NOISE, DISTRACTION AND PRIVACY IN CONVENTIONAL AND OPEN SCHOOL ENVIRONMENTS

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Introduction

Open, unpartitioned space has been used to accommodate large numbers of workers engaged in similar tasks - secretarial pools, machine shops etc. - in business and industry for years. Recently, open office"landscaping" has been employed in business organizations to accommodate several departments or divisions (including professional, managerial, technical and clerical personnel) in common open work space in an effort to improve communication, work efficiency and reduce building costs.[1] Similarly, school building design practices have also employed "landscaping" approaches in recent years, creating what are commonly called "open-space" schools.[2] Rather than a series of classrooms of equal size arranged along corridors or vertically in various levels, the open-space school is composed of larger areas lacking interior partitions in which the visual and acoustical separation between teaching stations and classroom areas is limited or eliminated.

Attempts to rearrange the interior space of the school building into other than standard size classrooms have come about during a period in which theory and practice in both education and architecture have changed.[3] Most open-space schools have been planned on the basis of new requirements brought about by new curriculum materials and equipment, new student and staffing organization and new time allotments for instruction and planning.

A common picture brought to mind by the term "open" is a large loft area, unbroken by interior walls, occupied by several class groups and their teachers. Actually open-space schools vary widely in design characteristics. While space becomes increasingly open as square footage increases and the use of partitions decreases open space buildings range from those that make extensive use of flexible partition systems and are commonly referred to as "modified" open space to those that do not have any floor-to-ceiling partitions and are truly "open."

The first open-space schools were a handful of "experimental" buildings, constructed 9-10 years ago, consisting of instructional areas equivalent to two to four classrooms in size. These have largely been stereotypical as "larger" self-contained boxes." Newer schools have a wide range of design configurations and some have open instructional areas equivalent to over 30 classrooms in size[4]. Surveys have revealed that over 50% of all new schools constructed within the last four years have been of open design.[5]

The Problem

Combining several class groups and teachers in open instructional areas has created a more complex task environment as many diverse activities occur simultaneously in common space, than has been the case in conventional classrooms designed for one teacher and one class group. Efforts have been made to reduce the effects of acoustically incompatible activities through zoning, separation by low visual dividers, cooperative scheduling among teachers and tighter control of student behavior. A recent study has shown that background noise, speaker-to-listener distance, speech effort, barrier attenuation and speaker orientation are significant variables that can be controlled in both the design and modification of the acoustical environment to insure proper speech communication and privacy in open-space facilities.[6]

It is questionable, however, if adequate acoustical control can be achieved equally in open offices and schools. The task environment of the office is much less complex. Comparatively the density factor is 7-8 times greater in schools, most tasks depend largely upon complex verbal communication patterns that take place in various size groups, there is frequent change in the composition, size and location of task groups and many tasks are performed with the aid of audio-visual equipment.

The fact remains that noise reduction between class groups provided by floor-to-ceiling partitions in conventional classrooms is lowered considerably in unpartitioned open-space schools; thus, teachers and students are subjected to a wider range of potentially disruptive acoustical stimuli.

Claims and counter-claims have been made by critics and proponents regarding noise in open-space schools. Critics claim that high noise levels, high distraction, and reduced privacy have adverse effects upon students and teachers. On the other hand, proponents claim that excessive noise is eliminated through the use of

carpeting and the constant background noise common in open space has a positive ubbering effect. Both sides readily cite ample anecdotal data - comments made by students and teachers - to support their arguments. There is, however, little systematic research data to indicate how noise affects teaching-learning activities or to what degree open space and conventional classrooms compare acoustically.

An extensive review of research comparing noise and task performance revealed few findings relevant to or generalizable to schools.[7] Most studies were highly controlled laboratory experiments utilizing subjects much older than elementary or high school students, employing tasks dissimilar to most learning tasks, or using distracting noise levels much higher than those normally found in schools. The presence of one or more of these factors in the studies cited make it impossible to draw definite conclusions about the relationship of noise and learning in school.

A survey of the acoustical environment of open and conventional classrooms was made when open-space planning was first employed in a small number of schools.[8] The "open" classrooms included in the study were simple modifications of conventional designs - classrooms not having doors, classrooms lacking corridor walls, or classrooms lacking separating walls. The five open classrooms lacking separating walls were approximately two equivalent classrooms in size, and of the 37 total classrooms in the study, only two were carpeted. Although noise measurements showed noise reduction to be generally lower in open rooms, noise levels were equal in open and conventional rooms. Staffing ratings of both types of rooms were also equal; most rooms were rated as "excellent" or "good." Those rooms receiving unacceptable ratings had severe acoustical defects.

