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ABSTRACT

Recent classroom environment research has investigated the association between students' cognitive and affective learning outcomes and their perceptions of psychosocial characteristics of their classrooms. The findings of these studies suggest that student outcomes can be improved by creating environments that are conducive to learning. This study was designed to examine the impact of assisting science teachers in obtaining information about student perception of the learning environment and guiding systematic improvement in science classroom environments by using practical programs proposed by B. J. Fraser and P. O'Brien in 1985. The study sampled 1,216 science students, grades 6-8, from 6 urban public schools. Twelve teachers were involved in the study. The following are some implications of the study for teachers: (1) teachers need to be aware of classroom climate and the need for responsiveness to student perception of that environment; and (2) with support, during the improvement plan to address implementation concerns, teachers can become agents of change in their own classrooms. Contains 38 references. (ZWH)

Running head: REDUCING DIFFERENCES IN SCIENCE CLASSROOMS

Reducing Differences Between Student Actual and Preferred Classroom Environments in Science Classrooms.

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The purpose of this study was to examine the impact of assisting science teachers in obtaining information about student perception of the learning environment and guiding systematic improvement in science classroom environments by using the practical program proposed by Moos (1979) Fraser (1981) and Fraser & O'Brien (1985). Recent classroom environment research has investigated the association between students' cognitive and affective learning outcomes and their perceptions of psychosocial characteristics of their classrooms. Fraser (1989) reviewed over sixty such studies in which the effects of classroom environment on science student outcomes were investigated. The findings of the studies suggest that student outcomes can be improved by creating classroom environments which are conducive to learning. All sixty classroom environment studies reviewed by Fraser (1989) used student perceptual data. None relied on outside observers. Fraser (1981b) describes advantages which student perceptual measures have over observational techniques. First, questionnaires are more economical than trained observers. Second, student perceptions are based on many lessons or classes, while observations are based on restricted or limited numbers of observations. Third, the information obtained is the pooled judgement of all of the students in the class as opposed to the single view of an observer. Fourth, the student perception is based on their real behavior and therefore more important than inferred behavior based on observer judgements. Fifth, perceptual measures account for more variance in student learning outcomes than observed variables. This approach is limited by the assumption that the students can render valid judgements about the classroom. Additionally, it has the shortcomings of questionnaires in general. Questionnaires contain predetermined categories and the assumption is made that the students can read and comprehend the statements.

Background

A conceptual framework for environmental assessment was developed by Moos (1979). He states that environmental assessment is important in its own right. Researchers mistakenly focus on impact and evaluate only those aspects of the educational setting they believe to be related to the outcome they wish to explain. The environmental setting must be adequately conceptualized before it can be evaluated. Environmental assessment procedures should be guided by a flexible conceptual orientation. Moos mentions the notion of environmental press as helping formulate the items that identify characteristics of classrooms to be studied.

Recently, two previously unconnected bodies of research, educational productivity and talent development, were brought together by Walberg (1987). In reviewing productivity research, he cites several scientific breakthroughs that have resulted from analyses of large-scale educational surveys and the syntheses of over 3,000 comparative studies of educational research results (Fraser, Walberg, Welch and Hattie, 1987). He contends that 9 factors, emerge from the studies and are powerful and consistent in influencing learning. The seventh factor is classroom environment -- the principal focus of this study. He indicates that the 9 generalizable constructs are the chief influences on cognitive, affective and behavioral learning. Although not all of the factors are alterable by educators, the construct of classroom environment can be improved. Walberg (1987) concludes by stating that although somewhat disconnected, the areas of learning environments, educational productivity and talent development might enrich each other.

Rosenshine (1970) distinguishes between high-inference and low-inference measures in a discussion of classroom observational issues. Category systems are classified as low-inference measures because the events recorded are frequency counts. Low-inference responses are primarily concerned with directly observable specific phenomena of the environment. Rating systems are high-inference measures because they lack specificity and require a greater amount of inference on the part of the observer. These would include self-report techniques. They ask the person to make a judgement about the meaning of what is going on around them and of what they think about it.

