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ABSTRACT

To relate the design of open education programs to their outcomes, the authors surveyed 72 research studies on the effects of open education and examined the methods and findings of three previous literature surveys on this topic. The 72 studies were divided by an objective statistical test into those showing large effects of open education and those showing small effects. The researchers then compared seven features and four aspects of open education with six student outcome variables, controlling for nine characteristics of the research studies' design and methodology. Among the open education features were multigrade student groupings, open space, individualized instruction, and team teaching; open education aspects included the number and extensiveness of open education features in each study. Outcome variables comprised students' self-concept, creativity, attitude toward school, and reading, math, and language achievement. The results showed that the size of open education effects varied for different features and outcomes. For instance, for student self-concept, open education programs showing large effects averaged two more features than those showing small effects, while for student creativity, programs with larger effects had one more feature. (RW)

Identifying Features of Effective Open Education Programs

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Identifying Features of Effective Open Education Programs

The identification of general effects for open education is complicated by the fact that open education is not a single, well-defined treatment. Open education programs which all share some common philosophical assumptions about the nature, development, and learning of children, nonetheless differ widely in both the types of features and number of features of open education which are implemented (Giaconia, 1980). Some open education programs emphasize open space as the salient feature of a good open education program: other programs emphasize teaching practices and the role of the child; still other programs emphasize some combination of open space and teaching practices.

These naturally-occurring variations in open education programs would not hinder efforts to draw general conclusions about the efficacy of open education, if a consistent treatment effect could be identified across all the empirical studies of open education programs. But open education seems to produce a variety of effects across all program implementations. Some open education programs produce particularly large positive effects for student outcomes such as self concept, reading achievement, creativity, locus of control, mathematics achievement, and attitude toward school. Yet other open education programs yield large negative effects for these same student outcomes (Hedges, Giaconia, & Gage, 1981).

This paper reports on the attempt to relate the observed variability in the features of open education which were implemented in different open education programs to the observed variability in program effects. In order to achieve this end, this paper suggests a strategy for: (1) identifying effective versus less effective open education programs, by use of an unbiased estimate of effect size rather than the statistical significance

of the reported results; and (2) identifying the distinctive features of effective open education programs, by a comparison of the features of open education found in the one-third of the studies that yielded the largest positive effect sizes and the one-third of the studies that yielded the largest negative effect sizes. These descriptions of the features of open education that distinguish effective from less effective open education programs can serve as the starting point for the design of more systematic studies to test the relative contribution of each open education program feature to overall program effects.

The Open Education Debate

The relative merits of open and traditional education have been a subject of debate since the time of Socrates (Broudy & Palmer, 1965). Over the years, a plethora of terms has emerged for innovative educational programs that all seem to share some common philosophical assumptions and observable features of open education, e.g., progressive education, informal education, free school, open space school, open corridor school, integrated day plan, alternative school, and so on. In recent times, anecdotal evidence and logical analysis have yielded to empirical research as admissable evidence in the open versus traditional education debate. Proponents of both open and traditional education have tried to bolster their claims about the efficacy of open or traditional education with systematic empirical studies of open education programs. Horwitz (1979) identified over 200 of these empirical studies.

The persistence of the open education debate, and the large number of empirical studies that have been generated by this debate, both suggest the importance of attempts to search for meaningful ways to summarize the empirical findings, to identify general effects for open education. Three of these

recent attempts will be reviewed briefly: a review by Horwitz (1979), a meta-analysis by Peterson (1979), and a meta-analysis by Hedges, Giaconia, and Gage (1981).

The Review by Horwitz

Horwitz (1979) identified about 200 empirical studies that evaluated open education programs. Most of these studies involved comparisons of an open education program with a traditional education program. Studies were included in the review if the educational treatment had either been explicitly labeled with the term "open" or if it had been described as having characteristics generally ascribed to open education, such as flexibility of space, student choice of activity, richness of learning materials, integration of curriculum areas, and more individual and small-group than large-group instruction.

Nine student outcome variables were reported in this review: academic achievement, self concept, attitude toward school, creativity, independence and conformity, curiosity, anxiety and adjustment, locus of control, and cooperation.

Horwitz used a "box score" method to summarize findings across the studies. That is, for each student outcome variable, he tallied the number of studies whose results could be classified as either "open better", "traditional better", "mixed results", or "no significant differences." Conclusions were drawn about the effects of open education on the basis of which category received the most tallies. Horwitz found that in many instances the studies showing no significant differences or mixed results outnumbered those studies showing open better or traditional better.

For the student outcome variables academic achievement, self concept, anxiety and adjustment, and locus of control, the "no significant differences"

category received the most tallies. For the student outcome variables attitude toward school, creativity, independence and conformity, curiosity, and cooperation, the "open better" category contained the largest number of studies.

Horwitz concluded, "At this time, the evidence from evaluation studies of the open classroom's effects on children is not sufficiently consistent to warrant an unqualified endorsement of that approach to teaching as decidedly superior to more traditional methods (p. 83)."

The Meta-analysis by Peterson

Peterson (1979) completed a meta-analysis of the studies reviewed by Horwitz and other studies that she located. She used only those 45 of the studies that contained enough information to permit calculation of effect sizes (means and standard deviations of open and traditional education groups). Peterson did not retricve the doctoral dissertations reviewed by Horwitz and found that the abstracts of these dissertations often contained too little information to compute effect sizes. Thus Peterson's sample of 45 studies was only about 1/4 as large as Horwitz's original sample.

Peterson's rationale for undertaking a meta-analysis of a sample of the same studies that Horwitz had already reviewed was to eliminate two major problems inherent in the box score or vote-counting method that Horwitz used. First, the box score procedure maximized the likelihood of Type II errors when the studies were sorted according to the statistical significance of the result (rather than the direction of the results regardless of statistical significance). That is, because sample sizes in most studies of teaching (including studies of open education) are small and because effects for any single teaching variable are expected to be small (Gage, 1978, pp. 26-27), use of this procedure increases the probability

of incorrectly concluding that there was no difference between open and traditional education when a true difference may have existed. In general, the box score or vote-counting procedure has a high probability of a Type II error when sample sizes or treatment effects (or both) are small (Hedges & Olkin, 1980).

Second, the box score method used by Horwitz provided no indication of the magnitude of the open education treatment effect. Glass (1978) argued that the box score procedure does not allow the research integrator to determine whether a treatment "wins by a nose or a walkaway." Glass recommended calculating an "effect size" for each study, as a measure of the strength of the treatment effect.

Peterson computed an effect size, using Glass's estimator of effect size, for each study, for each student outcome variable. Glass's estimator of effect size is given by

$$\frac{\bar{X}_E - \bar{X}_C}{s_C}$$

where $\bar{X}_E$ = sample mean of the experimental group (open education group)

$\bar{X}_C$ = sample mean of the control group (traditional education group)

s_C = standard deviation of the control group

(In general, an effect size can be interpreted directly as the difference between the average performance in the experimental and control groups, in z-score units. Alternatively, because z-scores can be translated into percentile ranks, an effect size can be interpreted as the percentile rank corresponding to the performance of the average person in the experimental group. For example, an effect size of +.50 indicates that the average

performance in the experimental group is one-half of a standard deviation higher than the average performance in the control group. Similarly, an effect size of +.50 indicates that while the performance of the average person in the control group is at the 50th percentile, the performance of the average person in the experimental group is at the 69th percentile.)

Peterson then averaged the effect sizes for all studies, for each of the student outcome variables: composite achievement, mathematics achievement, reading achievement, creativity, problem-solving, self concept, attitude toward school, attitude toward teacher, curiosity, locus of control, anxiety, and independence. Peterson noted that in the case of most of the student outcomes, effect sizes were quite small, indicating little adavantage for either open or traditional education. She based conclusions about the effects of open education on both the direction and magnitude of the average effect sizes; a positive effect size meant average performance was higher in the open education groups, while a negative effect size indicated that average performance was higher in the traditional education groups.

Average effect sizes for mathematics achievement, reading achievement, and composite achievement were negative and showed about 1/10 of a standard deviation (or slight) adavantage for the traditional education groups. Average effect sizes for locus of control and anxiety were near zero, showing no advantage for either open or traditional education.

For the student outcomes creativity, attitude toward school, and curiosity, average effect sizes were positive and indicated an advantage for open education students between 1/10 and 1/5 of a standard deviation.

Independence and attitude toward teacher yielded relatively larger effect sizes that showed an advantage for the open education students of between 1/3 and 1/2 of a standard deviation.

Peterson concluded (about the main effects of open education), "...although a more direct or traditional approach appears to be better than a more open approach for increasing students' achievement, an open approach appears to be better than a more direct approach for increasing students' creativity, independence, curiosity, and favorable attitudes toward school and learning (p. 67)."

The Meta-analysis by Hedges, Giaconia, and Gage

Hedges, Giaconia, and Gage (1981) undertook yet another meta-analysis of research on open education. This meta-analysis was designed to improve upon the meta-analysis by Peterson in at least three ways. First, doctoral dissertations were retrieved and used in the analysis. Peterson had excluded these from her meta-analysis. These dissertations numbered about 90 and constituted over half of the total sample of studies used by Hedges and his co-workers.

