5	42.	1 2 3 4 5	Pa ___
3.	1 2 3 4 5	13.	1 2 3 4 5	23.	1 2 3 4 5	33.	1 2 3 4 5	43.	1 2 3 4 5	Id ___
4.	1 2 3 4 5	14.	1 2 3 4 5	24.	1 2 3 4 5	34.	1 2 3 4 5	44.	1 2 3 4 5	Iv ___
5.	1 2 3 4 5	15.	1 2 3 4 5	25.	1 2 3 4 5	35.	1 2 3 4 5	45.	1 2 3 4 5	D ___
6.	1 2 3 4 5	16.	1 2 3 4 5	26.	1 2 3 4 5	36.	1 2 3 4 5	46.	1 2 3 4 5	Pe ___
7.	1 2 3 4 5	17.	1 2 3 4 5	27.	1 2 3 4 5	37.	1 2 3 4 5	47.	1 2 3 4 5	Pa ___
8.	1 2 3 4 5	18.	1 2 3 4 5	28.	1 2 3 4 5	38.	1 2 3 4 5	48.	1 2 3 4 5	Id ___
9.	1 2 3 4 5	19.	1 2 3 4 5	29.	1 2 3 4 5	39.	1 2 3 4 5	49.	1 2 3 4 5	Iv ___
10.	1 2 3 4 5	20.	1 2 3 4 5	30.	1 2 3 4 5	40.	1 2 3 4 5	50.	1 2 3 4 5	D ___
				Remember you are rating your <u>actual</u> classroom						

Pe ___ Pa ___ Id ___ Iv ___ D ___

APPENDIX B

SCORING DIRECTIONS FOR ICEQ

The Answer Sheet for the long form of the ICEQ shown on the next page has two features which facilitate ready hand scoring. First, underlining of item numbers identifies those items which need to be scored in the reverse direction. Second, items from the five scales are arranged in cyclic order so that all items from a particular scale are found in the same position in each block of five items. For example, the first item in every block belongs to the Personalization scale.

The ICEQ's Answer Sheet on the next page can be scored using the following simple method of hand scoring:

(a) Score each item and record the item score. Items not underlined are scored by allocating the number circled (i.e., by scoring 1, 2, 3, 4, and 5, respectively, for the responses Almost Never, Seldom, Sometimes, Often, and Very Often). Underlined items are scored in the reverse manner (i.e., by allocating 5, 4, 3, 2, and 1, respectively, for the responses Almost Never, Seldom, Sometimes, Often, and Very Often). Omitted or invalidly answered items are given a score of 3.

(b) Add the 10 item scores, one from each block of five items, for each scale to obtain the total score for each ICEQ scale. The first item is each block measures Personalization (Pe), the second item measures Participation (Pa), the third item measures Independence (In), the fourth item measures Investigation (Iv), and the last item in each block measures Differentiation (D). For example, the total score for Personalization scale is obtained by adding the individual scores for Items 1, 11, 21, 31, and 41 (and this sub-total can be recorded in the space next to Pe in the Teacher Use Only column) and those for Items 6, 16, 26, 36, and 46 (whose sub-total can be recorded in the space in the Teacher Use Only column). Scale totals can be recorded in the spaces provided at the bottom of the Answer Sheet.

The following page illustrates how these hand scoring procedures were used to obtain a total of 25 for the Personalization scale and a total of 30 for the Differentiation scale.

