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ABSTRACT

This paper argues the merits of including the topic of classroom psychosocial environment in the curriculum of science teacher education programs, on the assumption that having a positive classroom environment is an educationally desirable end in its own right. Discussions focus on the potential of the classroom environment as a way of: (1) sensitizing preservice teachers to subtle but important aspects of classroom life; (2) illustrating the environment's usefulness in curriculum evaluation; and (3) facilitating practical improvements in classrooms. Given the ready availability of instruments, the salience of classroom environment, the impact of classroom environment on student outcomes, and the potential of environmental assessments in guiding educational improvement, it seems crucial that researchers and teachers begin to include classroom environment instruments as part of the batteries of measures used in school evaluations and school effectiveness studies. (JN)

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Improving Science Teacher Education Programs Through Inclusion of Research on Classroom Psychosocial Environment

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It is understandable that science teachers today often teach as they were taught themselves as students. After all, given that students spend 15,000 hours in classrooms by the end of their secondary schooling (Rutter, Maughan, Mortimore, Ouston & Smith, 1979), the teacher's time as a school student far exceeds his or her period of teacher training. What is needed to break this nexus is new input and new ideas within science teacher education programs, especially those which will help teachers become more reflective and retrospective about the way they are teaching.

Science education research provides one possible source of ideas whose inclusion has the potential of improving science teacher education curricula. Already the NSTA-sponsored What Research Says to the Teacher series in the USA and the Science Teacher Education Project (STEP) in the UK provide some good examples of the relevance and value of particular research concepts and findings for the improvement of science teaching. It is desirable that preservice teachers begin to become acquainted with these ideas through their incorporation into science teacher education programs.

The field of classroom psychosocial environment provides a good illustration of a thriving field of study among science education researchers (see Fraser, 1981b, 1985a; Chavez, 1984; Fraser & Walberg, 1981) which furnishes a number of ideas and techniques which are potentially valuable for improving teaching practice and for inclusion in science teacher education programs. After a brief introduction to the field of classroom environment, this paper aims to demonstrate the usefulness in science teacher education programs of material from the field of classroom environment which (1) sensitizes preservice teachers to subtle but important aspects of classroom life, (2) illustrates the usefulness of classroom environment measures in curriculum evaluation,

and (3) illustrates how assessments of classroom environment can be used to facilitate practical improvements in classrooms.

Field of Classroom Environment

Although it is clearly important for educators to consider student academic achievement and other valued educational outcomes, they cannot give science teacher education students a complete picture of the educational process. Classroom environment work provides one approach to investigating what happens to students during their schooling which involves students' perceptions of psychosocial aspects of their classroom learning environments.

In contrast to methods which rely on outside observers, the approach described in this paper defines classroom environment in terms of the shared perceptions of the students and sometimes the teachers in that environment. This has the dual advantage of characterizing the class through the eyes of the actual participants and capturing data which the observer could miss or consider unimportant. For example, students often ignore frequently occurring classroom stimuli and act in the light of how they expect the teacher to behave. Students are at a good vantage point to make judgments about classrooms because they have encountered many different learning environments and have enough time in a class to form accurate impressions. Also, even if teachers are inconsistent in their day-to-day behavior, they usually project a consistent image of the long-standing attributes of classroom environment.

Fraser and Walberg (1981) outline some advantages which student perceptual measures have over observational techniques. First,

paper-and-pencil perceptual measures are more economical than classroom observation techniques which involve the expense of trained outside observers. Second, perceptual measures are based on students' experiences over many lessons, while observational data usually are restricted to a very small number of lessons. Third, perceptual measures involve the pooled judgments of all students in a class, whereas observation techniques typically involve only a single observer. Fourth, students' perceptions, because they are the determinants of student behaviour more so than the real situation, can be more important than observed behaviours. Fifth, perceptual measures of classroom environment typically have been found to account for considerably more variance in student learning outcomes than have directly observed variables.

Another approach to studying classroom environments involves application of the techniques of naturalistic inquiry and case study which are well illustrated by the vivid descriptions of classroom settings found in popular books such as To Sir With Love, Up the Down Staircase, Death at an Early Age, and Thirty-Six Children. Some good examples of classroom environment studies following these more qualitative approaches include Jackson (1968), Cusick (1973), Rutter et al. (1979), Case Studies in Science Education (Stake & Easley, 1978), and Gallagher (1984). Cusick, for instance, gathered his descriptions during a six-month period in which he attended a high school daily, associated with students, went to class, had meals in the cafeteria and took part in informal classroom and corridor activities.

The work described here builds upon the seminal independent research programs commenced by Herbert Walberg and Rudolf Moos two decades ago. It was almost 20 years ago when Walberg began developing earlier versions of the widely used Learning Environment Inventory as part of the research

and evaluation activities of Harvard Project Physics (see Anderson & Walberg, 1968; Walberg, 1968; Walberg & Anderson, 1968a, b). Two decades ago also marks the time when Moos began developing the first of his world-renowned social climate scales, including those for use in psychiatric hospitals (Moos & Houts, 1968) and correctional institutions (Moos, 1968), which ultimately resulted in development of the widely known Classroom Environment Scale.