Second, effect sizes were computed using an unbiased estimator of effect size, for which Hedges (1980) had developed the statistical theory. This estimator of effect size is given by

$$\frac{\bar{X}_E - \bar{X}_C}{S_{pooled}} C_m$$

where $\bar{X}_E$ = sample mean of the experimental group (open education group)

$\bar{X}_C$ = sample mean of the control group (traditional education group)

S_{pooled} = pooled estimate of the standard deviation

C_m = constant for m degrees of freedom, where $m = n_E + n_C - 2$

The exact formula for C_m is given by Hedges (1981), but a good approximation

is given by

$$1 - \frac{3}{4m - 1}$$

where $m = n_E + n_C - 2$.

The third way in which the meta-analysis by Hedges and his co-workers was designed to improve upon the meta-analysis by Peterson was by taking into account various characteristics of each study. These characteristics of each study included subject characteristics (grade, SES, sex, ethnicity, entering ability); experimental design characteristics (method of determining openness; method of assigning students to open and traditional education programs, duration of the treatment, unit of matching, and unit of analysis); experimenter characteristics (rating of the predisposition of the investigator to favor open or traditional, clarity of the research report); and experimental context variables (type of publication, year of publication). This information was used to test multifacet interaction models for the series of studies on all possible comparisons of open and traditional education, i.e., to look for differences in the magnitude of effect sizes for various configurations of these study characteristics, e.g., differences in effect sizes for experiments versus correlational studies, for younger students versus older students, for studies with longer treatments and those with shorter treatments, and so on.

Hedges and his co-workers used a sample of about 153 studies that was similar to the sample of studies reviewed by Horwitz. A few studies that had been published after Horwitz's bibliography was prepared were added. Several studies that Horwitz had reviewed were excluded because a complete report could not be obtained, because the study did not compare open education to any other group, or because it appeared that the open education group

was not receiving any open education treatment (i.e., the treatment did not include any elements of open instruction or open space).

Hedges' (1980) unbiased estimator of effect size was used to compute an effect size for each comparison of open and traditional education, in each study, for each student outcome variable separately. That is, rather than computing one effect size per study for each student outcome, Hedges and his co-workers computed separate effect sizes for each independent comparison, if enough information to do so has been provided, i.e. if means and standard deviations were tabled or could be obtained algebraically. For example, a study might report means and standard deviations for open-traditional comparisons at each of three grades. Three separate and independent sizes were computed, one for each grade. If additional data were reported such as in breakdowns by sex or SES within a study, the effect size estimates were computed but not used in subsequent analyses. When a study did not provide enough information to permit calculation of an effect size, only the direction of the difference was recorded (favors open, favors traditional, or favors neither).

Hedges and his co-workers identified 38 student outcome variables and reported average effect sizes for 16 of these: achievement motivation, adjustment, anxiety, attitude toward school, attitude toward teacher, cooperativeness, creativity, curiosity, general mental ability, independence and self-reliance, locus of control, self concept, language skills achievement, mathematics achievement, reading achievement, and miscellaneous achievement.

The average effect sizes for each of these student outcomes were based on the unweighted average of the comparisons across studies. (Each study may have contributed a different number of comparisons to the average.) Hedges and his co-workers also reported the percentage of studies for which the direction of the effect favored open, favored traditional, or favored neither

The average effect sizes for the student outcomes adjustment, attitude toward

school, attitude toward teacher, curiosity, and general mental ability, were all positive and showed an advantage for the open education group of about 1/5 of a standard deviation. The direction of the effect for the majority of studies also favored open education for these student outcomes.

The average effect sizes were positive, but near zero, for the student outcomes locus of control, self concept, anxiety, and miscellaneous achievement. The direction of the effect for the majority of the studies favored traditional education for locus of control, anxiety, and miscellaneous achievement. For self concept, the direction of effect for the majority of studies favored open education.

For cooperativeness, creativity, and independence, average effect sizes were positive and indicated an advantage for open education of between 1/4 and 1/3 of a standard deviation. The majority of the studies showed a direction of effect that favored open education for all of these student outcomes.

The average effect sizes for language achievement, mathematics achievement, and reading achievement were negative, but near zero, indicating no particular adavantage for either open or traditional education. The direction of effect for the majority of studies, however, favored traditional education.

Hedges and his co-workers concluded that some of the claims of proponents of open education had been supported, but that open education did not produce consistent effect across the different student outcomes. Open education made its strongest showing for the student outcomes creativity, cooperativeness, independence and self reliance, attitude toward teacher, curiosity, attitude toward school, and adjustment. Open education made its weakest showing for reading, mathematics, and language achievement.

Summary of the Reviews of Open Education

Table 1 summarizes the results reported in the three reviews of open education by Horwitz, Peterson, and Hedges and his co-workers. The table shows no major discrepencies in the three reviews for those student outcomes which all three reported. Student outcomes for which Peterson and Hedges both reported average effect sizes near zero (e.g. anxiety and locus of control) were also outcomes in which Horwitz's "no significant differences" category contained the most studies. Student outcomes for which both Peterson and Hedges and his co-workers reported relatively larger effect sizes (e.g. creativity, independence, attitude toward school, curiosity), were also outcomes in which Horwitz's "open better" category contained the most studies.

Two major conclusions seem warranted from the results reported in Table 1. First, in general, open education is only somewhat more effective that traditional education and for only some student outcomes. Traditional education is only slightly more effective than open education for the traditional academic achievement measures. For many student outcomes, there are near zero differences between open and traditional education.

Second, these general conclusions about the effectiveness of open education must be tempered by the fact that the variability of the effects of open education programs is often quite high. The ranges of effect size reported by Peterson for each student outcome were quite large. For example, mathematics achievement yielded an average effect size of -.14, but the range was -1.01 to +.41. Similarly, the standard deviations of effect size reported by Hedges and his co-workers were large. For example, mathematics achievement yielded an average effect size near zero (-.034), but the standard deviation was .383. Thus, while the average effect sizes across studies were in most cases quite small, some studies produced particularly large positive or particularly large negative effect sizes. It is these

Table 1

Summary of the Results Reported in Three Reviews of Open Education

	Review by Horwitz (1979)					Meta-analysis by Peterson (1979)			Meta-analysis by Hedges, Giaconia, and Gage (1981)					
		Percentage of Studies Classified as				Effect Size			Effect Size			Percentage of Studies Which		
Student Outcomes	N of Studies	Open Better	Traditional Better	Mixed Results	No Sig. Diff.	N of Studies	M	Range	N of Comparisons	M	SD	Favor Open	Favor Trad.	Favor Neither
Academic Achievement Composite	102	14	12	28	46	25	-.12	-.78 to +.41	-	-	-	-	-	-
Language Achievement	-	-	-	-	-	-	-	-	32	-.053	.581	36	57	7
Math Achievement	-	-	-	-	-	18	-.14	-1.01 to +.58	62	-.034	.383	47	48	5
Reading Achievement	-	-	-	-	-	20	-.13	-.72 to +.44	73	-.038	.362	42	54	4
Miscellaneous Ach.	-	-	-	-	-	-	-	-	23	.014	.889	38	55	7
Problem Solving	-	-	-	-	-	1	.98	-	-	-	-	-	-	-
General Mental Ability	-	-	-	-	-	-	-	-	13	.178	.434	61	35	4
Achievement Motivation	-	-	-	-	-	-	-	-	11	-.278	.285	27	60	13
Adjustment	22	31	0	50	19	-	-	-	19	.167	.578	58	42	0
Anxiety	17	18	29	6	47	5	.07	-.63 to +.69	30	.026	.599	51	49	0
Attitude Toward School	57	40	4	25	32	15	.12	-.43 to +.48	68	.166	.447	68	31	1
Attitude Toward Teacher	-	-	-	-	-	2	.42	+.29 to +.56	20	.199	.497	67	25	8
Cooperativeness	9	67	0	11	22	-	-	-	6	.214	.481	78	11	11
Creativity	33	36	0	30	33	11	.18	-.23 to +.50	23	.302	.403	71	17	11
Curiosity	14	43	0	36	21	3	.14	-.17 to +.52	5	.169	.430	57	29	14
Independence	23	78	4	9	9	3	.30	+.07 to +.55	26	.258	.659	68	30	2
Locus of Control	24	25	4	17	54	5	.03	-.34 to +.70	20	.023	.336	41	54	5
Self Concept	61	25	3	25	47	14	.16	-.14 to +1.45	84	.056	.420	53	41	6

extreme groups of studies which this paper examines.