Thus, in comparing open and conventional classrooms in 1963, acoustical measurements and staff ratings revealed few differences. It is questionalbe, however, to what degree these findings can be applied to contemporary open-space facilities. Further, little evidence has been obtained as to the effect of the open-space school upon the primary user - the student.

This paper focuses on the relationships between noise, distraction and privacy as perceived by students in open and conventional elementary and secondary schools. The effects of such factors as the nature of the educational program and classroom density upon student perceptions are also explored.

It is commonly assumed that high noise levels result in high distraction. Research has shown[7] that this assumption is not commonly supported. Several factors must be considered. First, the nature of the noise itself has different properties and is perceived differently; noise comes from many sources. Thus, different types of noise at the same intensity may have different effects. Secondly, not only are there different types of noise that may have disruptive effects, but there are also distracting factors not associated with noise, e.g., movement, crowding, temperature, etc. Third, the nature of the activity being performed may not require low noise levels for proper concentration. Fourth, perceptual levels vary with individuals. Thus, the first task was to determine to what extent noise levels were perceived differently by students in open and conventional space. The second task was to determine to what degree such factors as the type of educational program or classroom crowding (density) affect these relationships. Third was the task of investigating the noise-distraction relationship and to determine if students were distracted to a greater degree in open space. And a fourth task was to determine if open space results in reduced privacy for students.

Method

Sample

The elementary sample consisted of one-third of the 4th, 5th, and 6th grade boys and girls randomly selected from their home room groups in three schools - two open-space schools and one school with conventional classrooms. One of the open-space schools and the conventional schools were in the same school district. Both schools utilized the same basic curriculum and for the most part employed traditional teacher directed, group-based instructional methods. Although some teachers were in the process of encouraging greater student direction of learning activities, the programs in these schools were defined as conventional. The second open-space school employed a highly innovative program in which students were encouraged to work in small groups or individually without direct teacher supervision. Efforts were made to avoid whole class group instruction. As compared to the other two schools, the program was defined as individualized.

Both open-space schools were composed of instructional areas equivalent to four to six classrooms. Specific design configurations varied, however. All three schools were located in middle class suburban neighborhoods and served similar socio-economic populations.

The high school sample consisted of approximately one-third of all students in grades 9-12 enrolled in science courses in three

suburban high schools in the same school district. In two schools an independent study program in all courses had been implemented. Students worked on study packets using reference materials and then completed laboratory exercises. Students were free to move between study centers and laboratories and worked both individually and in groups. Teachers worked with students upon request. In one school, the study area consisted of a large open area furnished with tables, study carrels, and bookcases. In the other students used conventional classrooms as study centers. Laboratories in both schools were of conventional design.

The program in the third school was conventional in nature. Teachers directed normal class groups in both study and laboratory activities.

Procedure

A 23-item questionnaire was administered to the elementary students as part of a larger research study concerned with several envirnmental variables including noise, distraction and privacy.

Similarly 65-item questionnaires were administered to the high school students as part of a larger study investigating the overall effects of the independent study programs. However, additional measures were employed in the open science department including the measurement of noise levels, temperature, and humidity, and structured observation of student behavior.

Results and Discussion

Noise and Distraction

Students in the three elementary schools were asked to indicate how often "your classes are too noisy" and how often "you are distracted in class." The percent of students in each school reporting their classes were too noisy and they were distracted "most of the time" are presented in Table I.

The data show that if the activity levels are held constant - the two schools with conventional programs - almost three times more students (56%) in conventional classrooms reported their classes as being too noisy most of the time as compared to 19% of the students in open space. However, 54% of the students in the second open-space school with a program marked by a high degree of small group interaction, the use of a variety of audio-visual equipment and constantly changing activity patterns and groupings reported it was too noisy most of the time. On-sight observations indicated that noise levels were higher in the open-space, individualized school; noise levels seemed to be about the same in the two schools with conventional programs. The "quality" of the acoustical environments, not the noise levels seemed to be the most important factor, however.

The hard surfaces of the tile floors and walls in the conventional classrooms created highly reverberant conditions which did not lessen the multiple effects of constantly generated scraping noises such as chairs and feet on the floor, banging noises such as dropped books and conversational noises. Carpeting and the lack of classroom walls in the opne-space schools created better reverberant conditions and eliminated many noises. The major source of noise was from conversations and created a general acoustical background for specific learning activities. Thus, much extraneous noise was eliminated in the open schools and minimized the potentially negative effects of the high noise levels in the individualized program.