The way that the important pioneering work of Walberg and Moos on perceptions of classroom environment developed into major research programs and spawned a lot of other research is reflected in numerous comprehensive literature overviews. These include books (Moos, 1979a; Walberg, 1979), monographs (Fraser, 1981b; Fraser & Fisher, 1983a), a guest-edited journal issue (Fraser, 1980), an annotated bibliography (Moos & Spinrad, 1984), several state-of-the-art literature reviews (Anderson & Walberg, 1974; Randhawa & Fu, 1973; Walberg, 1976; Walberg & Haertel, 1980; Fraser, 1984, 1985e; Chavez, 1984), including special purpose reviews with an emphasis on classroom environment work in science education (Fraser & Walberg, 1981), in Australia (Fraser, 1981a), and in Germany (Dreesman, 1982; Wolf, 1983).

The considerable body of prior classroom environment research which has focused specifically on science classrooms includes studies of the effects of classroom environment on student outcomes (Walberg, 1972; Lawrenz, 1976; Fraser, 1979; Hofstein, Gluzman, Ben-Zvi, & Samuel, 1979; Haladyna, Olsen, & Shaughnessy, 1982; Fraser & Fisher, 1982a, b), the use of classroom environment variables as process criteria in curriculum evaluations (Welch & Walberg, 1972; Fraser, 1979a), the study of differences between students and teachers in their perceptions of actual

and preferred classroom environment (Fisher & Fraser, 1983), the investigation of the person-environment fit hypothesis of whether students achieve better in their preferred classroom environment (Fraser & Fisher, 1983b, c), the application of classroom environment assessments in facilitating improvements in classrooms (Fisher & Fraser, 1985), and studies of the way that classroom environment varies with other variables such as teacher sex (Lawrenz & Welch, 1983), class size (Anderson & Walberg, 1972), grade level (Welch, 1979), or grouping of students in the laboratory on the basis of formal reasoning ability (Lawrenz & Munch, 1984).

Sensitization to Subtle, Important Aspects of Classrooms

Through research on classroom environment, there is an opportunity for science educators to familiarize their students with many important but subtle aspects of classroom life. In particular, this familiarization can be achieved by introducing teacher education students to instruments which assess classroom environment and have them administer an instrument in classrooms during teaching practice periods. If organized in appropriate ways, discussion of results obtained via questionnaire administration can provide a very worthwhile stimulus for preservice teachers to reflect seriously about their classrooms and to plan actions which will lead to the improvement of classroom environments.

Table 1 provides the scale name and a scale description for five widely applicable classroom environment instruments. The first three of these - namely, the Learning Environment Inventory (LEI) (Anderson & Walberg, 1974; Fraser, Anderson, & Walberg (1982), the Classroom Environment Scale

(CES) (Trickett & Moos, 1973; Moos & Trickett, 1974), and the Individualized Classroom Environment Questionnaire (ICEQ) (Rentoul & Fraser, 1979; Fraser, 1985d) - are suitable for use at the high school level. The My Class Inventory (MCI) (Fisher & Fraser, 1981; Fraser, Anderson, & Walberg, 1982) is designed for the elementary school level, whereas the College and University Classroom Environment Questionnaire (CUCEI) (Fraser, Treagust, and Dennis, 1984) is intended for use at the higher education level. Although the main application of these instruments in past research has been the measurement of students perceptions of actual classroom environment, numerous interesting studies also have used these scales to assess preferred classroom environment. The preferred forms are concerned with goals and value orientations and measure the perceptions of the classroom ideally liked or preferred by students.

Insert Table 1 about here

The initial development and validation of a preliminary version of the LEI began in the late 1960s in conjunction with the evaluation and research on Harvard Project Physics. Initially, Walberg (1968) devised an instrument called the Classroom Climate Questionnaire, which included 18 scales selected by factor analysis and considered meaningful for the description of school class groups. The LEI is an expansion and improvement of the Classroom Climate Questionnaire. A form of the LEI developed in 1968 contained 14 scales, but a 1969 revision was expanded to include 15 scales. In selecting the 15 climate dimensions, an attempt

was made to include as scales only concepts similar to those found useful in theory and research in education and concepts which intuitively appeared relevant to classrooms. The final version of the LEI contains a total of 105 statements (i.e., seven per scale) descriptive of typical school classes. The respondent expresses degree of agreement or disagreement with each statement on a four-point scale with response alternatives of Strongly Disagree, Disagree, Agree, and Strongly Agree. Typical items contained in the LEI are "All students know each other very well" (Cohesiveness), "Certain students in the class are responsible for petty quarrels" (Friction), "Students do not have to hurry to finish their work" (Speed), and "The class is well organized and efficient" (Disorganization). The scoring direction (or polarity) is reversed for some items. Also, in the most recent published version of the LEI (Fraser, Anderson, & Walberg, 1982), the response format is arranged in such a way as to allow ready hand scoring.

The CES is one of a set of nine separate, but somewhat similar instruments, called the Social Climate Scales (Moos, 1974b) which were developed to assess a variety of human environments including hospital wards, university residences, correctional institutions, military companies, families, and work settings. The original version of the CES consisted of 242 items representing 13 conceptual dimensions (Trickett & Moos, 1973). Following trials of the items in 22 classrooms and subsequent item analysis, the number of items was reduced to 208. This item pool was administered in 45 classrooms and modified to form the final version. These items were 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 contains nine scales with 10 items of True-False response format in each scale. This version is available in published form which includes a separate answer sheet and a transparent hand scoring key (Moos & Trickett, 1974). Typical items in the CES are "This class is more a social hour than a place to learn something" (Task Orientation), "Students don't always have to stick to the rules in this class" (Teacher Control) and "New ideas are always being tried out here" (Innovation). The scoring direction is reversed for half of the items in each CES scale.