Rationale for this Study

The wide variability in the numbers and types of features of open education which are implemented in open education programs has been documented by both researchers and reviewers of open education (cf. Horwitz, 1979). Similarly, the wide variability in the sizes of effects produced by different open education programs has been shown by the ranges and standard deviations in Table 1. Further, Hedges (1981) developed a statistical test of the homogeneity of effect sizes. This procedure tests whether the obtained effect sizes could have arisen by chance in samples from populations with the same underlying effect size. This test of homogeneity, when applied to the effect sizes computed in the meta-analysis by Hedges and his co-workers, showed that for every student outcome variable the variability in effect sizes was greater than could be accounted for by error or random sampling variability. Some factor or factors other than chance were contributing to the variability in effect sizes across studies.

This study examined the relation of the observed variability in effect sizes to the observed variability in the numbers and types of open education features implemented and to study design characteristics.

Methods

The 153 studies of open education which were used in the meta-analysis by Hedges and his co-workers served as the data base. For each of the 16 student outcomes, studies were sorted into one of three categories on the basis of the magnitude and direction of the unbiased estimate of effect size for the study. (When more than one effect size had been computed per study for each student outcome, the median effect size was used as the basis for classifying the study.)

"Large effect" studies were the one-third of the studies with the

largest positive effect sizes. "Small effect" studies were the one-third of the studies with the smallest effect sizes, including those less than zero. "Medium effect" studies were the one-third of the studies remaining after the large effect and small effect studies had been identified. Only large and small effect studies were used in the subsequent analyses.

Since statistical significance depends on sample size, a high degree of statistical significance is not equivalent to a large effect magnitude. Indeed, the reason for effect size indices stems from the need for an index of effect magnitude that is independent of sample size. Therefore we sorted the studies into large effect (effective) versus small effect (less effective) categories on the basis of effect size rather than statistical significance of the reported result. Sorting the studies into large effect and small effect categories for each student outcome variable separately was more theoretically justifiable than trying to identify generally (across student outcomes) effective versus generally ineffective open education programs. One property of effect sizes is that they are homogeneous with respect to linear transformation (Hedges, 1980). Therefore two variables that are perfectly correlated will have the same effect size. But because different student outcomes are not linear transformations of each other (e.g. measures of reading achievement are not linear transformations of measures of mathematics achievement, i.e., they are not perfectly correlated), combining effect sizes across student outcome variables is inadvisable.

A total of 72 different studies were used in this study. Table A in the appendix lists the studies and how they were classified (large, small, or medium effect) for each student outcome.

Descriptions of Student Variables

The student outcome variables used in this study were those for which there were at least seven studies in each of the large effect and small effect categories. These outcome variables were self concept, creativity, attitude toward school, reading achievement, mathematics achievement, and language achievement.

Table 2 summarizes the number of large effect and small effect studies

Table 2

Average Effect Sizes for All Studies, Large Effect Studies, and Small Effect Studies

Student Outcome	All Comparisons Across All Studies			Large Effect Studies			Small Effect Studies		
	M	SD	n[a]	M	SD	n[b]	M	SD	n
Self Concept	.056	.420	84	.641	.423	16	-.347	.249	16
Creativity	.302	.403	23	.724	.187	7	-.169	.234	7
Favorable Attitude Toward School	.166	.447	68	.730	.279	13	-.329	.253	13
Reading Achievement	-.038	.362	73	.344	.315	17	-.498	.136	17
Mathematics Achievement	-.034	.383	62	.387	.204	14	-.616	.239	14
Language Achievement	-.053	.581	32	.494	.434	8	-.590	.147	8

Note. [a] n equals number of comparisons; some studies yielded more than one comparison per student outcome, e.g., separate effect sizes were computed for each grade level within a study.

[b] n equals number of studies; one effect size per study (per student outcome) was used in computing means and standard deviations.

that were compared for each of the six student outcome variables. It also lists the mean effect sizes and standard deviations for each student outcome, for all the studies, for the large effect studies, and for the small effect studies. The average effect sizes for the large effect studies are all much higher than the average effect sizes for both the small effect studies and all studies. Similarly, the average effect sizes are all much lower for the small effect studies than the average effect sizes for either all studies or large effect studies. Thus, the large effect and small effect studies do seem to represent extreme groups in terms of average effect size.

Table B in the appendix lists the measures used in the large and small effect studies for each student outcome. The numbers and types of different measures used for each student outcome provide some information about the nature of the student outcome construct as it was actually measured.

Self concept was broadly defined to include self-appraisal, self-security, or self-acceptance in both academic and general life situations. Fifteen different measures of self concept were reported in the 32 large effect and small effect studies. Most of these measures of self concept were group-administered, student self report inventories. The measures differed primarily in terms of the situational specificity of self concept, e.g., general self concept versus self concept in academic situations versus physical self concept. There are reasons to suspect that

construct interpretations from such a large set of different measures should be made cautiously. Shavelson, Hubner, and Stanton (1976), in a review of studies of self concept, argued that there is a general lack of an agreed-upon definition of self concept, a lack of adequate validation of interpretations of self concept measures, and a lack of empirical data on the equivalence of the self concept measures currently being used.

Problems may also arise in the interpretation of scores on some measures of academic self concept, if the actual ability level of the student is not taken into account. "Yes" responses to items like "I think my grades are poor," "I think I am poor in arithmetic," and "Most of my grades are lower than other kids' grades" may be a realistic self-evaluation on the part of a low-ability student and poor self-evaluation or excessive self-criticism on the part of a high ability student. A desirable student outcome may be for all students to feel good about themselves no matter what their ability levels are. But this should be distinguished from unrealistic self evaluations of ability. Thus higher scores on self concept measures of this sort may not always represent a desired student outcome.

Creativity was defined to include the fluency, flexibility, originality, and elaboration dimensions of behavior, in both the verbal and figural domains. Six different measures of creativity were used by the 14 large effect and small effect studies. Most of these studies reported scores for the Torrance Tests of Creative Thinking. Most of the measures of creativity that were used required the student to produce either ideas, figures, or drawings in response to a verbal or figural stimulus. Only one measure (Pennsylvania Assessment of Creative Tendency) was a self-report inventory that measured attitudinal factors which support creative behavior. Thus the measures reported for creativity are fairly homogeneous with respect to the construct that they purport to measure.

Favorable attitude toward school was defined to include favorability toward, interest in, or appreciation of various aspects of school life, such as learning, peer relations, physical environment, structuring of tasks, teacher's role, school and classroom policies, and so on. Eighteen different measures were reported in the 26 large and small effect studies. Most of these measures of attitude toward school were student self-report inventories, and many were instruments developed by the investigator for his or her particular study of open education.

The measures of attitude toward school differed widely in the extent to which they emphasized the various aspects of school life (e.g. physical environment, teacher relations), and in the breadth of coverage of the aspects of school life.

One crucial problem with a few of these measures of attitude toward school was that they seemed more like measures of implementation of an open education program than measures of the desired student outcome of favorability toward school. For example, one measure that used a semantic differential approach, asked students to indicate on a seven-point scale the extent to which they generally felt the anchored adjective described their feelings toward the classroom. One item used "teacher-centered" and "student-centered" as anchor points. But by definition, the open education program in this study was student-centered and such an item may merely reflect whether this aspect of the program was implemented, and not students' favorable attitudes toward school.

Thus the measures used for attitude toward school are fairly heterogeneous and it is not clear that they are all measuring the same construct.

Reading achievement represented a summary measure of all reading subskills, such as reading comprehension and vocabulary. Twelve different

measures of reading achievement were reported in the 34 large effect and small effect studies.

Mathematics achievement represented a summary measure of mathematics subskills such as computation, concepts, reasoning, and problem-solving. Ten different measures of methematics achievement were used in the 28 large effect and small effect studies.

Language achievement represented a summary measure of language subskills, such as spelling, usage, and capitalization and punctuation. Eight different measures of language achievement were reported in the 16 large effect and small effect studies.

All of the achievement measures for reading, mathematics, and language are quite homogeneous. Most of these measures were subtests of standardized achievement batteries, for which extensive reliability and validity data had been gathered. Thus the interpretation of effects across the different reading, mathematics, and language measures is probably less ambiguous than the interpretation of effects across the different self concept and attitude toward school measures.

Description of the Design Characteristics of Studies

Nine different design characeristics on which the large effect and small effect studies could differ were identified. These characteristics included some of the subject variables, experimental design variables, experimenter variables, and context variables on which Hedges and his co-workers collected information for their meta-analysis. Following are brief descriptions of the characteristics and categories on which the large effect and small effect studies were compared.

(1) Design of the study -- Two categories were included: correlational and experimental or quasi-experimental. It was necessary to combine

experiments and quasi-experiments into one category because too few studies were true experiments. The purpose of including this characteristic was to look for systematic differences in the extent to which large effect and small effect studies allowed causal inferences to be made about the results reported in each study.

(2) Type of publication -- Four categories were included: dissertation, journal article, book or monograph, and ERIC document. Dissertations typically provided more detail about the open education treatment while journal articles were typically reports of better-designed studies.

(3) Method of determining open education treatment -- Three categories were included: observation or questionnaire, open space (architecture), and judgment of the investigator(s). This characteristic was thought to be an index of treatment fidelity and strength, i.e., whether implementation of the open education program was actually measured (observation or questionnaire) or just assumed (judgment of investigator) and whether the open education treatment was based on open space alone or on teaching practices (questionnaire and judgment).