Method

Some self-report instruments are the Learning Environment Inventory (LEI) by Anderson and Walberg (1974), the Classroom Environment Scale (CES) by Moos & Trickett (1974), the Individualized Classroom Environment Questionnaire (ICEQ) of

Rentoul and Fraser (1979) and the My Class Inventory (MCI) by Fisher and Fraser (1981).

The instrument used in this study to assess the differences in student perception of ideal and preferred classroom environment was the short form of the My Class Inventory (MCI). The MCI was developed as a simplification of the widely used Learning Environment Inventory (LEI). The MCI differs from the LEI in that it can be used with elementary students and junior high students with reading problems. It contains only five of the LEI's original 15 scales (Cohesiveness, Friction, Difficulty, Satisfaction and Competitiveness).

The study sampled 1216 science students, grades 6-8, from six urban public schools. Twelve teachers were involved in the study; six experimental and six control groups completed pretest and posttest *My Class Inventories*. Pretesting was conducted in October followed by posttesting in April of the same academic year. The experimental treatment lasted for approximately two months and consisted of teacher-generated strategies based on feedback developed from student discrepancies on ideal-real versions of the MCI.

Person-Environment Fit scores were computed by subtracting real (actual) environment scores from ideal (preferred) scores. The Climate Vector was computed by subtracting the posttest PEF scores from pretest PEF scores.

Two experimental teachers chose one climate dimensions to address and four chose two resulting in ten experimental programs. Each targeted dimension was analyzed for the effects of group membership (experimental or control) and time (pretest or posttest). When teachers attempted to improve the climate dimension Satisfaction, statistically significant pretest-posttest Climate Vectors were found. The other statistically significant Climate Vector was found after experimental intervention by a teacher addressing the dimension of Friction.

The treatment given to the experimental group consisted of the feedback from the *My Class Inventory* (MCI). Profiles derived from the student responses were provided permitting ready identification of the changes needed to reduce major differences between the nature of the actual and preferred environment perceived by the students.

The following steps were suggested by Fraser (1981b) and Fraser & O'Brien (1985) to improve environments by providing profiles: assessment, feedback, reflection and discussion, intervention, and reassessment.

<u>Assessment:</u>

Teachers received identical administration instructions directing them to distribute the actual version of the MCI and see that student completed it. After collecting the actual version, they were to administer the preferred version in a like manner. This was to be done during the same class period. Teachers were instructed to read the questionnaire to the students. This was done to prevent reading difficulties from confounding the study. Some of the teachers indicated that they had not read all of the items to all of their students. The preferred and actual forms were administered during the same class period.

Feedback:

Data were summarized and given to the experimental teachers in profiles representing class means of students' actual and preferred environment scores.

Reflection and Discussion:

Teachers from the experimental classes received feedback based on discrepancies between student ideal-real pretest scores. The profiles they received consisted of bar graphs comparing the two test scores. Teachers were to reflect upon and discuss the profile with colleagues and the researcher. If a sizable pretest difference occurred and the teacher was concerned about the discrepancy, then improvement strategies were to be planned.

Intervention:

The teachers introduced the intervention for approximately two months in an attempt to change the environment. The intervention consisted of a variety of strategies, some from discussions with the researcher and others from examination of the ideas contained in the MCI items.

Reassessment:

The actual student form of the MCI was readministered at the end of the intervention to both control and experimental classes.