Despite the wide application and proven usefulness of the LEI and CES, these instruments exclude some of the aspects of classroom environment which are particularly relevant in classroom settings commonly referred to as individualized, open, or inquiry-based. Consequently, the ICEQ was developed to measure those dimensions which differentiate conventional classrooms from individualized ones involving either open or inquiry-based approaches. The ICEQ could be used either on its own in studies focusing exclusively on individualized settings or in conjunction with an instrument such as the LEI or CES to provide coverage of a broader range of classroom characteristics. The initial development of the long form of the ICEQ, which is discussed in detail by Rentoul and Fraser (1979), was guided by several criteria including consistency with the literature of individualized education and salience to teachers and students. Preliminary versions were modified after receiving reactions from experts, teachers, and students and in the light of the results of item analyses performed on data collected during field trials. The final version of the ICEQ contains 50 items altogether, with an equal number of items belonging to each of the five scales. Each item is responded to on a five-point scale with the alternatives of Almost Never, Seldom,

Sometimes, Often, and Very Often. The scoring direction is reversed for many of the items. Typical items are "The teacher lectures without students asking or answering questions" (Participation), "The teacher decides which students should work together" (Independence), and "Different students do different work" (Differentiation). The ICEQ is now available in published form which consists of a handbook, a test master set from which unlimited numbers of copies of the questionnaire may be made, and a separate hand-scorable answer sheet (Fraser, 1985e).

The MCI is a simplification of the LEI suitable for children in the 8 to 12 years age range. The MCI differs from the LEI in four important ways. First, in order to minimize fatigue among younger children, the MCI contains only five of the LEI's original 15 scales (namely, Cohesiveness, Friction, Satisfaction, Difficulty, and Competitiveness). Second, item wording has been simplified to enhance readability. Third, the LEI's four-point response format has been reduced to a two-point (Yes-No) response format. Fourth, students answer on the questionnaire itself instead of on a separate response sheet to avoid errors in transferring responses from one place to another. The original version of the MCI contained nine items per scale and is included in the first and second versions of the LEI/MCI Manual. But the reliability of some scales in the original version was less than desirable. Consequently, the third and most recent version of the LEI/MCI Manual contains a new 38-item version of the MCI which has improved scale reliabilities (Fraser, Anderson, & Walberg, 1982). The 38-item version has 6 items in the Cohesiveness scale, 8 items each in the Friction and Difficulty scales, 9 items in the Satisfaction scale, and 7 items in the Competitiveness scale. Typical items in this version of the MCI are "Children in our class fight a lot" (Friction), "Schoolwork is hard to

do" (Difficulty) and "The class is fun" (Satisfaction). It can be seen from these examples that the reading level of the MCI is appreciably lower than that of the LEI and is well suited to use among primary school students.

Despite strong traditions of classroom environment research at the primary and secondary school levels, surprisingly little analogous work has been conducted at the higher education level. One likely explanation for this is simply the unavailability of suitable, reliable, and practical instruments for use in higher education classrooms. Consequently the College and University Classroom Environment Inventory (CUCEI) was developed for use in small groups (say, of up to approximately 30 students). The CUCEI is not suitable for use in lectures or laboratory classes, although it may be used where the instructor is involved in lecturing for a relatively minor part of class time. The initial development of the CUCEI involved examining the individual scales and individual items contained in the LEI, CES, and ICEQ. A set of items was written and subjected to the scrutiny of a number of tertiary educators, including some with extensive questionnaire writing experience. After rewriting and eliminating many items in the light of reactions obtained, a trial version of the CUCEI containing 12 items per scale was field tested. The final form of the CUCEI contains 49 items altogether, with 7 items in each scale (Fraser, Treagust, & Dennis, 1984). Each item is responded to using the four categories of Strongly Agree, Agree, Disagree, and Strongly Disagree. The scoring direction is reversed for approximately half of the items in each scale. Typical items are "Activities in this class are clearly and carefully planned" (Task Orientation) and "Teaching approaches allow students to proceed at their own pace" (Individualization).

For each of the instruments lisied in Table 1, comprehensive validation information has been accumulated for science classrooms. Some of these validity data are taken from Fraser (1985a) and Fraser and Fisher (1983a) and summarized in Table 2 which reports each scale's internal consistency reliability (using the alpha coefficient), discriminant validity (using the mean correlation of a scale with the other scales in the same instrument as a convenient index), and ability to differentiate between the perceptions of students in different classrooms (significance level and eta^2 statistic from ANOVAs). Table 2 is confined to the student actual form of each instrument and the use of the individual student as the unit of analysis. Data are based on sample sizes of 1,048 students for the LEI (with the exception of mean correlations which are based on 149 class means because no data are available for individuals), 1,083 students for the CES, 1,849 students for the ICEQ, 2,305 students for the MCI, and 127 students for the CUCEI. No data are available on the LEI's ability to differentiate between classrooms.

Insert Table 2 about here

As the LEI, CES, ICEQ, and MCI are suited for use in school classrooms, it could be useful to have preservice teachers administer some scales during teaching practice session and to discuss this information when they return to their teacher training institutions. In the case of the CUCEI which is intended for higher education classrooms, it has been found that having preservice education students rate one of their

education classes with the CUCEI provides a useful vehicle for introducing them to the field of classroom environment.