(4) Grade level of students -- Four categories were included: kindergarten to grade2, grades 3 and 4, grades 5 and 6, grade7 and above. This characteristic was studied because some researchers have questioned whether the assumptions underlying open education are equally true for children of different ages (cf. Traub, Weiss, Fisher, & Musella, 19/2). This characteristics also provided an indirect index of the strength of the open education treatment. Younger students in open education programs are more likely than older students to have experienced only open education: older students in open education programs are more likely than younger students to have experienced both open and traditional education programs.

(5) Degree of comparability of open and traditional students -- Three categories were used: high, medium, and low. Coding this characteristic involved a judgment by the reader of the study. Information such as mention of random assignment of students; matching of students, classes, teachers, or schools

was used in evaluating the degree of comparability of students in the open and traditional education groups.

In making this judgment, the reader of the study also looked at the amounts of open or traditional education to which each group had been exposed. A common problem in many of the studies was the comparison of traditional education students whose whole educational experience had been in traditional education programs with open education students who were new to open education and who had experienced unknown prior amounts of traditional education.

This design characteristic was included because the comparability of students in the experimental (open education) and control groups bears directly on the validity of causal inferences that can be made from the results of a study.

(6) Country in which the study was implemented -- Two categories were included: USA and Britain, Canada or Australia. This characteristic was studied because of qualitative differences that may exist between open education programs in the USA and Britain. Britain has a longer history of open education and the open education programs that are implemented there tend to be more homogeneous with respect to the model of open education on which they are based than the open education programs implemented in the USA.

(7) Duration of the open education treatment -- Four categories were used:

less than one year, one school year, between one and two years, and more than two years. This characteristic was included as an index of the strength of the open education treatment; longer open education treatments were expected to be related to larger effects.

(8) Quality of the study -- Three categories were included: very good, moderately good, and poor. The reader of the study made a summary judgment about the quality or interpretability of each study, on the basis of information such as adequacy of the experimental design, sampling procedures, descriptions of the open and traditional education treatments, explicitness of the research question(s), appropriateness of the procedures used to test the research hypotheses, and quality of the measures used for the student outcome variables.

This characteristic provided a global index of the "trustworthiness" of the results of the study. Inter-reader agreement for this characteristic was 87%. This percentage of agreement was computed for the 72 studies reviewed for this study and which had been coded previously in the meta-analysis by Hedges and his co-workers.

(9) Commitment of the investigator -- Three categories were used: favors open education, neutral, favors traditional education. The reader of the study made a judgment about the commitment of the investigator(s) largely on the basis of the tone of the research report, e.g., from comments in the introduction to the report that suggested that the study was designed to "support" versus "test" versus "challenge" the claims of open education.

The commitment of the investigator could be related to large or small effects for at least two different reasons. First, a strong commitment to open education could have resulted in experimenter biases

of the sort that produce artifactually large effects. Or, second, a strong commitment to open education could indicate that the investigator was more informed about the types and features of open education programs (than the investigator with a commitment to traditional education) and was more likely to implement a sound, extensive open education program that would produce large effects.

Inter-reader agreement for rating this characteristic was 81% for the 72 studies reviewed in this study.

The percentages of large and small effect studies falling into each of the designated categories, for each of these nine design characteristics, were determined. The chi-square statistic or Fisher's Exact Test was computed for each characteristic, in order to determine the relationship between the classification of a study as large effect or small effect and each of the design characteristics.

Descriptions of the Features of Open Education Programs

The careful identification of a complete and representative set of features of open education programs on which to compare large effect and small effect studies was crucial to this study. Two major decisions had to be made: Which features of open education to include in the analysis and how to code information about these features.

The first decision involved a tradeoff between compiling an exhaustive, detailed list of features that would fully capture all the nuances of different open education programs and the practical constraint that most studies included too little information about the open education treatment to conduct this fine-grained analysis.

The features of open education that were used in this study to compare

large effect and small effect studies were based partly on the general categories proposed by Traub, Weiss, Fisher, and Musella (1972), partly on the categories described by Walberg and Thomas (1972), and largely on general impressions gathered in the course of reading the 153 studies reviewed in the meta-analysis by Hedges, Giaconia, and Gage (1981).

Traub and his co-workers developed a teacher questionnaire (Dimensions of Schooling) which categorized several features that were found to distinguish open education programs from traditional education programs. Two criteria were used by Traub and his co-workers in identifying these features of open education programs. First, the feature could not contradict any of the assumptions about the way children behave, develop, and learn that Barth (1969) had identified as central to open education. Second, the feature had to have two or more program manifestations that could be easily ranked in degree of openness.

Ten dimensions of schooling were proposed by Traub and his co-workers:

(1) Setting Instructional Objectives -- process by which instructional objectives are set, i.e., participation of students in this process.

(2) Materials and Activities -- diversity of material, activities, and media.

(3) Physical Environment -- flexible use of space and furnishings.

(4) Structure for Decision-Making -- student choice in assignment to teachers.

(5) Time Scheduling -- no fixed timetables, time for independent study, unstructured time, no attendance requirements.

(6) Individualization of Learning -- small group instruction, individually-paced instruction, student choice in method of learning.

(7) Composition of Classes -- multi-age grouping of students.

(8) Role of Teacher -- teacher as resource person, teacher as diagnoser of student problems and progress, teacher guides but does not force students, teacher works with individuals or small groups of students.

(9) Student Evaluation -- little or no use of conventional tests, purpose of evaluation is to direct student learning, student also provides self-evaluations, continuous evaluation, use of observations, work samples, and anecdotal evidence.

(10) Student Control -- role of student in rule-formulation and rule-enforcement.

Walberg and Thomas (1972) identified eight themes of open education which they used as the starting point for the development of a 50-item open education observation scale and a parallel teacher questionnaire. The eight themes proposed by Walberg and Thomas were based largely on the ten themes that Bussis and Chittenden had arrived at from their interviews with open education teachers. These eight themes and sample indicators include:

(1) Provisioning for Learning -- diversity of manipulative materials, freedom of movement for students, students group themselves for instruction.

(2) Humaneness, Respect, Openness, and Warmth -- environment includes materials developed by students, students' activities and ideas are reflected in the classroom.

(3) Diagnosis of Learning Events -- test results not used to group students, tests used to find out what student knows.

(4) Instruction, Guidance, and Extension of Learning -- individualized instruction, small group instruction, little use of curriculum guides or textbooks.

(5) Evaluation of Diagnosti- Information -- teacher writes individual histories of each student's development, tests not used to compare students, teacher collects samples of student's work, evaluation used to guide instruction.

(6) Seeking Opportunities for Professional Growth -- use of teacher aides, teacher relies on colleagues.

(7) Self-Perception of Teacher -- teacher tries to keep all students in view in order to make sure they are doing what they are supposed to.

(8) Assumptions about Children and Learning -- student involvement, warm and supportive emotional climate, clear set of rules and regulations.

Seven general features of open education were identified for use in this study: open space, materials to manipulate, multi-age grouping of students, individualized instruction, role of the child in learning, team teaching, and diagnostic evaluation. In addition, four other aspects of the open education programs were evaluated: the number of the features of open education that were implemented, the extensiveness of the open education treatment, the specificity of the theoretical model of open education on which the program was based, and the emphasis of the model of open education on which the program was based.

Table 3 gives the definitions of each of these seven features and four aspects of open education programs. The table also lists keywords or descriptive statements reported in some of the studies that are examples of each of the seven features.

Table 4 shows the correspondences among the features of open education identified for this study, the dimensions of schooling described by Traub and his co-workers, and the open education themes reported by Walberg and Thomas. The table shows some evidence of convergence among the three sets of features, although some of the features differ in specificity and some of the categories do not overlap perfectly.

Table 3

Descriptions of the Features of Open Education on which Large Effect and Small Effect Studies Were Compared

Feature: OPEN SPACE

Definition: Physical environment of the classroom involving flexible use of space and furnishings

Indicators and descriptive statements:

-open area classroom
-open space architecture
-flexible school architecture
-open instructional area
-activity centers
-fluid space
-decentralized classroom
-pod facility school
-open plant facility
-no interior walls or movable walls
-school without walls
-flexible seating arrangements
-physically unstructured

Feature: MATERIALS TO MANIPULATE

Definition: Presence of diverse set of materials to stimulate student exploration and learning.

Indicators and descriptive statements:

-sensory materials
-exploration and discovery-oriented materials
- use of natural materials
- rich material environment
-alternative modalities for learning
-diversity of materials
-abundance of instructional aids
-tactile confrontation with manipulative materials
-real world materials

Feature: MULTI-AGE GROUPING OF STUDENTS

Definition: Grouping students for instruction in which grade labels are not applied; two or more grades may be housed in the same area.