Results

The study was composed of a control and experimental group of six classes each. t-tests were used to test group mean differences between student actual and preferred inventories on both experimental and control groups. Group mean differences were compared in the following manner: experimental AND control groups on pretest results only or on posttest only; experimental OR control groups on a retest results only or posttest only; and finally on experimental and control groups on pretest-posttest results. Analysis of variance also tested group mean differences accounting for the effects of group membership (experimental or control) and over time (pretest versus posttest). PEF, Person-Environment Fit Score, as defined in this study, is a numerical score indicating the amount of discrepancy between actual and preferred scores on the MCI. The closer that the PEF score is to zero the better, since this would indicate little variance between what a student would prefer and what the student feels exists in their classroom. This score is determined by subtracting the actual minus the preferred score on both pretest and posttest for both groups. When the posttest PEF score is subtracted from pretest scores, another sum, called the Classroom Climate Vector is determined. The following will illustrate how to arrive at this score. Whenever the MCI is administered:

Ideal Score minus **Real Score** = **Person Environment Fit Score (PEF)**
(first difference)

PEF Score minus **PEF Score** = **Climate Vector Score**
(second difference)

A Person-Environment Fit score (PEF) was computed for each student by finding the difference between the scores on the *My Class Inventory* when students described the "preferred environment" and when they described the "actual environment" for their classes. In the "ideal" classroom, PEF scores would be zero; that is, there would be no difference between the preferred and actual classroom climate.

The summary of treatment activities shows that when teachers chose areas for improvement, four directed efforts into two areas while the remaining two teachers chose only one climate dimension for improvement. The classroom environmental improvement strategies included:

a. Varying classroom grouping practices (to raise cohesiveness.)

b. Redirecting competition from individual to between science groups only (to lower competitiveness.)

c. Formation of discussion groups to foster improved social skills and conflict resolution (to raise cohesiveness.)

d. Small group meetings to identify learning activities and projects that would raise levels of cooperation and understanding (to lower friction.)

e. Implementation of homework grading program and changes of grouping practices (to raise satisfaction.)

f. No implementation of any other than normal teacher activity (target climate area was to raise satisfaction.)

The effectiveness of each effort to improve classroom climate was assessing by comparing pre- and posttest Person-Environment Fit scores and by comparing the Climate Vector Scores of treatment groups with the control group.

Comparisons across time and between experimental and control groups were made using the paired t-test procedure. Group mean differences between pretest "actual" and "preferred" scores were found to be significant in nine out of the ten experimental scales targeted for improvement. Analysis of variance indicated three attempts to address Satisfaction and one to address Friction reached statistical significance. Six attempts to improve classroom environment did not reach statistical significance.

Data collected from pretest and posttest *My Class Inventories* administered to elementary students indicated significant differences in Climate Vector scores between experimental and control groups on two of the five climate variables. Experimental treatment data were reported for ten target climate dimensions and several teacher strategies to address each one. There appears to be movement of the treatment group toward reducing PEF scores on the dimensions Satisfaction and Friction.

The results of the current study build on the work of Fraser (1981b), Fraser and O'Brien (1985), and others in the field by presenting accounts of teacher implementation of strategies to better accommodate person-environment fit in science classrooms. It is the first time that teacher strategies have been explored and applied to each targeted climate dimension. While statistically significant improvement has been reported by others in the field, none to date have explained in any detail how implementation was accomplished and what resulted.

Teachers received feedback and used it to address a discrepancy on a variable of the MCI. The variable to be addressed should have shown a discrepancy between real and ideal perception in the pretest. Six teachers addressed one or more climate dimensions. The study can be viewed as ten mini-experiments. Out of the ten, nine addressed a Person-Environment score that differed significantly from zero on the pretest.

After posttesting, two climate variables, Satisfaction and Friction, had statistically significant pretest-posttest different Climate Vectors based on analysis of variance.

Teachers 2, 3 and 6 identified Satisfaction as a target area for improvement. Their pretest profiles had real-ideal differences on this dimension that were statistically significant. After posttesting, analysis of variance showed significant differences between pretest and posttest scores for all three teachers' students.