Curriculum Evaluation Studies

One of the applications of classroom environment instruments which might be included in science teacher education programs is curriculum evaluation As one promising use of classroom environment instruments is as a source of process criteria in the evaluation of science curricula and innovations, Walberg (1975) and Fraser (1981b) urge educators more often to incorporate classroom environment dimensions into their evaluations. The use of these process criteria is especially important since it is becoming common for the philosophy of contemporary science curricula and innovations to define, not only the aims to be achieved by students, but also the nature of the learning environment considered desirable (e.g., emphasis on cooperation or individualization). Moreover, Walberg (1975) decries the overemphasis on standard achievement criteria in curriculum evaluation and advises researchers to view socio-psychological classroom processes as valuable ends in their own right. Additionally several studies of alternative curricula (Welch & Walberg, 1972; Fraser, 1979) have shown that classroom environment variables have differentiated revealingly among the curricula when a variety of cognitive outcome measures have shown little sensitivity. Because of the potential usefulness of classroom environment measures in curriculum evaluation, this section is devoted to reviewing prior work which has included environmental variables among the criteria of effectiveness.

Anderson, Walberg, and Welch (1969) attempted to use students' perceptions on the LEI to differentiate classes using the penultimate version of Harvard Project Physics materials from classes following alternative physics curriculum materials. The sample consisted of 3,264 high school students in 150 physics classes in the U.S.A. The statistical analysis involved multiple discriminant analysis, including rotation of principal discriminant loadings, with the class mean as the unit of analysis. It was found that students in classes using Harvard Project Physics perceived their classrooms as more diverse and democratic, less difficult and goal directed and having a better physical environment and less friction. In another examination of the effects of using Harvard Project Physics materials on the classroom learning environment involving the randomly chosen classes in the original sample, Welch and Walberg (1972) found that students in Harvard Project Physics classes perceived their classes as having greater diversity and less favoritism and difficulty than was perceived by students in classes using alternative materials.

Three different studies have employed student perceptions of classroom environment as criteria in the evaluation of materials developed by the Australian Science Education Project (ASEP). The first study (Fraser, 1976, 1979) employed a modified nine-scale version of the LEI with a sample of 541 seventh grade students in Melbourne to compare the perceived environment in ASEP and conventional classrooms six months after the beginning of the school year. When student socioeconomic status, general ability, and sex were controlled, multiple regression analyses revealed that ASEP students perceived their classrooms as more satisfying, more individualized, and having a better material environment. The second study (Fisher & Power, 1978; Power & Fisher,

1979) traced changes occuring in student perceptions on the LEI and eight scales from the Class Activities Questionnaire (Steele, House & Kerins, 1971) during the use of an ASEP unit in 20 junior high school classrooms. It was found that significant changes occurred on 12 of the 23 learning environment dimensions. In fact, after using the ASEP unit, students perceived their classrooms as having greater cohesiveness, diversity, goal direction, satisfaction, formality, cliqueness, humour, and discussion of interesting ideas and less speed, favoritism, disorganization, and apathy. In the third study (Northfield, 1976), a modified version of the LEI was used in the 17 seventh grade classes to monitor changes during the use of another ASEP unit. When student ability in science was controlled, it was found that significant pretest-posttest changes had occurred for five of the nine environment dimensions considered. After using the ASEP unit, students perceived their classes as more goal directed and individualized and less satisfying, difficult, and competitive.

Similarly, in the Netherlands, Kuhlemeier (1983) and Wierstra (1984) used the ICEQ in evaluating PLON, a new physics curriculum emphasizing inquiry-based teaching methods. Kuhlemeier's data were obtained by administering a Dutch instrument to a sample of 15-16 year-olds consisting of 257 PLON students in 15 classes and 307 control students in 15 classes. MANOVA revealed that, in contrast to control students, PLON students perceived their classrooms as having greater emphasis on participation, independence, investigation, and differentiation. When Wierstra administered a scale based on a translation and modification of the ICEQ's Participation and Investigation scales to 254 PLON students and 144 control students, again it was found that PLON students perceived

greater levels of inquiry in their classrooms than did the control students.

Levin's (1980) study reported the use of student perceptions of classroom environment as dependent variables in evaluating an individualized curriculum in 57 first to third grade classrooms in three cities in Israel. Of these classes, 43 served as an experimental group in which an individualized instructional strategy was implemented, while 14 comparable control clas: .. ..owed a traditional instructional strategy. Student perceptions were measured with a 45-item instrument measuring the following seven dimensions: Autonomy, Competition, Social Relations, Discipline and Organization, Cooperation, Affective Behavior of Teachers, and Instructional Behavior of Teachers. Results indicated that the experimental and control groups differed significantly on only one of the seven classroom environments scales: students in individualized classrooms perceived greater autonomy than students in traditional classrooms.

Talmage and Hart (1977) have reported a study in which the MCI was used as a source of criterion variables in an evaluation study. The experimental group consisted of 23 elementary-school classes in metropolitan Chicago taught by teachers who had participated in a National Science Foundation one-year program on investigative approaches to the teaching of mathematics (e.g., exploring problems in a laboratory setting). This experimental group, together with a control group of 23 classes whose teachers had not participated in the program, responded to the MCI at the beginning of the year in which the program was run and again at the end of the same year. When a multiple regression analysis was performed separately for each MCI scale with the class mean as the unit of statistical analysis, it was found that the group variable

(experimental/control) accounted for a significant increment in posttest cohesiveness scores beyond that attributable to pretest cohesiveness scores. The interpretation of this finding was that students in classes taught by participants in the training program perceived their mathematics classes as more cohesive than students in classes whose teachers had not been trained in investigative teaching.

