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The development of new instructional organizations has placed demands on school facilities that cannot be met adequately with the procedures currently used for school design. Organizational methods, for example, that stress small-group and individual work in non-age-graded settings are not accommodated easily by either of the two common forms of school structures in the United States--the closed-classroom, eggcrate design, or the large, open-pod design. To improve the design of school facilities, a recording technique has been developed for gathering information on educational activities. A floor plan of a school that shows all areas that are potentially useable for school activities is labeled and the major characteristics of the spaces including equipment are recorded. For each activity observed, the location, duration, and equipment used are recorded, along with the type of activity and certain characteristics of the students and instructor. These data are then analyzed to yield information on instructional patterns, space and facility requirements, and student circulation. (Author)

Technical Report No. 391

OBSERVATION AND RECORDING OF EDUCATIONAL ACTIVITIES AS AN AID TO SCHOOL DESIGN

by

Richard L. Venezky

Report from the Project on
Organization for Instruction
and Administrative Arrangements

Wisconsin Research and Development
Center for Cognitive Learning
The University of Wisconsin
Madison, Wisconsin

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PREFACE

The objective of the work reported here is to improve the design of elementary and middle schools through a systematic analysis of the functions which these schools are to support. Central to this objective is the analysis of existing and projected pedagogical methods in an effort to derive design specifications based on such physical needs as working spaces, storage, and student circulation.

The projected end product is a guide which relates organizational methods such as team teaching and multi-unit grouping to spatial needs, so that for a given number of students and a given organizational plan, an architect can derive the number, types, and sizes of spaces which are required, the storage and student circulation requirements, and other physical parameters which are essential for functional design. The desire here is not to dictate pedagogy, nor is it to design schools directly, but instead to provide guidelines for the design of educational facilities so that the physical forms will not constrain educational functions.

This report summarizes an approach to collecting data on space utilization in elementary schools. Techniques for translating these data into design criteria for remodeling existing structures or for building new schools will be discussed in a forthcoming report.

ABSTRACT

The development of new instructional organizations has placed demands on school facilities which can not be met adequately with the procedures currently used for school design. Organizational methods, for example, which stress small-group and individual work in non-age-graded settings are not accommodated easily by either of the two common forms of school structures in the United States--the closed-classroom, eggcrate design, or the large, open pod design. To improve the design of school facilities, a recording technique has been developed for gathering information on educational activities. A floor plan of a school which shows all areas that are potentially useable for school activities is labeled and the major characteristics of the spaces including equipment are recorded. For each activity observed, the location, duration, and equipment used are recorded, along with the type of activity and certain characteristics of the students and instructor. These data are then analyzed to yield information on instructional patterns, space and facility requirements, and student circulation.

I

INTRODUCTION

Primary and secondary education in most advanced countries has reached the point where coordinated planning of curriculum, staff, and facilities is required for both effectiveness and efficiency. Attempts to offer the maximal opportunity for all children to participate in learning experiences which are suited to them have led to greater complexities in curriculum development, scheduling, and staff training, and to greater demands upon physical facilities than ever before. If the physical structures themselves are not to be a major constraint upon the education procedures which they are to support, then basic facility design must be derived from analyses and projections of teaching methodologies. This requires not only collection of data on what actually occurs (or is planned to occur) in classrooms and schools under different organizational plans, but also translation of this information into space needs. These are the main concerns of this study.

If pedagogy throughout the world were to continue to be dominated by self-contained classrooms and traditional teaching techniques, then this study would have little potential value. However, in most countries there is a strong movement away from teacher-dominated instruction, and a smaller, but equally significant movement away from the self-contained classroom. Several attempts have been made in the past few years to evolve instructional methodologies which are well-defined in terms of pacing, grouping, or evaluation (see Glaser, 1970, and Klausmeier, in press). Nevertheless, it can already be observed within the more successful non-traditional schools that lack of appropriate instructional spaces along with inadequate furniture and storage within the existing physical structures places serious burdens on teaching methods.

To base instruction on the personal needs of students requires at a minimum that the teacher be able to vary with ease his/her instructional organization from large group to small group to individual, with frequent restructuring of groups. Under most new instructional organizations, primary emphasis is placed on small group and individual work, with large group meetings reserved primarily for non-instructional work. But how does a teacher in grade 1, for example, with 30 students, manage a class if a major part of the class time is spent working with one to five students? How are the remainder of the students supervised while the teacher instructs a small group? One approach commonly used is to assign a half-time aide to the teacher. Under this plan the aide can manage a large group of students while the teacher instructs a smaller group. But the aide generally cannot do the same instructional tasks which the teacher can do, which means that the teacher can engage in small group instruction only when the remainder of the class does not need professional instruction, i.e., when the aide can monitor, read a story, or the like. Thus organizational variation is limited in a self-contained classroom, even with an aide (on this point see especially Clinchy [cited in Oddie, 1966]).

To achieve a higher degree of variation, whole classrooms must be arranged so that a group of teachers (plus aides) can work as a team. Assume, for example, that two grade 1 classes (70 students) work together as a unit with their two teachers, plus a single full-time aide. During the times the aide can monitor both classes, the teachers can work with small groups or individuals. During other times of the day, one teacher can instruct a large group while the other teacher works with a small group and the aide either does administrative work or monitors a third group in the class. Even when the two teachers work with their separate classes, the aide can monitor individual work. Besides the added efficiency gained by combining the staffs of the two classes, there is an additional gain in that some duplication of small group instruction is removed. In the self-contained classroom plan, on the other hand, students in different classrooms with identical problems might receive separate instruction. In a combined plan, these students could be instructed in the same group.