INDIVIDUALIZED CLASSROOM ENVIRONMENT QUESTIONNAIRE

ACTUAL LONG FORM

ANSWER SHEET

NAME Mary James SCHOOL ______ CLASS/GRADE ______

	ALMOST NEVER / SELDOM / SOMETIMES / OFTEN / VERY OFTEN			ALMOST NEVER / SELDOM / SOMETIMES / OFTEN / VERY OFTEN			ALMOST NEVER / SELDOM / SOMETIMES / OFTEN / VERY OFTEN			ALMOST NEVER / SELDOM / SOMETIMES / OFTEN / VERY OFTEN			ALMOST NEVER / SELDOM / SOMETIMES / OFTEN / VERY OFTEN		Teacher Use Only
							Remember you are rating your actual classroom								
1.	1 2 3 4 5	4	11.	1 2 3 4 5	3	21.	1 2 3 4 5	5	31.	1 2 3 4 5	2	41.	1 2 3 4 5	1	Pe 15
2.	1 2 3 4 5		12.	1 2 3 4 5		22.	1 2 3 4 5		32.	1 2 3 4 5		42.	1 2 3 4 5		Pa
3.	1 2 3 4 5		13.	1 2 3 4 5		23.	1 2 3 4 5		33.	1 2 3 4 5		43.	1 2 3 4 5		Id
4.	1 2 3 4 5		14.	1 2 3 4 5		24.	1 2 3 4 5		34.	1 2 3 4 5		44.	1 2 3 4 5		Iv
5.	1 2 3 4 5	4	15.	1 2 3 4 5	1	25.	1 2 3 4 5	1	35.	1 2 3 4 5	3	45.	1 2 3 4 5	4	D 13
6.	1 2 3 4 5	2	16.	1 2 3 4 5	1	26.	1 2 3 4 5	3	36.	1 2 3 4 5	3	46.	1 2 3 4 5	1	Pe 10
7.	1 2 3 4 5		17.	1 2 3 4 5		27.	1 2 3 4 5		37.	1 2 3 4 5		47.	1 2 3 4 5		Pa
8.	1 2 3 4 5		18.	1 2 3 4 5		28.	1 2 3 4 5		38.	1 2 3 4 5		48.	1 2 3 4 5		Id
9.	1 2 3 4 5		19.	1 2 3 4 5		29.	1 2 3 4 5		39.	1 2 3 4 5		49.	1 2 3 4 5		Iv
10.	1 2 3 4 5	2	20.	1 2 3 4 5	5	30.	1 2 3 4 5	3	40.	1 2 3 4 5	5	50.	1 2 3 4 5	2	D 17
							Remember you are rating your actual classroom								

63

64

Pe 25 Pa ___ Id ___ Iv ___ D 30

APPENDIX C

CLASSROOM ENVIRONMENT SCALE

ACTUAL LONG FORM

DIRECTIONS

This questionnaire contains statements about practices which could take place in this classroom. You will be asked how well each statement describes what your class is actually like.

There are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Please do not write on this questionnaire. All answers should be given on the separate Answer Sheet.

Think about how well each statement describes what your actual classroom is like. Draw a circle around

T if it is TRUE or MOSTLY TRUE that the practice actually takes place;

F if it is FALSE or MOSTLY FALSE that the practice actually takes place.

Be sure to give an answer for all questions. If you change your mind about an answer, just cross it out and circle another.

Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Simply give your opinion about all statements.

CES LONG FORM (ACTUAL OR PREFERRED)

1. Students put a lot of energy into what they do here.
2. Students in this class get to know each other really well.
3. This teacher spends very little time just talking with students.

4. Almost all class time is spent on the lesson for the day.
5. Students don't feel pressured to compete here.
6. This is a well-organized class.

7. There is a clear set of rules for students to follow.
8. There are very few rules to follow.
9. New ideas are always being tried out here.

10. Students daydream a lot in this class.
11. Students in this class aren't very interested in getting to know other students.
12. The teacher takes a personal interest in students.

13. Students are expected to stick to classwork in this class.
14. Students try hard to get the best grade.
15. Students are almost always quiet in this class.

16. Rules in this class seem to change a lot.
17. If students break a rule in this class, they are sure to get into trouble.
18. What students do in class is very different on different days.

19. Students are often "clock-watching" in this class.
20. A lot of friendships have been made in this class.
21. The teacher is more like a friend than an authority.

22. We often spend more time discussing outside student activities than class-related material.
23. Some students always try to see who can answer questions first.
24. Students fool around a lot in this class.