If it is assumed that student achievement measures cannot yield a complete picture of the educational process, then it becomes important that the evaluation of innovations in science education include a wider variety of criterion measures. As student perceptions of classroom psychosocial environment provide a promising source of process criteria of curricular effectiveness, it could be advantageous to include this application of classroom environment assessments in science teacher education programs.

Changing Classroom Settings

Although much research has been conducted on student perceptions of classroom learning environment, comparatively little has been done to help teachers assess and improve the environments of their classrooms. Consequently, this section attempts to encourage and facilitate future integration of this area into science teacher education curricula by, first, providing a review of some related literature and, second, reporting a case study of a successful attempt at using classroom environment assessments to guide improvements in classrooms. In particular, this section focuses on an approach in which feedback information based on student perceptions is employed as a basis for

reflection upon, discussion of, and systematic attempts to improve classroom environments (see Fisher & Fraser, 1985; Fraser, 1981b, c, 1985b, c). It involves, first, using assessments of student perceptions of both their actual and preferred classroom environment to identify discrepancies between the actual classroom environment and that preferred by students and, second, implementing strategies aimed at reducing existing discrepancies. This method can be justified partly in terms of recent person-environment fit research which suggests that students achieve better when in their preferred classroom environment (Fraser & Fisher, 1983c).

Very little literature deals directly with the use of student environment perceptions in facilitating changes in classroom environments, but there exists some interesting literature related indirectly to this task. For example, as part of the teacher-as-researcher movement in Britain (May, 1981), curriculum workers such as Stenhouse (1975) and Elliott (1973, 1976-77, 1978) have advocated a mode of action research in which teachers deliberately and systematically reflect upon, discuss and question their own classroom practice as a basis for improving their teaching. Literature devoted to educational program evaluation provides useful guidance about ways in which teachers can play a more prominent role in curriculum evaluation and in the self-evaluation of their own work (Davis, 1980; McCormick & James, 1983). In fact, Bodine (1973) has suggested that teachers engaging in self-evaluation procedures should employ various feedback techniques (e.g., observation by colleagues or use of rating forms) to identify areas in which teachers' classroom behaviors differ from what they consider ideal. Extensive work in England involving teachers in the self-evaluation of their own work has led Simons (1981) to two pertinent

conclusions. First, when teachers initially became involved in self-evaluation, they preferred the use of questionnaires to other methods (e.g., observation or interview) for obtaining information about their teaching. Second, teachers required support (e.g., on-site consultancy) to sustain self-evaluation. These observations suggest that two positive features of the proposed approach to improving classrooms are that it involves the use of questionnaires as a source of feedback information and that the researchers provide teachers with some on-site consultancy during the project. Furthermore, the fact that this method for improving classrooms utilizes feedback information based on student perceptions means that use is made of an important but often neglected source of information about classrooms (Weinstein, 1981).

The literature describing classroom interaction analysis and microteaching also provides ideas about the use of feedback to teachers as a means of promoting improved classroom practice (e.g., Olivero, 1970; Dunkin & Biddle, 1974; Peterson & Walberg, 1979). Classroom interaction analysis, which involves the coding of classroom communication (usually verbal) according to category schemes, has been used extensively and successfully in preservice and inservice education as a way of making teachers aware of and subsequently improving their own teaching. Microteaching usually involves the recording on videotape of a teacher's presentation of a teaching episode to a small group of students, followed by feedback involving the teacher, supervisor and peers and, finally, attempts to improve any identified defects in teaching (Brown, 1975). The success of using classroom interaction feedback and microteaching lends some credence to the idea that feedback information based on classroom environment profiles also could provide a useful basis for planning changes in classrooms.

Although there have been very few applications of these methods specifically in primary or secondary school classrooms, analogous techniques involving the use of Moos's Social Climate Scales have been implemented successfully in a range of other human milieus (Moos, 1974b, 1979b). For example, milieu inhabitants' perceptions of actual and preferred environment have been employed in facilitating change through use of the Ward Atmosphere Scale in psychiatric hospitals (Pierce, Trickett, & Moos, 1972; Moos, 1973; Verinis & Flaherty, 1978), use of both the Ward Atmosphere Scale and the Community Oriented Program Environment Scale in a psychiatric hospital (Friedman, 1982; Friedman, Jeger, & Slotnick, 1982), use of the CES in college and university classrooms (DeYoung, 1977; Waters, 1983), use of the Community Oriented Program Environment Scale in an adolescent residential care centre (Moos & Otto, 1972; Moos, 1973, 1974a) and in alcoholism treatment programs (Bliss, Moos, & Bromet, 1976), use of the Group Environment Scale in staff milieus (Schroeder, 1979), use of the Work Environment Scale in law enforcement agencies (Waters, 1978) and a hospital burn unit (Koran, Moos, & Zasslow, 1983), and use of the Family Environment Scale in family therapy groups (Fuhr, Moos, & Dishotsky, 1981). Although the above studies are related only peripherally to work in school classrooms, nonetheless, they attest to the efficacy of the general strategy of using environment assessments to guide environmental improvement and suggest some useful ways of conducting and reporting this type of work.