Further efficiencies can be gained by grouping three or four classrooms on the same level into a single unit, or by grouping across grade levels as is done in the multi-unit school plan (Klausmeier, in press) and in some infant and primary schools in England. However, most existing schools in the United States contain closed classrooms arranged along corridors and therefore do not allow efficient cross-class groupings. Even attempts to vary study arrangements within the class through creation of study corners and floor seating have been severely limited by small room sizes. A major increase in classroom size would allow each teacher to create micro-environments for variable instruction. However, much less space is required to achieve the same ends when groups of classes share different types of specialized spaces. In addition, cooperation between teachers can lead to greater ability to attend to individual needs.

The design of such facilities, however, requires careful analysis of the teaching methods which are to be used to ensure, _inter alia_, that the proper ratios of large, small, and individual spaces are obtained and that storage and circulation areas are adequate.[1]

The alternative to relating school design closely to educational methodology is to build such large and flexible structures that any arrangements of spaces could be obtained. The only general plan which attempts to do this is the open school which was developed in the United States (EFL, 1965; AASA, 1971). However, there is sufficient evidence now to show that such structures are both more expensive than more conventional designs and also considerably less functional than previously thought (Martin & Pavin, 1976).[2] Among the problems inherent in completely open facilities is the lack of accessible private and semi-private spaces for small group activities and the excessive burden placed on the teacher in moving furniture and partitions. Flexibility generally involves added costs and sacrifices in efficiency. The question in designing efficient and inexpensive educational structures, paradoxically, is not how much but how little flexibility to build in. Closed classrooms arranged along wide corridors clearly have too little flexibility; giant open pods appear to have too much. The range of flexibility which is desired between these extremes remains one of the most important questions to be answered.

The concern of the present report is with systematic procedures for the design of useable and cost-effective schools. It presents a general plan in four phases for achieving this (Section II), and elaborates on one component of this plan--the collection of observational data for determining instructional group sizes and patterns (Section III). Some suggestions are given in a concluding section (Section IV) on how observational data can be transformed into useable information for architectural design, but these suggestions are far from exhaustive.

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[1] Improved architecture is a necessary but not a sufficient condition for organizational variation. The other major component is improved instructional systems, with their corresponding student management and teacher training components.

[2] Data on floor space per student, costs, and utilization of open schools can be found in Bregar, 1973. For a general discussion of spatial needs and costs in school construction, see Oddie, 1966.

II

THE DESIGN PROCESS

The four phase plan presented here for the systematic design of complex educational facilities is a proposal for achieving efficient and effective school designs. It conceives of the planning, design, and testing of a facility as a cooperative venture of administrators, educators, and architects. It furthermore requires that a design incorporate a variety of considerations beyond the allocation of differentially labeled floor space, including storage, circulation paths, noise baffling, and furniture. Each phase generates information which serves as input to the succeeding phase and as evaluation criteria for the final design. This information will be entered on standard forms and stored in the Facility Planning Book so that (a) it is accessible to everyone who is concerned with teachers who will be assigned to it, and (b) it can be used as a guide for the planning of related facilities.

PHASE 1: PRIMARY DECISIONS (See Figure 1)

Administrative Decisions

Location. The planning of an educational facility begins with a decision at an administrative level, e.g., municipality or Ministry of Education, that a facility is needed in a certain location. Location, although geographic, is also demographic, in that children of certain ethnic, social, and economic backgrounds are expected to use the facility. The proper specification of these factors is essential for the later decisions which must be made on educational organization, especially as more and more evidence is compiled on the differential responses which children from different backgrounds make to educational methods.

Age Distribution. With the location decision should be a projection over at least a ten-year period of the numbers of children who will be entering the school at each age level for which the school is to be designed. Knowing the maximum number of children who will enter is usually not sufficient; design decision will depend upon whether the average age in the neighborhood is increasing (e.g., inner urban), remaining constant (e.g., suburban), or decreasing (e.g., urban fringe).