Table I also shows that perceived high noise does not automatically result in distraction among students. Approximately one-half as many students reported being distracted most of the time as compared to those reporting class was too noisy most of the time. It is also noted that some students reported noise was a problem, but were not distracted while others reported being distracted but did not feel it

TABLE I
NOISE AND DISTRACTION AMONG ELEMENTARY STUDENTS

	Individualized Program in Open Space (N=83)	Conventional Program in Open Space (N=67)	Conventional Program in Conventional Classrooms (N=74)
Class is too noisy most of the time	54%	19%	56%
Distracted most of the time	27%	9%	31%

TABLE II
SPECIFIC FACTORS CAUSING HIGH
DISTRACTION AMONG ELEMENTARY STUDENTS

Distracting Factor	Open Space/Individualized Program (N=83)	Open Space/Conventional Program (N=67)	Conventional Space/Conventional Program (N=74)
General Noise	30%	19%	33%
Students Talking	54%	66%	50%
Student Movement	16%	15%	17%

was too noisy.

Further analysis of those factors students reported distracted them "most of the time"(presented in Table II) reveals that the talking of other students, not general noise, is most distracting in all three schools. The percentage distributions of students reporting general noise as most distracting are similar to the percentage distributions in Table I. However, the school having the lowest perceived noise levels and general distraction, the open-space school with the conventional program, had the largest percentage of students distracted most by the talking of other students. This could be expected in comparison with the conventional school; as noted above noise in the open school was primarily that caused by conversation while noise in the conventional school was caused by many other factors. In comparison to the second open-space school with the individualized program, the difference can be explained in part by student expectations and acclimation. There is considerably more student conversation, but students are freely allowed and encouraged to engage in small group discussion. They were also more accustomed to working in this type of environment than the students in the open-space school with the conventional program.

The low and approximately equal percent of students reporting they were distracted most by movement seems to show that neither the type of space (open-closed) or the type of program (individualized-conventional) had an effect. This is somewhat surprising in light of the precent of students who reported they felt there was too much movement in their classes: 38% in open space with individualized instruction, 19% in open-space with conventional instruction, and 43% in conventional classrooms with conventional instruction. It would appear that acoustical distractions are more influential than visual factors.

To further study the question of whether noise is more of a problem in open space, student perceptions of distraction were compared in a high noise generating independent study high school science program carried out in open space and conventional classrooms. Students were asked to indicate to what degree they were distracted by general noise and activity during non-laboratory activities and during laboratory activities. A third school with a conventional science program carried out in conventional classrooms was used as a control.

The percent of students reporting they were distracted "very much" by general noise and activity during both laboratory and non-laboratory activities is presented in Table III. Almost three times more students in the independent study program in open space and conventional classrooms were distracted to a high degree during non-laboratory activities than were students in conventional classrooms with a conventional program. This was expected because of basic differences in non-laboratory activities in the two programs. Non-laboratory activities in independent study consist of student-directed research and study which is carried out in groups withhigh interaction over 50% of the time. On the other hand, conventional non-laboratory activities consist of teacher lectures and demonstrations with very little student-directed activity or interaction.

The low percent of students reporting high distraction during laboratory work in all three schools was surprising, however, as laboratory

TABLE III
HIGH SCHOOL STUDENTS REPORTING HIGH DISTRACTION
DURING TWO TYPES OF SCIENCE ACTIVITIES

Science Activities	Independent Study Open Space (N=445)	Independent Study Classrooms (N=332)	Conventional Program Classrooms (N=329)
Distraction during non-laboratory activities	26%	32%	11%
Distraction during laboratory activities	8%	14%	8%

TABLE IV
SPECIFIC FACTORS CAUSING DISTRACTION
DURING NON-LABORATORY ACTIVITIES

Distracting Factor	Independent Study Open Space (N=445)	Independent Study Classrooms (N=332)	Conventional Program Classrooms (N=329)
General Noise	22%	23%	7%
Presence of other students	15%	16%	10%
Student movement	10%	12%	5%
Student conversation - Science	9%	10%	12%
Student conversation - Social	29%	39%	24%

activities are largely student-directed, carried out in small groups, and marked by high interaction. Further, noise measurements averaged 65 dB in both the study center and laboratories in the open-space school. The low distraction during laboratory activities is attributed to basic differences in the two types of science activities, particularly in the independent study program. Laboratory work is largely task oriented, concerned with manipulation of equipment, while study activities require an extensive amount of reading and memorization using a high degree of concentration. It is noted that distraction was somewhat lower in open-space, lending support to the elementary findings and adding support to the notion that open space may be a superior acoustical environment.

Further analysis of the specific factors causing high distraction during non-laboratory activities is presented in Table IV. As expected the general noise level was a strong factor in the two independent study programs, but minor in the conventional program/conventional classroom school. This same relationship existed for two other factors that were also affected by the nature of the program - distraction caused by the presence of other students (density) and distraction by student movement; both schools with independent study had larger class sizes and unrestricted movement. However, distraction from the conversation of other students - both social and science-oriented - was not dependent upon the program and affected students about the same in all three schools, similarly to the elementary students. Social conversation was the factor creating the most distraction of all studied, with the largest percentage of students distracted in the conventional school with independent study.