Because only a handful of applications of these techniques in school classrooms has been published, this section illustrates the proposed methods by reporting one of these case studies in detail. This involved a teacher from a private secondary school in a suburb of Sydney in employing actual and preferred forms of the ICEQ in a systematic attempt

to improve the environment of one of his classes. This class consisted of 31 seventh grade boys of mixed ability who were studying several different subjects with the same teacher. The procedure followed incorporated the following five fundamental steps:

1. Assessment. The teacher administered the ICEQ to all students in the class. The actual form was answered first and the preferred form was answered a week later.
2. Feedback. Student data were analyzed by computer by the researchers and presented to the teacher in the form of profiles representing the class means of students' actual and preferred environment scores. During a visit to the school, the researchers explained the interpretation of results to the teacher. In particular, the profiles were used to identify changes in classroom environment needed in order to reduce discrepancies between the actual environment and the preferred environment.
3. Reflection and Discussion. After private reflection and informal discussion with the researchers, the teacher decided to introduce an intervention aimed at increasing the levels of Personalization and Participation in his class.
4. Intervention. The teacher introduced an intervention of approximately one month's duration in an attempt to increase classroom Personalization and Participation. This intervention consisted of a variety of strategies, some of which originated during a number of meetings between the teacher and researchers and others of which were suggested by examining ideas contained in individual ICEQ items. Strategies implemented to enhance classroom Personalization involved the teacher in moving around the class more

to mix with students, asking students about their welfare, praising and encouraging students, chatting with and being warm toward students, and avoiding snappiness. This required some restructuring of lessons so that the teacher had more time for moving around the class. Strategies used by the teacher in attempting to increase Participation were reducing teacher talk, providing more time for students to ask and answer questions, and organizing more group work. In brief, the overall rationale for these strategies was to place greater emphasis on the human element in teaching.

5. Reassessment. The student actual form of the ICEQ was administered at the end of the month of intervention to see whether students were perceiving their classroom environment differently from before. Again data were analyzed by computer and fed back to the teacher accompanied by lengthy discussion about the meaningfulness of results.

The results of the study are summarized graphically in Figure 1, which compares profiles of student actual-preferred discrepancy scores obtained before and after the intervention. These discrepancy scores were obtained simply by subtracting the class mean score for students' perceptions of actual environment from the mean score for preferred environment on each of the ICEQ's five scales. The distances between points on the discrepancy profiles and the horizontal line in Figure 1 represent the necessary increase or decrease in each area needed for the class to become as students would prefer it.

Insert Figure 1 about here

Figure 1 clearly illustrates that, during the time of the intervention, an appreciable reduction in actual-preferred discrepancy occurred for the dimensions of Personalization and Participation, but that a negligible change occurred for the Independence, Investigation, and Differentiation scales. These findings are especially noteworthy because the two dimensions on which the appreciable changes were recorded were those, and only those, on which the teacher had attempted to promote change. To further illustrate these findings, a t test for dependent samples for the significance of pretest-posttest changes in discrepancy scores was conducted for each scale. (Since only a single assessment of preferred environment was made, these t tests for pretest-posttest changes in discrepancy scores are equivalent to t tests for pretest-posttest changes in actual scores.) It was found that, during the intervention, large and statistically significant reductions occurred in actual-preferred discrepancy on the Personalization and Participation scales, but that negligible changes occurred on the other three ICEQ scales.

Generally the teacher found that information obtained from administration of the ICEQ was meaningful and that it was possible to identify phenomena in the class which were contributing to the profiles. In particular, the changes in environment picked up through use of the questionnaires accorded with the teacher's intuitive expectations based on student comments and classroom events. These observations are important because they suggest that, in this instance, the ICEQ was able to provide the teacher with feedback information about this class which

appeared plausible, which made him aware of specific problem areas, and which suggested starting points for implementing improvements.

Although the case studies reported in this paper and elsewhere (Fraser, 1985a) holds considerable promise, their limitations must be acknowledged in two important ways. First, as each case study involved only one teacher and his/her classroom, more work along these lines is urgently needed to verify the efficacy of these methods of environmental improvement in other geographic areas, in other school subjects, and at other grade levels. Second, because our primary concern was exploring the effectiveness of a newly proposed application of actual and preferred classroom environment scales, we did not pay a great deal of attention to the nature of the interventions which were instrumental in bringing out the observed environmental changes. Consequently, although this paper provides some evidence to justify teachers' confidence in using this approach to changing classrooms, the important task of accumulating detailed information about the nature of the interventions most likely to produce marked changes on particular dimensions of classroom environment has hardly begun. There is considerable scope and need in the future, then, to extend Johnson et al.'s (1984) admirable work in designing strategies for enhancing classrooms cooperation to the design and evaluation of general strategies for changing a classroom's emphasis on a range of other important classroom environment dimensions.

Whereas the case studies reported here and in Fraser (1985a) involved experienced teachers attempting to change their classrooms as part of inservice education initiatives, Lacy, Tobin, and Treagust (1984) recently involved preservice teachers in using a classroom environment instrument to provide feedback about their classrooms. The study involved 40 preservice science teachers involved in three microteaching

sessions, each one week apart, with small groups of students which made up a total sample of 180 students from one school. Student perceptions of preferred environment were assessed at the beginning of each microteaching session and perceptions of actual environment were assessed at the end of each session. It was found that students' perceptions of actual classroom environment became more positive over time, thus tentatively suggesting that feedback information about students' perceptions of actual and preferred environment helped preservice teachers to change their teaching in ways which students perceived to be improvements. This preliminary study suggests the potential value of introducing preservice science teachers to classroom environment instruments in order to provide them with a tangible means of obtaining feedback about and guiding improvements in their teaching.

Conclusion

This paper has argued the merits of including the topic of classroom psychosocial environment in the curriculum of science teacher education programs. In particular, discussion focused on the potential of classroom environment work, first, as a way of sensitizing preservice teachers to important but subtle aspects of classroom life, second, as a source of process criteria of effectiveness in curriculum evaluation, and, third, for guiding systematic attempts to improve classrooms.