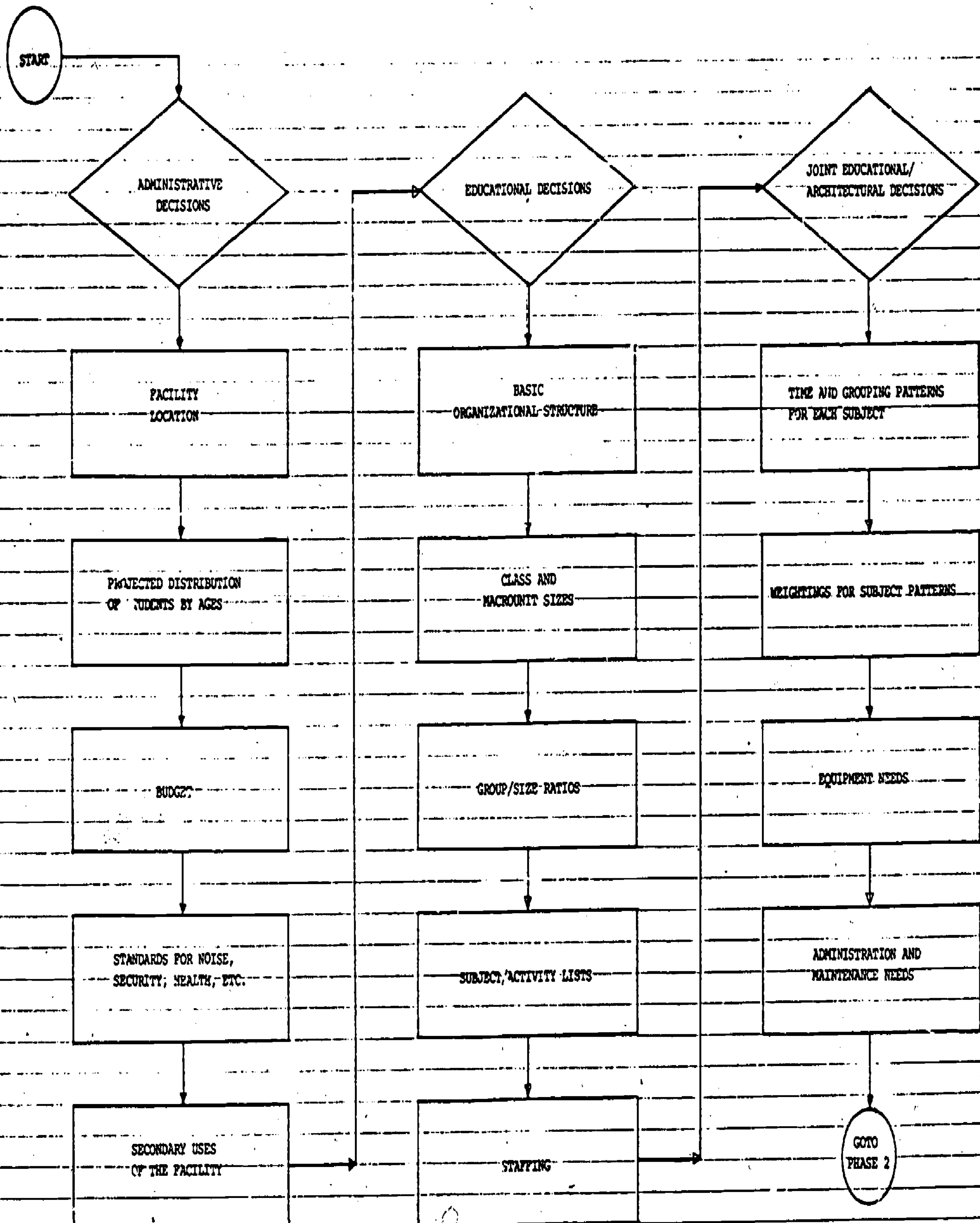


Figure 1. Phase 1: Primary decisions.

Budget. Budget constraints are often difficult to compile, yet obviously are essential for avoiding unrealistic designs. Included in any budget must be (at a minimum) costs or percentages for site acquisition and preparation, design and construction, and furniture.

Standards. Standards, like the budget, provide design constraints, either positively (spaces or facilities which must be present) or negatively (practices which are not allowed). These standards are a combination of general building standards (e.g., protection of electrical wiring) and specially designed educational standards (e.g., specification of a principal's office).

Secondary Uses. Some educational facilities are designed for specific secondary uses, such as neighborhood sports facilities or adult evening classes. Specification of such uses is a responsibility of the same administrators who initiate the facility design.

Educational Decisions

Once the primary administrative decisions have been made, a series of educational decisions is required. Ideally, these would be made in collaboration with the principal-designate, the area curriculum director, supervisors, teacher representatives, and parents. In practice, these decisions are usually made by Ministry-level personnel, although the input of principals, teachers, and supervisors at this point often helps to avoid major blunders.

Basic Organizational Structures. For reasons of cost and utility, it is recommended that educational facilities be designed for a limited number of well-defined educational organizations, and not for all possible educational plans. Facilities advertised as completely flexible are seldom as flexible in practice as in plan, and usually are built at an increased cost and lower utility than more specifically designed facilities. Educational organization includes such plans as team-teaching, multi-unit grouping, and individualized instruction, but these must be defined in sufficient detail that a prototypic schedule can be generated.

Sizes. Once an educational organization, or range of organizations, is designated, its implications for instructional grouping must be defined. For team teaching, for example, the maximum number of teachers in a group must be defined, thus giving a macrounit. Then, the sizes of the units which each teacher will manage (class) must be defined. Under some plans the lower elementary grades may be grouped differently from the middle grades. If so, the organization of each must be specified. All of these sizes are typically defined in terms of management or supervision, that is, by the numbers of students who will be affected by decisions at each major decision-making level.

Group/Size Ratios. Once decision-level sizes are determined, instructional sizes must be fixed. These are the ratios of time which children are expected (or desired) to spend in groups of various sizes: individual, small group, large group, class, and macrounit.

Subject Activity Lists. For groups at one or more decision levels (e.g., class, macrounits) lists are compiled of the curriculum subjects and other activities (e.g., math, reading, gymnastics, lunch) in which the groups will engage. Included with each subject or activity is the average amount of time needed, and any other characteristics which might affect the times during which it could be scheduled.

Staffing. The numbers and types of personnel who will use the facility are specified, along with the decision-level groups to which they are assigned or with which they will come in contact.

Joint Educational/Architectural Decisions

These are decisions which are basically educational in nature, but which require collaboration between the educational planners and the architectural planners for adequate definition.

Time and Grouping Patterns. The various general grouping plans which might be used for each curriculum subject are described in terms of group sizes, time, and supervision.

The physical interpretation of such terms as team teaching, activity-oriented teaching, and individual instruction should be evident from these patterns. The most important source for these patterns is observation of instruction. However, when suitable sites for observation are not available, patterns must be projected, based upon teacher and curriculum developer estimates of the way in which a particular plan might be implemented.

Weightings. For each subject-pattern defined, a weight is assigned, which describes the usage of that pattern relative to the other patterns for the same subject.

Equipment Needs. The types and quantities of instructional and secondary equipment which are desired, excluding heating, air-conditioning, and the like, are described here.

Administration and Maintenance Needs. Defined here are space types for administration and maintenance, including materials preparation, parent and staff meetings, visiting specialists, and storage.