Although the data show that acoustical factors seem to be most distracting, additional data from the open-space school point to a need for additional research. Students were asked to indicate to what degree they were distracted in the open-space science study center and a similar open-space facility - the social studies resource center. Activities in both were almost identical - a high amount of group interaction and work with reference materials. The noise levels in both areas were almost identical, ranging from 57-67 dB. The major difference in the two centers was the density - the science center was used as an assigned instructional space and provided 28 square feet per student, while the social studies center was used as supplementary space and provided 70 square feet per student. Consequently 31% of the students reported being distracted "very much" in the science center as compared to only 6% in the social studies center. Crowded conditions may amplify the effects of acoustical distractions, particularly if the major distracting factor is the social conversation of other students. Students may be able to cope with high noise levels if they can achieve greater physical separation.

Privacy

The open-space school has often been criticized because it affords students with little privacy. The elementary and high school data do not support this argument.

As a measure of personal privacy in the elementary schools studied, students were asked to indicate how often they were able to find an adequate place to study by themselves when needed. Over 50% of the students in the two open-space schools reported that they could find an adequate place "most of the time" as compared to 24% of the students in the conventional school. In considering the high noise

TABLE V
HIGH SCHOOL STUDENTS REPORTING INADEQUATE ACOUSTICAL
AND VISUAL PRIVACY DURING SCIENCE

Need	Independent Study Open Space (N=445)	Independent Study Classrooms (N=332)	Conventional Program Classrooms (N=329)
Acoustical Privacy	26%	29%	24%
Visual Privacy	27%	34%	40%

and distraction in the open-space school with the individualized program it would appear that distraction and privacy are independent factors. Further correlational analyses are needed.

The high school students were asked to indicate how often they were unable to find a quiet place for individual study and a place where they could not be seen by others - indicators of a need for acoustical and visual privacy respectively. The percent of students reporting they were unable to find either acoustical or visual privacy "almost all of the time" is presented in Table V.

Approximately one-quarter of the students in all three high school science programs indicated they did not have adequate acoustical privacy to do their work. It must be remembered that distraction from noise was over twice as great in the two independent study programs (see Tables III-IV). Fewer students in the open-space independent study program indicated a need for visual privacy as compared to the students in the two conventional schools. The students in the two independent study programs have considerably more personal choice as to where they could sit and also had a wider range of furniture to use including study carrels, particularly in the open study center. However, in comparing both open-space elementary and high schools with the conventional schools, the standard size classroom seems to provide students with far less opportunity to geographically separate themselves from their classmates; the lack of classroom boundaries in open space and additional common areas provide many more alternatives for choice of personal study space.

Summary

Contrary to popular criticisms, open space does not automatically result in higher noise and distraction or lower privacy as perceived by elementary and high school students. If program activity levels are held constant, open space may provide a superior acoustical environment through lowered reverberation conditions and the elimination of extraneous noise. This was particularly significant in comparing open and conventional elementary schools with conventional (low activity) programs.

A direct relationship between noise and distraction was not established. Analyses of specific distracting factors showed that "general noise" was not a good indicator as student perception was highly selective. Students were distracted most by student conversation - particularly social conversation. Furthermore, conversation was equally distracting in either open space or conventional space and in either high activity or low activity programs.

Differences in distraction were also found within general activity programs in the high schools studied. The differences between high and low activity programs were only significant for research and study activities; distraction was low and equal in laboratory activities.

Further analysis of two open-space study areas with equally high noise levels showed distraction to be significantly higher in the area with high density (crowded) conditions.

Open space provided students with greater privacy in both elementary and high schools with either high or low activity programs.

Notes

1. Lorenzen, Hans J. and Jaeger, Dieter, "The Office Landscape: A 'Systems' Concept," Contract Magazine, September 1968.

2. Educational Facilities Laboratories, Schools Without Walls, New York: EFL, 1965.

3. Educational Facilities Laboratories, Educational Change and Architectural Consequences, New York: EFL, 1968.

4. Brunetti, Frank A., ed., Open Space Schools Project Bulletin, School Planning Laboratory, Stanford University, March 1970, 7pp.

5. Brunetti, Frank A., Open Space: A Status Report, Memorandum #1, School Environment Study, School Planning Laboratory, Stanford University, August 1971.

6. Pirn, Rein, "Acoustical Variables in Open Planning," The Journal of the Acoustical Society of America, Vol. 49, No. 5 (Part 1) May 1971, 1339-1345.

7. SER 1: Environmental Abstracts, School Environments Research Project, University of Michigan, 1965.

8. Fitzroy, Dariel and Reid, John Lyon, Acoustical Environment of School Buildings, New York: Educational Facilities Laboratories, 1963.