Indicators and descriptive statements:

-family grouping
-nongraded school
-heterogeneous age grouping
-children from different grades work together in same classroom
-ungraded classrooms
-vertical grouping
-continuous progress education

Table 3 (continued)

Feature: INDIVIDUALIZED INSTRUCTION

Definition: Instruction based on the individual needs and abilities of each student; individualization of rate of, methods, and materials for learning; small group as opposed to large group instruction.

Indicators and descriptive statements:

-individualized instruction
-individualized approach
-individualized work
-environment responsive to individual learner needs
-individualizing the curriculum
-individualized goal setting
-learning in accord with their own rate and style
-small group or individual instruction

Feature: ROLE OF CHILD IN LEARNING

Definition: Child is active in guiding her own learning; child actively chooses materials, methods, and pace of learning; role of teacher as resource person; less teacher-centered instruction and more student-centered instruction.

Indicators and descriptive statements:

-voluntary action on the part of the child
-active agent in his own learning process
-self-motivated learning
-student initiates activities
-active participant rather than recipient of commands
-trust in the student's ability to choose his own learning experiences
-child-centered environment
-child's freedom and responsibility for his learning and development
-democratic learning atmosphere
-student sets rate of learning
-high degree of child contribution to the learning environment
-teacher as resource person
-teacher is authoritative not authoritarian

Feature: TEAM TEACHING

Definition: The sharing in planning and conducting instruction offered to the same group of students by two or more teachers: use of parents as teaching aides.

Indicators and descriptive statements:

-team teaching organization
-team teaching units
-teachers work together in teams with a team leader
-large spaces with two or more teachers

Table 3 (continued)

Feature: DIAGNOSTIC EVALUATION

Definition: Purpose of evaluation is to guide instruction; little or no use of conventional tests, but extensive use of work samples, observation, and written histories of the student.

Indicators and descriptive statements:

-charting of progress toward specific individual goals
-evaluation used to facilitate and guide learning
-child's performance not compared to that of other children
-teacher's record-keeping combines constant jotting in class and thoughtful writing about each child
-less standardized concept of student progress
-non-graded approach to evaluate student's performance

Aspect: NUMBER OF FEATURES OF OPEN EDUCATION

Definition: Measure of the breadth of the open education program; the sum of the number of the seven preceding features (open space, materials to manipulate, multi-age grouping of students, individualized instruction, role of child in learning, and team teaching) for which there was some evidence of implementation in the open education program.

Aspect: EXTENSIVENESS OF OPEN EDUCATION TREATMENT

Definition: Measure of the depth of the open education program; three levels: high, medium, low; determined by a judgment of the reader of the study on the basis of the descriptions of the open education treatment which the investigator provided.

Aspect: SPECIFICITY OF THEORY OF OPEN EDUCATION

Definition: Measure of the extent to which the open education program was based on a well-specified model of open education or on a hodge-podge of ideas about open education; three levels: high medium, low; a judgment by the reader of the study on the basis of comments made by the investigator in introducing her study.

Aspect: EMPHASIS OF THEORY OF OPEN EDUCATION

Definition: Measure of the extent to which the open education program emphasized open space, open teaching practices, or both open space and teaching practices; a judgment by the reader of the study made on the basis of descriptions of the open education program provided by the investigator.

Table 4

Comparison of the Categories of Open Education Features Proposed in Three Studies

Giaconia and Hedges (1981)	Traub, Weiss, Fisher, and Musella (1972)	Walberg and Thomas (1972)
Open Education Features	Dimensions of Schooling	Open Education Themes
Open Space	Physical Environment	-
Materials to Manipulate	Materials and Activities	Provisioning for Learning; Humaneness, Respect, Openness and Warmth
Multi-age Grouping of Students	Composition of Classes; Structure for Decision-Making	Provisioning for Learning
Individualized Instruction	Individualization of Learning	Instruction, Guidance, and Extension of Learning
Role of Child in Learning	Student Control; Setting Instructional Objectives; Role of Teacher	Provisioning for Learning; Humaneness, Respect, Openness, and Warmth
Team Teaching	-	-
Diagnostic Evaluation	Student Evaluation	Diagnosis of Learning Events; Evaluation of Diagnostic Information
-	Time Scheduling	-
-	-	Seeking Opportunities for Professional Growth
-	-	Self Perception of Teacher

A second decision, after choosing which features of open education on which to compare large effect and small effect studies, was how to code information in the 72 studies. The choice was between coding only the presence or absence of a feature in each open education program and coding qualitative aspects of each feature. The former approach was chosen because most of the studies contained too little information for a finer-grained analysis and because the number of studies we were examining for any one student outcome variable was small.

The percentages of large effect and small effect studies for which each feature of open education was present or absent were determined. A chi-square test or Fisher's Exact Test was computed for each feature, in order to determine the relationship between the classification of a study as large effect or small effect and the presence or absence of an open education program feature. A chi-square statistic was computed when the total number of large effect and small effect studies was greater than 30: Fisher's Exact Probability was computed when the total number of studies was less than 30.

Results and Discussion

Tables 5 and 6 report the percentage of large effect studies and the percentage of small effect studies falling into each of the different categories for each of the nine design characteristics. The values of χ^2 or Fisher's Exact Probability are also given. Table 5 reports this information for the student outcome variables: self concept, creativity, and attitude toward school. Table 6 reports this information for the student outcome variables: reading achievement, mathematics achievement, and language achievement.

The χ^2 tests reported for each design characteristic are not independent

Table 5

Comparison of Selected Characteristics of the Studies Yielding Large Effects and Small Effects for the Student Outcomes: Self Concept, Creativity, and Favorable Attitude Toward School

Characteristic of the Study	SELF CONCEPT			CREATIVITY			FAVORABLE ATTITUDE TOWARD SCHOOL		
	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2
Design of the Study			.00			.00			.18
Correlational	25	25		29	29		38	23	
Experimental or Quasi-experimental	75	75		71	71		62	77	
Type of Publication			3.20			.00			.40
Dissertation	50	75		57	57		62	62	
Journal Article	19	12		29	29		23	25	
Book or Monograph	12	0		-	-		-	-	
ERIC Document	19	13		14	14		15	23	
Method of Determining Open Education Treatment			7.72**			3.83			1.47
Observation or Questionnaire	69	25		43	71		69	46	
Open Space (Architecture)	12	56		14	29		15	31	
Judgment of Investigator(s)	19	19		43	0		16	23	
Grade Level of Students			6.54*			2.80			4.40
Kindergarten to Grade 2	19	6		14	29		0	23	
Grade 3 to Grade 4	25	38		57	14		46	46	
Grade 5 to Grade 6	31	56		29	57		46	31	
Grade 7 or Above	25	0		-	-		8	0	
Degree of Comparability of Open and Traditional Students			2.89			2.44			3.60
High	38	13		14	29		31	31	
Medium	50	62		57	71		23	54	
Low	12	25		29	0		46	15	

Table 5 (continued)

Characteristic of the Study	SELF CONCEPT % of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	CREATIVITY % of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	FAVORABLE ATTITUDE TOWARD SCHOOL % of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2
Country in Which the Study Was Implemented			.00			.00			.38
USA	94	94		86	86		85	92	
Britain, Canada, or Australia	6	6		14	14		15	8	
Duration of Open Education Treatment			7.68**			3.30			5.50
Less than One Year	6	38		0	13		54	23	
One School Year	31	44		38	62		8	46	
Between One and Two Years	19	6		12	13		15	8	
More than Two Years	44	12		50	12		23	23	
Quality of the Study			3.17			1.17			2.60
Very Good	25	13		14	29		38	23	
Moderately Good	62	47		72	43		23	54	
Poor	13	40		14	28		39	23	
Commitment of Investigator(s)			3.91			.00			2.18
Open Education	75	50		71	71		62	54	
Neutral	25	31		29	29		38	31	
Traditional Education	0	19		-	-		0	15	

Note. * $p < .10$
** $p < .05$

Table 6

Comparison of Selected Characteristics of the Studies Yielding Large Effects and Small Effects for the Student Outcomes: Reading Achievement, Mathematics Achievement, and Language Achievement

Characteristic of the Study	READING ACHIEVEMENT			MATHEMATICS ACHIEVEMENT			LANGUAGE ACHIEVEMENT		
	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2
Design of the Study			.00			.38			.00
Correlational	12	12		7	21		12	12	
Experimental or Quasi-experimental	88	88		93	89		88	88	
Type of Publication			1.84			5.47			7.29*
Dissertation	47	59		43	64		25	62	
Journal Article	18	18		36	7		38	0	
Book or Monograph	6	12		0	14		0	25	
ERIC Document	29	11		21	15		37	13	
Method of Determining Open Education Treatment			2.77			.22			1.03
Observation or Questionnaire	30	47		28	36		38	63	
Open Space (Architecture)	35	41		36	36		25	12	
Judgment of Investigator(s)	35	12		36	28		37	25	
Grade Level of Students			1.51			1.41			.48
Kindergarten to Grade 2	24	35		14	29		12	25	
Grade 3 to Grade 4	41	41		64	43		50	38	
Grade 5 to Grade 6	29	24		22	28		38	37	
Grade 7 or Above	6	0		-	-		-	-	
Degree of Comparability of Open and Traditional Students			8.06**			4.70*			4.80*
High	18	53		36	29		0	38	
Medium	53	47		28	64		50	50	
Low	29	0		36	7		50	12	