PHASE 2: DATA BASE GENERATION (See Figure 2)

The information compiled in Phase 1 is used for generating architectural space modules, that is, basic design units for the age levels of children involved and the kinds of activities in which they will be engaged, and a prototypic schedule which shows a typical

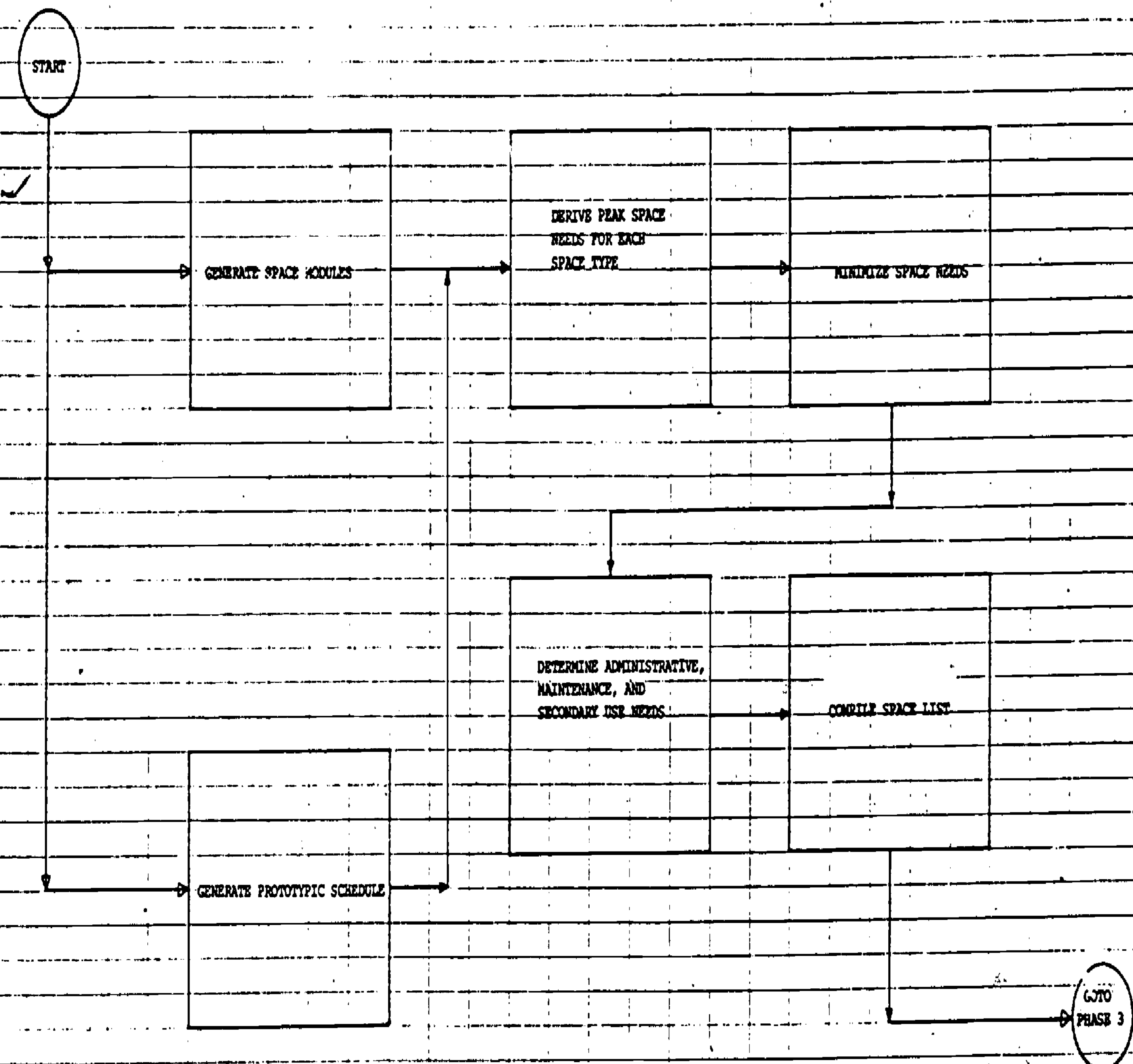


Figure 2. Phase 2: Data base generation.

major cycle (week, fortnight, or month), and the period-by-period, and day-by-day activities which would occur. Once the space modules and prototypic schedule are developed, space needs are derived, and then minimized. Finally, administrative, maintenance, and secondary-use needs are defined and a complete list of spaces compiled.

Generate Space Modules. These are developed from human dimension data and furniture sizes for such applications as sitting on a floor and sitting at a desk or table.

Generate Prototypic Schedule. The prototypic schedule is probably the most complex component in the entire design process, yet it is essential for both design and evaluation. It is developed from (a) the group/size ratios, (b) the class and macrounit sizes, (c) the subject/activities list, and (d) the time and grouping patterns (with their weights). Included in this schedule for each time unit are the subjects to be taught, the sizes and types of groupings to be used for each, and the supervision and space-time required.

Derive Peak Space Needs. At each point where space needs change, the total number of spaces of each type and size (defined by the space modules) is summed. The peak needs for each size and type, along with the minimum and average needs, are then summarized.

Minimize Space Needs. Two procedures are used to minimize space needs: (a) shifting of activities to a higher level space (e.g., from a desk space to a table space), and (b) permuting the schedule within the constraints previously established (e.g., math must be taught in the morning).

Determine Administrative, Maintenance, and Secondary Use Needs. The special requirements for administration, maintenance, and secondary use are brought in at this point.

Compile Space List. Finally, a complete inventory of space types and sizes is compiled.

PHASE 3: PRELIMINARY DESIGN (See Figure 3)

In this phase the space list compiled in Phase 2, plus general design constraints derived from Phase 1 decisions are incorporated into an initial facility design.