It has been assumed in this paper that having a positive classroom environment is an educationally desirable end in its own right. Moreover, the comprehensive evidence accumulated in prior research also clearly establishes that the nature of the classroom environment has a

potent influence on how well students achieve a range of desired educational outcomes. Consequently, educators need not feel that they must choose between striving to achieve constructive classroom environments and attempting to enhance student achievement of cognitive and affective aims. Rather, constructive educational climate may be viewed as both means to valuable ends and as worthy ends in their own right.

Given the ready availability of instruments, the salience of classroom environment, the impact of classroom environment on student outcomes, and the potential of environmental assessments in guiding educational improvement, it seems crucial that researchers and teachers begin to include classroom environment instruments as part of the batteries of measures used in school evaluations and school effectiveness studies. Hopefully this paper ultimately will contribute to a greater awareness of the importance of classroom environment among teachers by encouraging science teacher educators to introduce these key ideas as part of their teacher education programs for prospective science teachers.

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Table 1 Scale Description for the Individual Dimensions in LEI, CES, ICEQ, MCI and CUCEI

Scale	Scale Description
Learning Environment Inventory (LEI) (Secondary school level)	
Cohesiveness	Extent to which students know, help and are friendly towards each other
Diversity	Extent to which differences in students' interests exist and are provided for
Formality	Extent to which behaviour within the class is guided by formal rules
Speed	Extent to which class work is covered quickly
Material Environment	Availability of adequate books, equipment, space and lighting
Friction	Amount of tension and quarrelling among students
Goal Direction	Degree of goal clarity in the class
Favoritism	Extent to which the teacher treats certain students more favourably than others
Difficulty	Extent to which students find difficulty with the work of the class
Apathy	Extent to which the class feels no affinity with the class activities
Democracy	Extent to which students share equally in decision-making related to the class
Cliqueness	Extent to which students refuse to mix with the rest of the class
Satisfaction	Extent of enjoyment of class work
Disorganization	Extent to which classroom activities are confusing and poorly organized
Competitiveness	Emphasis on students competing with each other
Classroom Environment Scale (CES) (Secondary school level)	
Involvement	Extent to which students have attentive interest, participate in discussions, do additional work and enjoy the class
Affiliation	Extent to which students help each other, get to know each other easily and enjoy working together

Teacher Support	Extent which the teacher helps, befriends, trusts and is interested in students
Task Orientation	Extent to which it is important to complete activities planned and to stay on the subject matter
Competition	Emphasis placed on students competing with each other for grades and recognition
Order & Organization	Emphasis on students behaving in an orderly, quiet and polite manner, and on the overall organization of classroom activities
Rule Clarity	Emphasis on clear rules, on students knowing the consequences for breaking rules, and on the teacher dealing consistently with students who break rules
Teacher Control	The number of rules, how strictly rules are enforced, and how severely rule infractions are punished
Innovation	Extent to which the teacher plans new, unusual and varying activities and techniques, and encourages students to contribute to classroom planning and to think creatively

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Individualized Classroom Environment Questionnaire (ICEQ) (Secondary school level)

Personalization	Emphasis on opportunities for individual students to interact with the teacher and on concern for the personal welfare and social growth of the individual
Participation	Extent to which students are encouraged to participate rather than be passive listeners
Independence	Extent to which students are allowed to make decisions and have control over their own learning and behaviour
Investigation	Emphasis on the skills and processes of inquiry and their use in problem-solving and investigation
Differentiation	Emphasis on the selective treatment of students on the basis of ability, learning style, interests and rate of working

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My Class Inventory (MCI) (Primary school level)

Cohesiveness	Extent to which students know, help and are friendly towards each other

Friction	Amount of tension and quarrelling among students
Difficulty	Extent to which students find difficulty with the work of the class
Satisfaction	Extent of enjoyment of class work
Competitiveness	Emphasis on students competing with each other

College and University Classroom Environment Inventory (CUCEI) (Tertiary level)

Personalization	Emphasis on opportunities for individual students to interact with the instructor and on concern for students' personal welfare
Involvement	Extent to which students participate actively and attentively in class discussions and activities
Student Cohesiveness	Extent to which students know, help and are friendly towards each other
Satisfaction	Extent of enjoyment of classes
Task Orientation	Extent to which class activities are clear and well organized
Innovation	Extent to which the instructor plans new, unusual class activities, teaching techniques and assignments
Individualization	Extent to which students are allowed to make decisions and are treated differentially according to ability, interest and rate of working

Table 2. Internal Consistency (Alpha Reliability), Discriminant Validity (Mean Correlation of a Scale with Other Scales), and ANOVA Results for Class Membership Differences (Eta^2 Statistic and Significance Level) for Student Actual Form of Five Instruments Using Individual as Unit of Analysis