All attempts to address student Satisfaction resulted in statistically significant improvements. Teacher 3 reported that he never implemented strategies to improve the environment, yet his classes reduced discrepancies! How did this occur? Maybe he did implement change, but didn't know it. If he were concerned enough to participate in the study and his students' PEF scores showed significant discrepancies, perhaps he unknowingly implemented enough change to improve Satisfaction. The other teachers targeting Satisfaction gave a considerable amount of extra attention to their classes. First, by spending extra class time discussing student concerns and explaining content of teacher conversation, but additionally by conducting individual conferences and phoning parents to commend students. Control group student PEF scores did not reach significance on Satisfaction. This suggests that the teachers who did not know how students perceived their classes did nothing to change them.

Friction was the other climate dimension in which statistically significant differences in PEF scores were noted. It was targeted by Teacher 3 and 5 for improvement. Teacher 5 Climate Vector was statistically significant after posttesting. Student differences from Teacher 3 did not reach statistical significance.

The three remaining climate variables had statistical differences in the wrong direction or no differences of statistical significance. Wrong way significance refers to differences that while significant, are not in the desired direction of reducing discrepancies in student ideal-real scores. Examples of this were the attempts of Teachers 1 and 4 to address Cohesiveness. Both groups, after posttesting, had statistically significant differences that were larger instead of smaller. Activities that the teacher reported were apparently not effective in reducing PEF scores on the Cohesiveness variable of the MCI.

Another teacher's attempts that did not result in a statistically significant Climate Vector score for the experimental group was Teacher 1 students on the Difficulty variable. The statistical analyses show that the treatment resulted in a very small improvement in four out of the ten attempts. Fraser's improvement program consists of five steps. One of them is providing feedback to teachers based on student perceptions. The feedback must be properly interpreted to be of value. Results of this study indicate that the climate dimensions meant different things to different teachers. For example, teacher 2 targeted the variables of Satisfaction and Competitiveness hoping ultimately to address Cohesiveness. He did not acknowledge the distinction between these three variables. The feedback to teachers is in the form of a graph showing discrepancies between student ideal and real MCI scores. It would be better to show each teacher the questionnaire items that comprise each climate dimension. For instance, if the PEF differences were statistically significant for the Satisfaction dimension then questionnaire items 1,6,11,16 and 21 should be analyzed to tie the profile to the assessment items and accurately define the dimension Satisfaction.

Additionally, reports from teachers demonstrate that teachers need support in identifying needed changes. For example, Teacher 1 addressed the Cohesiveness dimension even though pretest ideal-real MCI score differences were not statistically significant.

The teachers in this study experienced difficulty interpreting the profile, choosing climate dimensions for improvement and making appropriate plans to address the PEF scores. Encouragement to adhere to the improvement program is also needed as indicated by Teacher 3 who reported that although he received the feedback profiles and developed a plan, he never implemented it. This section shows a missing element in the model developed by Fraser (1981b). The process must provide for teacher support. Providing feedback is not enough. The feedback must be interpreted and applied to statistically significant target differences. An appropriate plan must be developed with suitable activities to improve classroom environment. Activities that help improve one dimension do not necessarily improve another. For example, teacher 2 was able to raise Satisfaction scores by implementing a student grouping system. The same intervention did not appear to improve perceptions of Cohesiveness with the same students.

Summary

The proper interpretation of PEF scores is critical. Teachers should examine and discuss the climate dimensions with corresponding questionnaire items, one by one. A support and assistance program within the process is advised. This would insure that teachers choose only statistically significant target areas to begin with and that they understood the climate dimension itself.

The MCI seems to be a valuable instrument to measure student perception of person-environment fit in classrooms. It can identify discrepancies in classroom person-environment fit and teachers can be given feedback to devise an improvement program, but what activities should the teacher use to reduce PEF scores? This study examined change strategies used by six teachers. Until further research can spell out what strategies are best to improve different climate dimensions the following is proposed for consideration.

Johnson and Johnson (in press) surveyed over 520 studies conducted over 90 years on the constructive effects of social interdependence among students. They suggest cooperative learning experiences tend to promote higher achievement than do competitive and individualistic learning experiences. They claim cooperative learning experiences raise achievement, interest in the subject matter, and promote positive social interaction. To be effective the experiences must be well planned and implemented.