Configure Basic Macrounit. The first step in design is to configure the macrounit (or units). This might be a traditional class, but probably will be a larger unit encompassing two to four class-like subunits.

Incorporate Other Spaces. The spaces derived from administration, maintenance, and secondary use needs are added to the basic macrounits, along with any additional spaces required for health, sanitation, or security. The result is a crude floor plan.

Allocate Storage Areas and Circulation Paths. The amount of storage and its location is often crucial for the proper utilization of a facility. If, for example, student storage is within desks rather than in common storage areas, the ability to share the desks across different groups is severely limited. Circulation paths, similarly,

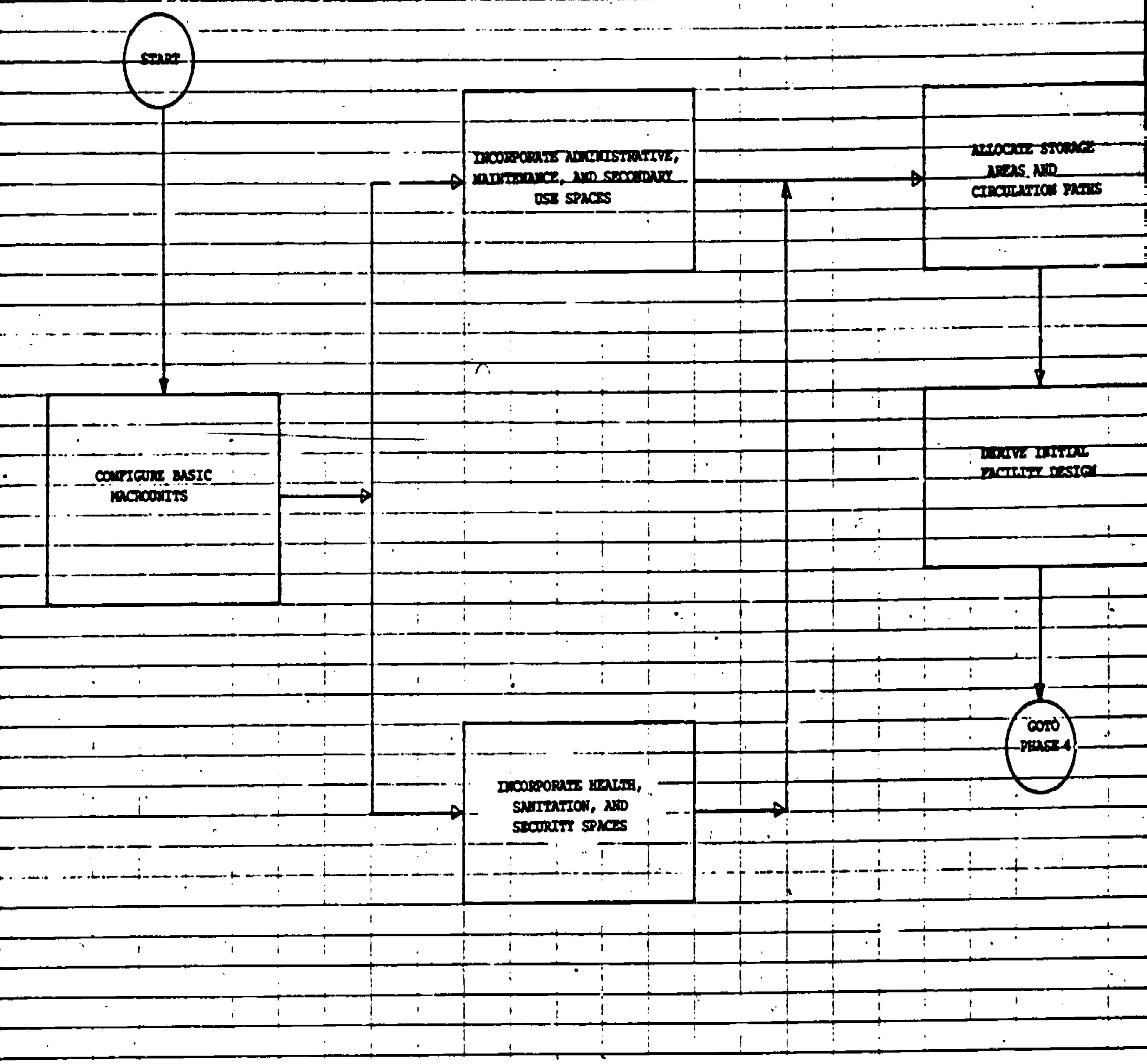


Figure 3. Phase 3: Preliminary design.

must be arranged for minimal interference with instruction and in general are derived from an analysis of the prototypic schedule and from observational data.

Derive Initial Facility Design. The result of Phase 3 processes is an initial design for the entire facility.

PHASE 4: SIMULATION/TESTING (See Figure 4)

The prototypic schedule is simulated in the initial design and the results used for design changes. Once a satisfactory scheduling fit is made, the final elements of the design are added, yielding the final design.

Simulate Prototypic Schedule. This involves a period-by-period assignment of groups to spaces within the structure, with accompanying analysis of circulation, distraction, and storage. For complicated designs, computer simulation is advisable. When scheduling conflicts are detected, changes are made either in the design or in the schedule, and the simulation repeated. This cycle continues until a satisfactory fit is found.

Specify Furniture and Equipment. The types and sizes of furniture, the environmental control equipment, and the acoustical treatment are specified, thus yielding a final design.