Scale	Alpha Reliability	Mean Correlation with Other Scales	ANOVA Results Eta^2
Learning Environment Inventory	(N = 1048 Students)	(N = 149 classes)	
Cohesiveness	0.69	0.14	-
Diversity	0.54	0.16	-
Formality	0.76	0.18	-
Speed	0.70	0.17	-
Material Environment	0.56	0.24	-
Friction	0.72	0.36	-
Goal Direction	0.85	0.37	-
Favoritism	0.78	0.32	-
Difficulty	0.64	0.16	-
Apathy	0.82	0.39	-
Democracy	0.67	0.34	-
Cliqueness	0.65	0.33	-
Satisfaction	0.79	0.39	-
Disorganization	0.82	0.40	-
Competitiveness	0.78	0.08	-
Classroom Environment Scale	(N = 1,083 students)		
Involvement	0.70	0.40	0.29*
Affiliation	0.60	0.24	0.21*
Teacher Support	0.72	0.29	0.34*
Task Orientation	0.58	0.23	0.25*
Competition	0.51	0.09	0.18*
Order & Organization	0.75	0.29	0.43*
Rule Clarity	0.63	0.29	0.21*
Teacher Control	0.60	0.16	0.27*
Innovation	0.52	0.19	0.26*
Individualized Classroom Environment Questionnaire	(N = 1,849 students)		
Personalization	0.79	0.28	0.31*
Participation	0.70	0.27	0.21*
Independence	0.68	0.07	0.30*
Investigation	0.71	0.21	0.20*
Differentiation	0.76	0.10	0.43*
My Class Inventory	(N = 2,305 students)		
Cohesiveness	0.67	0.20	0.21*
Friction	0.67	0.26	0.31*
Difficulty	0.62	0.14	0.18*
Satisfaction	0.78	0.23	0.30*
Competitiveness	0.71	0.10	0.19*
College and University Classroom Environment Inventory	(N = 127 students)		
Personalization	0.85	0.33	0.28*
Involvement	0.77	0.39	0.49*
Student Cohesiveness	0.85	0.21	0.37*
Satisfaction	0.92	0.45	0.20*
Task Orientation	0.72	0.35	0.22*
Innovation	0.85	0.39	0.25*
Individualization	0.87	0.24	0.32*

* $p<0.01$

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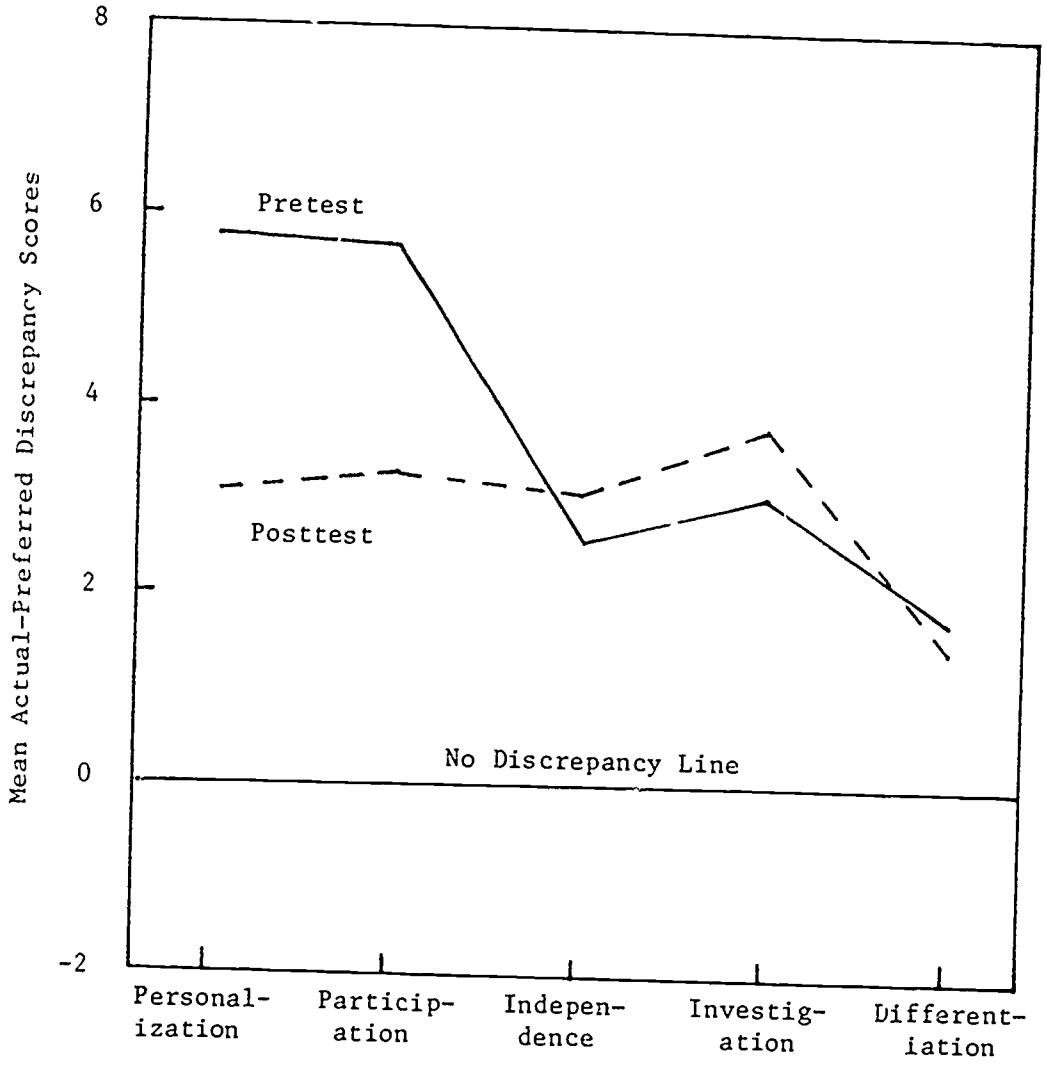

FIGURE 1

PRETEST AND POSTTEST PROFILES OF MEAN ACTUAL-PREFERRED DISCREPANCY SCORES