Johnson, Maruyama, Johnson, Nelson and Skon (1981) caution that prepackaged cooperative learning programs do not work. They believe that good teachers would feel too restricted using the plans and average teachers would soon abandon them after a short implementation period. Their recommendations are specific enough to give guidance but flexible enough to permit freedom of movement and individual adaptation. Tobin and Gallagher (1986) report that activity settings can control student behavior. They use Doyle's (1983) definition of "activity" to refer to the way students are organized to work for a given time. They further identify students, referred to as target students, who experience a different learning environment and are involved in a markedly greater proportion of the whole class interactions than are their classmates. Teachers should be aware of the target student when considering environmental improvement. Tobin and Gallagher (1986) show that it is possible for certain students to monopolize whole class interaction. Tobin and Gallagher (1986) have identified four distinct environmental structures: whole class non-interactive, whole class interactive, small group and individualized settings. Student grouping for instruction seems to be very important as does a reduction of whole-class interactive time.

Teachers seeking to improve the climate in their classroom should be aware of the environmental structures and possible influences on the person-environment fit. In the present study student grouping was attempted in several improvement attempts but was effective in only the Satisfaction dimension. More research is needed to identify effective approaches for addressing other climate dimensions. Principals and supervisors may be able to help teachers improve their classroom environments. Tobin and Gallagher's (1986) findings should be emphasized as well as the feedback based on student PEF scores The change agent should be the teacher desiring to cause the change. However, environmental improvement is not likely to be improved through administrative mandates. Teachers must feel an ownership in the plan, value it and want to use it in their classes. One support researcher for every teacher change agent would be ideal. Significant pretest profiles should be analyzed and target dimensions identified together. Other supportive steps outlined earlier would improve the likelihood of succes . Fraser (1989) views the process as a cycle. The five steps, assessment, feedback, reflection/ discussion, intervention and reassessment can be repeated one or more times until changes in the classroom environment reach the desired level.

Although this study resulted in only four successful attempts out of ten at improving classroom environments, Fraser (1986) reports over 70 successful studies suggesting the potential usefulness of science teachers employing classroom environment instruments to provide meaningful information about their classroom and be guided to improvements in classroom environment.

Teachers will feel less pressured if they are aware of the cyclical nature of the process. If they do not succeed in reducing PEF score during the first attempt, they can try again later. Theories of environmental structure and target students (Tobin and Gallagher, 1986) should be offered as in-service training to the teachers.

Implications

The following are some implications of the study for teachers. They need to be aware of classroom climate and the need for responsiveness to student perception of that environment. This can be accomplished by the use of the MCI and Fraser's (1981b) improvement plan. With support, during the improvement plan to address implementation concerns covered earlier, teachers can become change agents in their own classrooms. The body of research in this field clearly ties student achievement to classroom climate (Fraser, 1989).

What is needed in future research is better descriptions of teachers' uses of the MCI and resulting feedback for practical, school-based purposes. Effective classroom environment improvement strategies are needed as well as confirmation of the usefulness of cooperative learning situations in science classrooms. Fraser's (1989) proposal for deliberate change in classroom environment to establish clearer relationships to student outcome is repeated here. Also, linkage is needed between classroom climate and important aspects of schooling. Climate and its relationship to pupil outcome is a needed area for study as well as classroom climate and its relationship to social goals. Also, studies are needed to determine how problem solving and critical thinking are affected by classroom environment. Is there a relationship between higher order thinking skills and aspects of classroom climate? Current thought encourages mainstreaming of special education students. Special education classroom environment studies are needed to see if there are climate relationships between special education and mainstreamed classes.

Further study is necessary to determine how effective improvement strategies are in reducing discrepancies between students' actual and preferred environments and the impact of these reductions on achievement of school goals.

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