25. The teacher explains what will happen if a student breaks a rule.
26. The teacher is not very strict.
27. New and different ways of teaching are not tried very often in this class.

28. Most students in this class really pay attention to what the teacher is saying.
29. It's easy to get a group together for a project.
30. The teacher goes out of his/her way to help students.

31. Getting a certain amount of classwork done is very important in this class.
32. Students don't compete with each other here.
33. This class is often very noisy.

34. The teacher explains what the rules are.
35. Students can get into trouble with the teacher for talking when they're not supposed to.
36. The teacher likes students to try unusual projects.

37. Very few students take part in class discussions or activities.
38. Students enjoy working together on projects in this class.
39. Sometimes the teacher embarrasses students for not knowing the right answer.

40. Students don't do much work in this class.
41. Students' grades are lowered if they get homework in late. *
42. The teacher hardly ever has to tell students to get back in their seats.

43. The teacher makes a point of sticking to the rules he/she has made.
44. Students don't always have to stick to the rules in this class.
45. Students have very little to say about how class time is spent.

46. A lot of students "doodle" or pass notes.
47. Students enjoy helping each other with homework.
48. This teacher "talks down" to students.

49. We usually do as much as we set out to do.
50. Grades are not very important in this class.
51. The teacher often has to tell students to calm down.

52. Whether or not students can get away with something depends on how the teacher is feeling that day.
53. Students get into trouble if they're not in their seats when the class is supposed to start.
54. The teacher thinks up unusual projects for students to do.

55. Students sometimes present something they've worked on to the class.
56. Students don't have much of a chance to get to know each other in this class.
57. If students want to talk about something, this teacher will find time to do it.

58. If a student misses class for a couple of days, it takes some effort to catch up.
59. Students here don't care about what grades the other students are getting.
60. Assignments are usually clear so everyone knows what to do.

* Items 41, 63, and 86 were not included when calculating the statistics reported in section 6.3.

61. There are set ways of working on things.
62. It's easier to get into trouble here than in a lot of other classes.
63. Students are expected to follow set rules in doing their work.*

64. A lot of students seem to be only half awake during this class.
65. It takes a long time to get to know everybody by their first names in this class.
66. This teacher wants to know what students themselves want to learn about.

67. This teacher often takes time out from the lesson plan to talk about other things.
68. Students have to work for a good grade in this class.
69. This class hardly ever starts on time.

70. In the first few weeks the teacher explained the rules about what students could and could not do in this class.
71. The teacher will put up with a good deal.
72. Students can choose where they sit.

73. Students sometimes do extra work on their own in the class.
74. There are groups of students who don't get along in class.
75. This teacher does not trust students.

76. This class is more a social hour than a place to learn something.
77. Sometimes the class breaks up into groups to compete with each other.
78. Activities in this class are clearly and carefully planned.

79. Students aren't always sure if something is against the rules or not.
80. The teacher will kick a student out of class if he/she doesn't behave.
81. Students do the same kind of homework almost every day.

82. Students really enjoy this class.
83. Some students in this class don't like each other.
84. Students have to watch what they say in this class.

85. The teacher sticks to classwork and doesn't get sidetracked.
86. Students usually pass even if they don't do much. *
87. Students don't interrupt the teacher when he/she is talking.

88. The teacher is consistent in dealing with students who break the rules.
89. When the teacher makes a rule he/she means it.
90. In this class, students are allowed to make up their own projects.

* Items 41, 63, and 86 were not included when calculating the statistics reported in section 6.3.