Table 6 (continued)

Characteristic of the Study	READING ACHIEVEMENT			MATHEMATICS ACHIEVEMENT			LANGUAGE ACHIEVEMENT		
	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2
Country in Which the Study Was Implemented			.00			.00			(.23)
USA	76	70		71	79		100	75	
Britain, Canada, or Australia	24	30		29	21		0	25	
Duration of Open Education Treatment			.70			2.64			3.30
Less than One Year	18	29		22	29		0	12	
One School Year	29	24		21	43		38	63	
Between one and Two Years	18	18		21	7		12	12	
More than Two Years	35	29		36	21		50	13	
Quality of the Study			2.72			.70			2.31
Very Good	24	19		21	23		0	25	
Moderately Good	35	62		50	62		62	50	
Poor	41	19		29	15		38	25	
Commitment of Investigator(s)			6.73**			.72			4.40*
Open Education	88	47		72	57		88	38	
Neutral	12	47		21	36		12	50	
Traditional Education	0	6		7	7		0	12	

Note. * $p < .10$
** $p < .05$

of each other, because some of the study characteristics covary. But undue reliance should not be placed on either the magnitude or statistical significance of these values in any event. (Because the sample of studies is small, the risk of a Type II error is increased.) It is important to look for patterns in the ways the large effect and small effect studies are distributed across categories, regardless of statistical significance.

Overall, there are few general statements that can be made about differences in large effect and small effect studies on these study characteristics, that are consistent across all six student outcomes. One general finding that held for all student outcomes (except creativity) was that the commitment of the investigator was more likely to be "favors open education" for large effect than small effect studies. As was suggested earlier, the tendency for a commitment to open education to be related to large program effects may be due to either experimenter bias or experimenter thoroughness, i.e., the large effects may be artifacts or they may reflect carefulness in implementing the open education program.

Another general finding that held for all the student outcomes (except for attitude toward school) was that large effect studies were more likely than small effect studies to have had a duration of the open education treatment of greater than two years. The small effect studies were more likely than the large effect studies to have had a duration of treatment of less than one year. This finding that longer exposure to open education is related to larger effects is not unexpected. The failure of some open education programs to produce positive effects may be due, in part, to an inadequate duration of (weak) treatment.

The three traditional achievement variables, reading, mathematics,

and language, often showed the same patterns of differences between large effect and small effect studies, and in a direction that was often opposite to that for self concept, creativity, or attitude toward school. For example, the method of determining the open education treatment was more likely to be observation or questionnaire for the small effect studies than the large effect studies for reading, mathematics, and language. The opposite held true for the self concept and favorable attitude toward school outcomes. Similarly, the quality of the study was more likely to have been rated "poor" for large effect than for small effect studies for reading, mathematics, and language. For self concept and creativity, the small effect studies were more likely than the large effect studies to have been rated "poor" in quality.

With the exception of self concept, the nine study characteristics also did not consistently distinguish between large effect and small effect studies within each student outcome, i.e., the different characteristics that were all indices of study quality and interpetability did not show the same direction of differences between large effect and small effect studies. Within any one student outcome, large effect studies might be more likely than small effect studies to have a high degree of comparability of students, yet also have been rated as poor in quality. For the student outcome self concept, however, all the indices pointed to the large effect studies as higher in quality, with greater treatment fidelity, and more validly able for causal inferences to be made about the reported results.

Results of the Analysis of Open Education Features

Tables 7 and 8 report the percentages of large effect studies and the percentages of small effect studies for which each feature of open education

Table 7

Comparison of the Features of Open Education Found in the Studies Yielding Large Effects and Small Effects for the Student Outcomes: Self Concept, Creativity, and Favorable Attitude Toward School

	SELF CONCEPT			CREATIVITY			FAVORABLE ATTITUDE TOWARD SCHOOL		
Feature of Open Education	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2
Open Space			.006			(1.000)			(.101)**
Yes	87	81		71	71		54	85	
No	13	19		29	29		46	15	
Materials to Manipulate			14.350***			(.348)			(.217)
Yes	100	27		80	50		82	56	
No	0	73		20	50		18	44	
Multi-age Grouping of Students			.000			(.121)*			(.621)
Yes	81	75		83	33		46	46	
No	19	25		17	67		54	54	
Individualized Instruction			9.894***			(.500)			(.594)
Yes	100	44		83	67		80	75	
No	0	56		17	33		20	25	
Role of Child in Learning			8.167***			(.437)			(.322)
Yes	100	50		86	67		85	69	
No	0	50		14	33		15	31	
Team Teaching			.068			(.500)			(.207)
Yes	67	69		40	57		36	62	
No	33	31		60	43		64	38	
Diagnostic Evaluation			(.002)***			(.091)**			(.297)
Yes	100	46		100	50		73	50	
No	0	54		0	50		27	50	

Table 7 (continued)

Feature of Open Education	SELF CONCEPT % of Large Effect Studies	SELF CONCEPT % of Small Effect Studies	SELF CONCEPT Fisher's Exact Test or χ^2	CREATIVITY % of Large Effect Studies	CREATIVITY % of Small Effect Studies	CREATIVITY Fisher's Exact Test or χ^2	FAVORABLE ATTITUDE TOWARD SCHOOL % of Large Effect Studies	FAVORABLE ATTITUDE TOWARD SCHOOL % of Small Effect Studies	FAVORABLE ATTITUDE TOWARD SCHOOL Fisher's Exact Test or χ^2
Extensiveness of Open Education Treatment			14.670***			1.200			1.620
High	75	25		43	29		46	23	
Medium	25	13		29	14		8	15	
Low	0	62		28	57		46	62	
Specificty of Theory of Open Education			1.530			.530			1.640
High	19	37		29	43		31	54	
Medium	62	44		43	43		54	31	
Low	19	19		28	14		15	15	
Emphasis of Theory of Open Education			11.380***			2.440			1.530
Open Space	0	50		14	29		15	31	
Teaching	56	38		57	71		77	54	
Both	44	12		29	0		8	15	

Note. Studies for which there was no information on a particular feature and for which an informed judgment could not be made were excluded from the analysis for that feature. Median percentage of cases excluded for all features, for all student outcomes, was 7% of total sample.

Fisher's Exact Probability was computed for 2 X 2 analyses when $N < 30$; these probabilities are in parentheses. Chi-square was computed when $N \geq 30$ studies and for all the 2 X 3 analyses; these values are not in parentheses.

* $p < .15$ ** $p < .10$ *** $p < .01$

Table 8

Comparison of the Features of Open Education Found in the Studies Yielding Large Effects and Small Effects for the Student Outcomes: Reading Achievement, Mathematics Achievement, and Language Achievement

Feature of Open Education	READING ACHIEVEMENT			MATHEMATICS ACHIEVEMENT			LANGUAGE ACHIEVEMENT		
	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	% of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2
Open Space			1.092			(.500)			(.500)
Yes	75	94		71	79		75	88	
No	25	6		29	21		25	12	
Materials to Manipulate			(.147)*			(.433)			(.500)
Yes	77	50		67	54		83	67	
No	23	50		33	46		17	33	
Multi-age Grouping of Students			.000			(.210)			(.427)
Yes	71	65		57	79		57	75	
No	29	35		43	21		43	25	
Individualized Instruction			(.469)			(.641)			(.467)
Yes	85	77		83	86		86	100	
No	15	23		17	14		14	0	
Role of Child in Learning			.167			(.615)			(.733)
Yes	75	75		71	69		86	88	
No	25	25		29	31		14	12	
Team Teaching			.929			(.500)			(.214)
Yes	73	50		62	54		71	38	
No	27	50		38	46		29	62	
Diagnostic Evaluation			(.585)			(.632)			(.731)
Yes	82	77		80	83		86	83	
No	18	23		20	17		14	17	

Table 8 (continued)

Feature of Open Education	READING ACHIEVEMENT % of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	MATHEMATICS ACHIEVEMENT % of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2	LANGUAGE ACHIEVEMENT % of Large Effect Studies	% of Small Effect Studies	Fisher's Exact Test or χ^2
Extensiveness of Open Education Treatment			.160			.830			1.140
High	24	24		21	36		50	38	
Medium	47	31		50	36		25	50	
Low	29	35		29	28		25	12	
Specificity of Theory of Open Education			6.650**			2.570			5.200*
High	30	18		36	14		38	0	
Medium	35	76		36	64		25	75	
Low	35	6		28	22		37	25	
Emphasis of Theory of Open Education			1.110			1.410			4.600
Open Space	30	24		29	14		25	0	
Teaching	35	53		43	64		38	88	
Both	35	23		28	22		37	12	

Note. Studies for which there was no information on a particular feature and for which an informed judgment could not be made were excluded from the analysis for that feature. Median percentage of cases excluded was 7%.