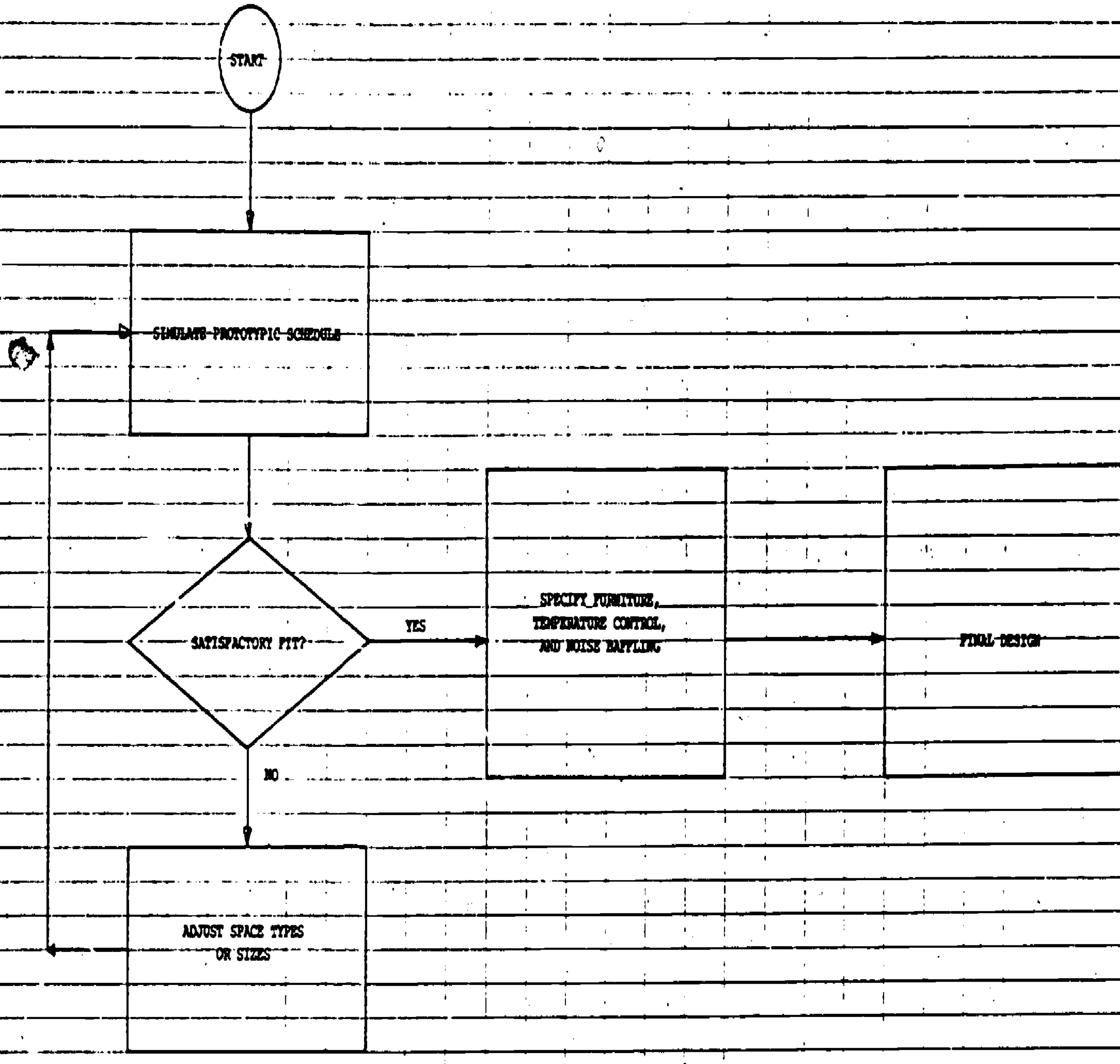


Figure 4. Phase 4: Simulation/Testing.

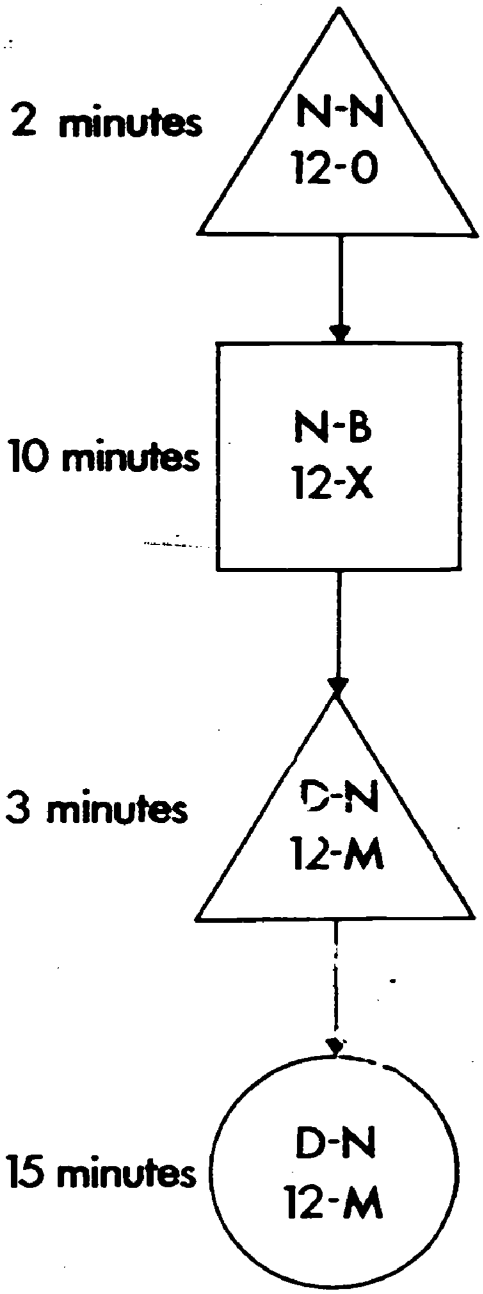
III

DATA COLLECTION

GOAL

The goal of the procedure described here is to characterize the various functions which occur or should occur in educational facilities so that these functions can be translated into physical requirements. Functions is meant to include both administrative activities (e.g., teacher meetings, visiting nurse, food service) and curricular activities. For the latter category we attempt to characterize each teaching method in terms of sizes of groups, types of lessons, and materials required. For example, a writing lesson may begin with two minutes of preparation time, during which 12 children without any personal materials come into a space, find seats and are then ready for instruction. A teacher explains for 10 minutes, using a blackboard, how to do a workbook page; then the children go to a common storage area, take out their workbooks, and return to their seats where they work individually while the teacher monitors them. As each child finishes, he or she returns the workbook to the teacher and leaves. The last child requires 15 minutes to conclude the work.