CLASSROOM ENVIRONMENT SCALE

ACTUAL LONG FORM

ANSWER SHEET

NAME ______________________ SCHOOL ______________________ CLASS/GRADE ______________________

Remember you are rating your actual classroom

										Teacher use only
1. T F	10. T F	19. T F	28. T F	37. T F	46. T F	55. T F	64. T F	73. T F	82. T F	Inv ______
2. T F	11. T F	20. T F	29. T F	38. T F	47. T F	56. T F	65. T F	74. T F	83. T F	Aff ______
3. T F	12. T F	21. T F	30. T F	39. T F	48. T F	57. T F	66. T F	75. T F	84. T F	TS ______
4. T F	13. T F	22. T F	31. T F	40. T F	49. T F	58. T F	67. T F	76. T F	85. T F	TO ______
5. T F	14. T F	23. T F	32. T F	41. T F	50. T F	59. T F	68. T F	77. T F	86. T F	Com ______
6. T F	15. T F	24. T F	33. T F	42. T F	51. T F	60. T F	69. T F	78. T F	87. T F	OO ______
7. T F	16. T F	25. T F	34. T F	43. T F	52. T F	61. T F	70. T F	79. T F	88. T F	RC ______
8. T F	17. T F	26. T F	35. T F	44. T F	53. T F	62. T F	71. T F	80. T F	89. T F	TC ______
9. T F	18. T F	27. T F	36. T F	45. T F	54. T F	63. T F	72. T F	81. T F	90. T F	Inn ______

Remember you are rating your actual classroom

APPENDIX D

SCORING DIRECTIONS FOR CES

The CES Answer Sheet on the next page has some features which facilitate hand scoring. Underlining of item numbers identifies items scored in the opposite direction to other items. Also, items are arranged in cyclic order so that all items from a particular scale are found in the same horizontal row in the Answer Sheet. The copy of the Answer Sheet on the next page illustrates the following simple method of hand scoring:

(a) Score each item and record the item score as shown. Items not underlined are scored 3 for True and 1 for False. Underlined items are scored in the reverse manner (i.e., 1 for True and 3 for False). Omitted or invalidly answered items (e.g., Items 24 and 51) are given a score of 2.

(b) Add the 10 item scores in each horizontal row to obtain the total score for ICEQ scales. For example, the sum of the scores for the items in the first horizontal row (i.e., Items 1, 10, 19, 28, 37, 46, 55, 64, 73, and 82) represents the total on the Involvement scale. The second, third, fourth, fifth, sixth, seventh, eighth, and ninth horizontal rows on the Answer Sheet contain items measuring, respectively, Affiliation, Teacher Support, Task Orientation, Competition, Order and Organization, Rule Clarity, Teacher Control, and Innovation.

The next page illustrates how these hand scoring procedures were used to obtain a total of 18 for the Involvement scale and a total of 24 for the Order and Organization scale.

CLASSROOM ENVIRONMENT SCALE

ACTUAL LONG FORM

ANSWER SHEET

NAME ____________ SCHOOL ____________ CLASS/GRADE ____________

Remember you are rating your actual classroom

1. T F 1	10. T F 3	19. T F 1	28. T F 1	37. T F 1	46. T F 3	55. T F 3	64. T F 1	73. T F 3	82. T F 1	Inv 18
2. T F	11. T F	20. T F	29. T F	38. T F	47. T F	56. T F	65. T F	74. T F	83. T F	Aff
3. T F	12. T F	21. T F	30. T F	39. T F	48. T F	57. T F	66. T F	75. T F	84. T F	TS
4. T F	13. T F	22. T F	31. T F	40. T F	49. T F	58. T F	67. T F	76. T F	85. T F	TO
5. T F	14. T F	23. T F	32. T F	41. T F	50. T F	59. T F	68. T F	77. T F	86. T F	Com
6. T F 3	15. T F 3	24. T F 2	33. T F 3	42. T F 3	51. T F 2	60. T F 3	69. T F 1	78. T F 1	87. T F 3	OO 24
7. T F	16. T F	25. T F	34. T F	43. T F	52. T F	61. T F	70. T F	79. T F	88. T F	RC
8. T F	17. T F	26. T F	35. T F	44. T F	53. T F	62. T F	71. T F	80. T F	89. T F	TC
9. T F	18. T F	27. T F	36. T F	45. T F	54. T F	63. T F	72. T F	81. T F	90. T F	Inn

Teacher use only

Remember you are rating your actual classroom

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