Fisher's Exact Probability was computed for 2 X 2 analyses when $N < 30$; these probabilities are in parentheses. Chi-square was computed when $N \geq 30$ studies and for all 2 X 3 analyses; these values are not in parentheses.

* $p < .15$ ** $p < .10$ *** $p < .01$

was present or absent. The values of chi-square or Fisher's Exact Test are also given. Table 7 reports this information for the student outcomes: self concept, creativity, and favorable attitude toward school. Table 8 reports this information for the student outcomes: reading achievement, mathematics achievement, and language achievement.

Table 9 reports the mean number of features of open education found in the large effect and small effect studies which measured each student outcome variable. T-tests for differences between the means are also reported. Table 10 summarizes the direction of the differences between large effect and small effec studies on each feature of open education, regardless of the statistical significance of the difference.

As was true of study characteristics, there are few features of open education that distinguish large effect from small effect studies for all six student outcome variables. The student outcome variables did seem to cluster into two groups in terms of consistency in directions of differences reported for each open education feature. Self concept, creativity, and favorable attitude toward school formed one cluster, while language achievement and mathematics achievement formed another cluster. Reading achievement seemed to alternate between the self concept cluster and the achievement cluster in the direction of differences between large effect and small effect studies that it displayed. The two clusters often showed opposite directions of differences.

The mean number of features of open education (reported in Table 9) which were implemented showed little differences between large effect and small effect studies, except for self concept and creativity. For self concept, large effect studies contained an average of two more features than small

Table 9

Differences between Large Effect and Small Effect Studies in the Mean Number of Features of Open Education which Were Implemented

	Large Effect Studies			Small Effect Studies			
Student Outcomes	M	SD	n	M	SD	n	t
Self Concept	6.12	.81	16	3.88	1.78	16	4.60*
Creativity	4.71	1.80	7	3.71	1.38	7	1.17
Favorable Attitude Toward School	4.15	1.68	13	3.92	1.75	13	0.34
Reading Achievement	4.47	1.46	17	4.53	1.46	17	-0.12
Mathematics Achievement	4.43	1.02	14	4.71	1.77	14	-0.52
Language Achievement	4.75	1.75	8	5.00	1.69	8	-0.29

Note. Maximum number of features is 7.

* $p < .01$

Table 10

Summary of the Direction of Differences between Large Effect and Small Effect Studies on Features of Open Education

Feature of Open Education	Self Concept	Creativity	Favorable Attitude Toward School	Reading	Mathematics	Language
Open Space	L > S	No Diff.	S > L**	S > L	S > L	S > L
Materials to Manipulate	L > S***	L > S	L > S	L > S*	L > S	L > S
Multi-age Grouping of Students	L > S	L > S**	No Diff.	L > S	S > L	S > L
Individualized Instruction	L > S***	L > S	L > S	L > S	S > L	S > L
Role of Child in Learning	L > S***	L > S	L > S	No Diff.	L > S	S > L
Team Teaching	S > L	S > L	S > L	L > S	L > S	L > S
Diagnostic Evaluation	L > S***	L > S**	L > S	L > S	S > L	L > S
Number of Features of Open Education	L > S***	L > S	No Diff.	No Diff.	No Diff.	No Diff.
Extensiveness of Open Treatment	***					
Low	S > L	S > L	S > L	S > L	L > S	L > S
Medium	L > S	L > S	S > L	L > S	L > S	S > L
High	L > S	L > S	L > S	No Diff.	S > L	L > S
Specificity of Theory of Open Education				**		*
Low	No Diff.	L > S	No Diff.	L > S	L > S	L > S
Medium	L > S	No Diff.	L > S	S > L	S > L	S > L
High	S > L	S > L	S > L	L > S	L > S	L > S
Emphasis of Theory of Open Education	***					*
Open Space	S > L	S > L	S > L	L > S	L > S	L > S
Teaching	L > S	S > L	L > S	S > L	S > L	S > L
Both	L > S	L > S	S > L	L > S	L > S	L > S

Note. ">" means more likely to include that feature of open education. "L" = large effect studies. "S" = small effect studies.

* $p < .15$ ** $p \leq .10$ *** $p < .01$

effect studies. The t-ratic for this difference between means was significant. The large effect studies for self concept also included between one and two more features of open education than the large effect studies for the other student outcome variables.

For creativity, large effect studies contained an average of one more feature than small effect studies.

The direction of the difference between mean number of features for large effect and small effect studies was negative for the three achievement outcomes, suggesting that while more features are related to positive effects for self concept, creativity, and favorable attitude toward school, more features are related to negative effects for reading, mathematics, and language achievement. This trend is also shown for other features of open education, as reported in Table 10.

The one general finding that held across all six student outcomes was that large effect studies were more likely to include manipulative materials as a program feature than small effect studies. Diagnostic evaluation was another feature that was more likely to be included in large effect than small effect studies for most of the six student outcomes.

Individualized instruction and team teaching are two features that demonstrated reverse directions of differences for the self concept, creativity, attitude cluster and the language and math achievement cluster. Individualized instruction was more likely to be found in large effect than small effect studies for the outcomes self concept, creativity, and attitude toward school, while individualized instruction was more likely to be found in small effect studies than large effect studies for the outcomes, language and mathematics achievement. Team teaching was more likely to be found in the small effect than large effect studies for self concept, creativity, and attitude toward school while the opposite was true for reading, mathematics, and language.

Similarly, ratings of the extensiveness of the treatment as low, specificity of the theory of open education as high, and emphasis of the theory of open education as open space, showed opposite directions of differences for the self concept, creativity, attitude toward school outcomes and the reading, mathematics, and language achievement outcomes. For self concept, creativity, and attitude toward school, small effect studies were more likely than large effect studies to have been of low extensiveness, to have been of high specificity of the theory of open education on which the program was based, and to have emphasized open space rather than teaching practices. The opposite was true for the achievement outcomes.

The consistency within each outcome variable was highest for self concept, creativity, and reading. That is, the direction of the differences between large effect and small effect studies was similar across the different features of open education. For language and mathematics achievement, the direction of differences favored large effect studies for about half of the features and favored small effect studies for half of the features.

The profile that emerges of the effective open education program depends, of course, on the desired student outcomes. For outcomes such as self concept, creativity, and favorable attitude toward school, the effective open education program is characterized as including most of the seven features identified in this study, as extensive in both breadth (number of features) and depth (extensiveness rating). This effective program also emphasizes teaching practices or teaching practices and open space, rather than open space alone. The effective program is not based on a specific theoretical model of open education, but draws on several different ideas and models.

For outcome such as mathematics and language achievement, "more is not

better."[6] Large effects for these outcomes are related to less extensiveness and fewer number of features of open education. Emphasis on open space rather than teaching practices is called for.

Implications for Educational Research and Practice

The call for more studies of open education may seem ill-advised, given the burgeoning body of open education studies. But what are needed are studies to systematically test the causal efficacy of various configurations of the open education features that have been shown in this study to be related to large program effects. Studies of this sort can determine the relative contribution of each feature to overall program effects. This information can then be used to identify a set of necessary and sufficient features of effective open education programs.

More generally, this study has illustrated a strategy for educational researchers to use when faced with a body of literature that shows a high degree of inconsistency in results. That is, an effect size for each study can be computed. The two extreme groups of studies on effect size can be compared and contrasted on both study design characteristics and dimensions or features of the treatment variable in question. Such an approach works best when the effect sizes across studies are not homogeneous, i.e., are highly variable. Hedges' (1980) statistical test of homogeneity of effect sizes can be used to establish this.

Recommendations for educational practice or the design of open education programs are tentative at best, until the causal efficacy of some of the features identified in this study is established. But in general, the educator who is primarily interested in self concept, creativity, and attitude toward school and learning as desired student outcomes, is advised

to include as many of the features of open education identified in this study (open space, manipulative materials, multi-age grouping of students, individualized instruction, role of the child in learning, team teaching, and diagnostic evaluation) as possible.