One way to diagram this sequence of activities is shown in Figure 5. The shape of a box indicates the grouping type: triangular for unorganized or transitional, rectangular for a single group, and round or oblong for individual work. Within each box the first line identifies the personal space needs and the group materials. The second line designates the number of students and the type of supervision. If the activity is inherently distracting to other groups around it, this is noted at the bottom of the box. The duration of each phase is written to the left of each phase enclosure. Within this record we have all the information required for assigning the lesson to a different space or set of spaces. For example, since the children do not need surface space for personal materials during phases one and two, these phases could be assigned to a rug area in front of a blackboard. However, phase three requires a desk top for each child. It could be assigned to either individual desks or to tables. Thus, a possible space assignment for this writing lesson could be initial presentation (phases one and two) in a rug area and then individual work in a common seating area, even with other groups present (so long as there is no inherent distraction). Since the teacher monitors phase three, the students could not be placed in physically separate spaces.



Twelve children enter space and find seats.

Teacher uses blackboard to explain a new work page. Children watch without books, papers or pencils.

Students locate their workbooks in a common storage area and return to their seats.

Students work individually while the teacher monitors their work.

Figure 5. Writing lesson in an activity-oriented first grade.

From repeated observations of similar lessons, plus discussions with teachers, the different patterns for lesson writing would be developed. Similarly, characterizations of the other curricular components would be developed so that for an entire method, a typical activity schedule could be constructed and physical requirements derived.

LIMITATIONS

The functions which occur in a school building are often quite difficult to characterize, especially if they must be observed in spaces which are not adequate for them. This is precisely the problem in observing teaching methods in open pods. We might observe in particular classrooms, for example, that children are frequently placed in clusters of six. Without further probing we are tempted to characterize this teaching approach as groups composed of six students each. However, more careful observations might reveal the the groups of six rarely work as units. Further observation might reveal that because of the existence of a standard, two-student desk in such classrooms, plus limitations on classroom space, clusters of three desks are very practical arrangements for small groups, although groups of four or eight children do occur. (Four such desks are difficult to arrange as a group and at the same time allow each student to attend easily to a common, external focus such as a teacher or blackboard. Two-desk clusters, on the other hand, require more circulation space than can be provided in most classrooms.)

Obviously, there are practical limitations on the quality and accuracy of data which can be collected in a school. We cannot afford, nor can we justify, a complicated sampling procedure which would stratify along such variables as climate and age of school, beside the more justifiable parameters such as socio-economic level and size. Nor can we justify year long observation within classrooms. Hence, data collection for teaching methods must be focused on those schools which can provide representative data of an adequately-implemented plan.

RECORDING OF CLASSROOM ACTIVITIES

The techniques described below were developed primarily in Israel for observation of elementary schools. However, they are based on work performed in the United States by the present author and his colleagues (see Bregar, 1973). They differ from most other observation techniques (see Biddle, 1967, and Weich, 1968) in their focus on the interactions of humans with spaces rather than on the interactions of humans with each other.

Form

Activity records are made of classrooms or other spaces within schools. From the floor plan of the school and from current measurements made in the classroom, an architect prepares a drawing of the room (or spaces) to be observed, assigns labels to all subspaces in which activities could occur (Figure 6) and records the physical characteristics, including furniture, of each subspace. An observer then records activity information directly onto the form shown in Figure 7. The various types of information recorded on this form and the instructions for its use are given in the Appendix.

The selection of information types to include or not include in the observation record was guided by one basic question: "What information is needed to reassign the activity to a different space?" Accordingly, certain types of information, such as student circulation patterns and seating arrangements within groups are ignored while such information as distraction and supervision is included. Generally, subjective decisions are avoided; however, some are required, as for example, in deciding whether a small group of children who talk occasionally to each other function as a group or as individuals. Often the teacher's opinion can resolve such a question, but not always.

Training of Observers

Observation in the United States and Israel has been primarily by graduate students who had no prior experience in observing classroom activities. A week-long training program for observers was developed with the following components:

1. Introduction to the purposes of the research project and to the role of direct observation.

2. Review of the floor plan, space descriptions, and observation forms.

3. Detailed review of the observation instructions (Appendix) and of problematic situations encountered in pilot testing. Emphasis in this phase of the training placed on the logical basis of the observational procedure.

4. Observers given filled out observation records and asked to explain from the record (and space descriptions) what happened in the classroom.