Appendix

Table A

Classification of the 72 Studies as Large Effect or Small Effect

Author(s)	Self Concept	Creativity	Attitude Toward School	Reading	Math	Language
Abelson, Zigler, and DeBlasi (1974)	L	-	S	L	L	L
Allen (1974)	-	-	L	L	L	-
Arlin and Palm (1974)	-	-	S	-	-	-
Bell, Switzer, and Zipursky (1974)	-	-	-	S	-	-
Bell, Zipursky, and Switzer (1976)	-	-	-	-	L	-
Bennett (1976)	-	-	-	S	S	S
Broward County School Board (1972)	-	-	-	L	-	L
Brown (1973)	L	-	-	-	-	-
Burychett (1972)	S	L	-	-	S	-
Burnham (1971)	-	-	-	L	-	-
Butson (1975)	L	-	-	L	-	-
Case (1970)	S	-	-	-	-	-
Cockerham and Blevins (1976)	L	-	-	-	-	-
Daniels (1974)	S	-	S		L	-
Day (1974)	-	-	-		L	-
Dornseif (1975)	-	-	-	L	L	L
Dugan (1976)	-	-	-	L	-	-
Earnshaw (1972)	-	L	-	S	S	S
Forman (1975)	-	S	-	S	S	-

Table A (continued)

Author(s)	Self Concept	Creativity	Attitude Toward School	Reading	Math	Language
Fox (1975)	-	S	S	L	-	-
Franks, Marolla, and Dillon (1974)	L	-	-	-	-	-
Franks (1977)	L	-	L	-	-	-
Glinsky (1973)	-	-	L	-	-	-
Godde (1972)	-	-	-	-	L	-
Grapko (1972)	S	-	-	S	L	-
Grogan (1976)	-	-	-	L	-	L
Groobman, Forward, and Peterson (1976)	S	S	L	-	-	-
Hill (1973)	-	-	-	L	L	-
Hopke (1974)	L	-	S	S	S	S
Horwitz (1976)	-	L	L	-	-	-
Hudson (1973)	S	-	S	-	-	-
Jensen (1976)	L	-	L	-	-	-
Klein (1975)	-	L	-	-	-	-
Koskoff (1973)	L	-	-	-	-	-
Kourilsky and Baker (1975)	-	-	S	-	-	-
Leroy (1973)	-	-	S	-	-	-
McBride (1975)	-	-	-	S	S	S
McCorkle (1974)	L	-	-	-	-	-
Meadow (1973)	S	-	-	S	-	-
Mealor, Perkins, and Reeves (1975)	-	-	-	-	L	L

Table A (continued)

Author(s)	Self Concept	Creativity	Attitude Toward School	Reading	Math	Language
Mills (1975)	S	-	-	S	S	-
Moore (1974)	S	-	-	-	S	S
Morris (1977)	-	-	-	-	L	L
Nixon (1973)	-	-	-	L	-	-
Nogrady (1975)	-	L	-	-	-	-
O'Neill (1974)	L	-	-	-	-	-
Ramey and Piper (1974)	-	L	-	-	-	-
Reeder (1975)	S	-	-	S	-	-
Reynolds (1974)	L	-	L	-	-	S
Riley (1976)	S	L	-	L	S	L
Robinson (1974)	-	-	S	S	-	-
Rothschild (1976)	-	-	L	-	-	-
Rozar (1976)	-	-	S	-	L	-
Sackett (1971)	S	-	-	-	-	-
Scheiner (1969)	-	-	L	-	-	-
Scheirer (1972)	-	-	-	-	S	S
Sewell (1975)	L	-	-	-	-	-
Shapiro (1971)	-	S	L	-	-	-
Shopland (1975)	S	-	-	-	-	-
Stowers (1974)	-	-	S	-	-	-
Travers (1974)	-	-	L	S	S	-
Trotta (1973)	-	-	-	-	L	-
Ward and Barcher (1975)	-	S	-	S	-	-

Table A (continued)

Author(s)	Self Concept	Creativity	Attitude Toward School	Reading	Math	Language
Weiss (1971)	-	-	L	-	-	-
White (1973)	S	-	-	-	-	-
Wright (1974)	S	S	-	S	S	-
York County Board of Education (1976)	-	S	S	L	-	-
Reynolds (1974)	L	-	S	S	-	-
Pine (1977)	L	-	-	L	-	-
Beil, Abrahamson, and Growse (1977)	-	-	-	S	S	-
Seidner (1978)	S	-	L	L	L	L
Angus, Beck, Hill, and McAtee (1979)	L	-	-	S	S	S

Note. "L" = large effect study

"S" = small effect study

"-" indicates that either the study was a medium effect study or did not report any results for that student outcome.

Table B

Measures Used for Student Outcomes[a]

Self Concept (n=32)[b]

(1) Attitude Questionnaire, Developed by Investigator, Jensen(1976), Personal Satisfaction Scale

(1) California Test of Personality, Sense of Personal Worth Scale

(9) Coopersmith Self Esteem Inventory, Academic Situation Scale and Total Score

(2) Gordon's How I See Myself, Academic Adequacy Scale, Interpersonal Adequacy Scale, and Total Self Concept

(2) Marolla Personal Competence, Inner Self Esteem Score

(7) Piers-Harris Children's Self Concept Scale, Self Approval Scale and Total Score

(2) Self Concept and Motivation Inventory (SCAMIN), Self Adequacy Scale and Total Self Concept

(1) Self Concept as a Learner Scale, Total Score

(1) Self Concept Measure, Rookey and Valdes(1972), Total Score

(1) Self Esteem, Developed by Investigators, Groobman et al.(1976), Total Score

(1) Self Social Symbols Task and Children's Self Social Constructs Tests, Ziller et al.(1971), Esteem Scale

(1) Student Self Image,Developed by Investigators, Abelson et al.(1974), Total Score

(1) The Institute of Child Study Security Test, "The Story of Jimmy," Security Scale

(1) Thomas Self Concept Values Test, Total Score

(1) Twenty Statements Test, Kuhn and McPartland(1954,1960), Scored for Self Derogation

Table B (continued)

Creativity (n=14)

(1) Group Test of Creativity, Metfessel et al. (1972), Total Score

(1) "How I Would Change My School" Essay, Scored for Creativity

(1) Pennsylvania Assessment of Creative Tendency, Rookey(1971), Total Score

(1) Test of Solving Puzzles, Kaya (1965), Divergent Thinking Score

(8) Torrance Tests of Creative Thinking, Total Score on All Scales

(2) Wallach-Kogan Creativity Measure, Total Uniqueness and Total Fluency Scores

Attitude Toward School (n=26)

(1) Attitude Questionnaire, Developed by Investigator Based on Schulman (1972), Environmental Satisfaction

(1) Attitude to Schooling, Developed by Investigator, Day (1974), Total Score

(1) Attitude Toward Learning Processes, Arlin and Hills (1975), Total Score

(1) Attitude Toward School Inventory, Developed by Investigator, Scheiner (1969), Total Score

(2) Attitude Toward School Questionnaire, Barker Lunn (1970), Total on All Scales

(3) Attitude Toward School Questionnaire, Klein and Strickland (1970), Total Score

(1) Classroom Self Perception Report, Developed by Investigator, Leroy (1973)

(1) ETC Attitude Toward School, Frieze (1972), Total Score

(2) Faces Test, School-Learning Scale

(1) Favorability Toward School, Paskal and Weiss (1971), Total Score

(1) Fitt Study of Attitudes, Scored for Attitude Toward School

Attitude Toward School (continued)

(1) Gordon's How I See Myself, Teacher-School Favorability Scale

(5) School Sentiment Index, Total Score and General Notions About School Scale

(1) Semantic Differential, Concept Rated: "School"

(1) Student Attitude Toward School Measure (SATSM), General Scale

(1) Student Attitude Toward School and Learning, Developed by Investigators, Groobman et al. (1976), Total Score

(1) Student Opinion Poll II, Getzels and Jackson (1962), School Scale

(1) Test to Measure a Child's Attitude, Tenenbaum (1940), Attitude Toward School Scale

Reading (n=34)

(1) A.C.E.R. Primary Reading Survey Test, Reading Comprehension

(2) California Achievement Test, Reading Total

(2) Canadian Tests of Basic Skills, Reading Comprehension

(1) Cooperative Primary Tests, Reading

(1) Edinburgh Reading Test, Total Score

(4) Gates-MacGintie Reading Tests, Reading Comprehension

(5) Iowa Tests of Basic Skills, Reading Comprehension

(7) Metropolitan Achievement Test, Reading Comprehension

(1) Peabody Individual Achievement Tests, Reading

(1) SCAT/STEP, Reading Total

(8) Stanford Achievement Test, Paragraph Meaning and Reading Total

(1) Wide Range Achievement Test, Reading

Table B (continued)

Mathematics (n=28)

(1) A.C.E.R. Mathematics Test, Money AM5

(2) California Achievement Test, Mathematics Total

(3) Canadian Tests of Basic Skills, Arithmetic Total

(1) Cooperative Primary Tests, Number Concepts

(6) Iowa Tests of Basic Skills, Arithmetic Total

(4) Metropolitan Achievement Test, Mathematics Total

(1) N.F.E.R. Mathematics Attainment, Mathematics Total

(1) Peabody Individual Achievement Tests, Mathematics

(7) Stanford Achievement Test, Mathematics Total

(2) STEP, Mathematics

Language (n=16)

(1) California Achievement Test, Language Total

(1) Canadian Tests of Basic Skills, Language Skills Total

(4) Iowa Tests of Basic Skills, Language Skills Total

(2) Metropolitan Achievement Test, Language Total

(1) N.F.E.R. English Progress Test, Total Score

(2) SCAT/STEP, English Expression

(4) Stanford Achievement Test, Language Total

(1) Written Expression I and II, Developed by Investigators, Angus et al.(1979), Total Score

Note. a Number in parentheses is the number of large and small effect studies in which that measure was used.

b Total number of large and small effect studies

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