5. Sample classroom situations described and the observer attempts to code them.

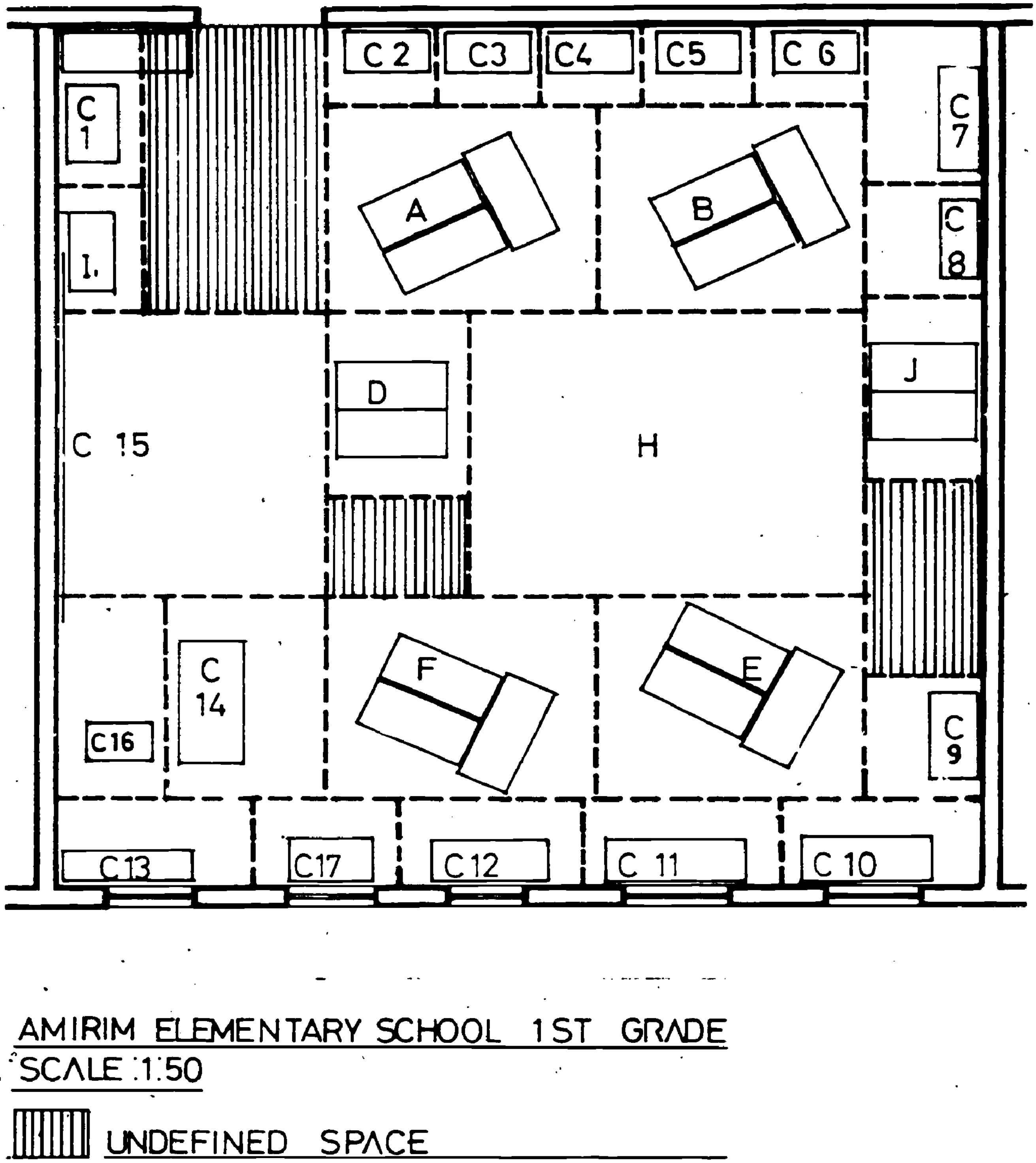


Figure 6. Floorplan of a classroom.

EDUCATIONAL ACTIVITIES RECORD

School name ______________________ Address ______________________

Space ______________ Date ________ Observer ________ Code ______________

Place	Time			Students			Instructor Roles		Resources		Comments
	Start	End	Organ.	Total	Interaction	Subject	Teacher	Aide	Space	Other	

Venezky/Even 1975

Figure 7. Educational activities record.

6. Observers go with a member of the staff to a classroom and record for a minimum of two hours.

7. General meeting of all observers and staff personnel held to discuss the observation procedure.

8. Records for the first few days of observation reviewed by the staff and corrective feedback given to each observer.

IV

DATA ANALYSIS

A variety of different approaches has been tried for summarizing and analyzing school observational data. Figure 8 shows a space utilization chart for a medium-size classroom at the second grade level in an Israeli school. This class uses an activity approach to instruction, which is immediately evident in the number of small groups which occur and the amount of individual work. For each activity, the first line gives the type of interaction among students (G=group, I=individual, U=unorganized), the second line encodes the equipment and space needs of each student (first symbol) and of the group as a whole (second symbol). These codes are defined in the Appendix under Resources (e.g., T=table top, C=center materials). The third line gives the number of students in the group (first symbol) and the type of supervision (second symbol). For supervision, M=monitored, X=none, and Ø=teacher participates. This example represents an earlier version of the observation scheme outlined in the Appendix. Therefore, the symbols and classifications are not identical.

The space utilization chart is usually done as a preliminary step in data analysis. Since many coding errors and inconsistencies are revealed through the process of filling in these charts, the charting procedure serves as a partial validity check on the data. The chart itself also gives a visualization of space utilization, group sizes, and activity patterns which is not evident in the line-by-line observational data.

A second display procedure is shown in Figure 9 for a first grade of 90 children. This type of display does not retain location information, but uses different shapes to indicate variations in interaction.

Quantitative summaries are usually the next step in data reduction, but these will vary according to the purposes of the original observation. In the Bregar (1973) study, for example, a computer model was being constructed for simulating activities in various types of spaces. Therefore, the significance of the differences found between various parameters was important and consequently statistical tests (e.g., chi-square, analysis of variance) were applied to his data. Shown in Figures 10 and 11 are two summaries from the Bregar study of a large, open-pod school in Janesville, Wisconsin.

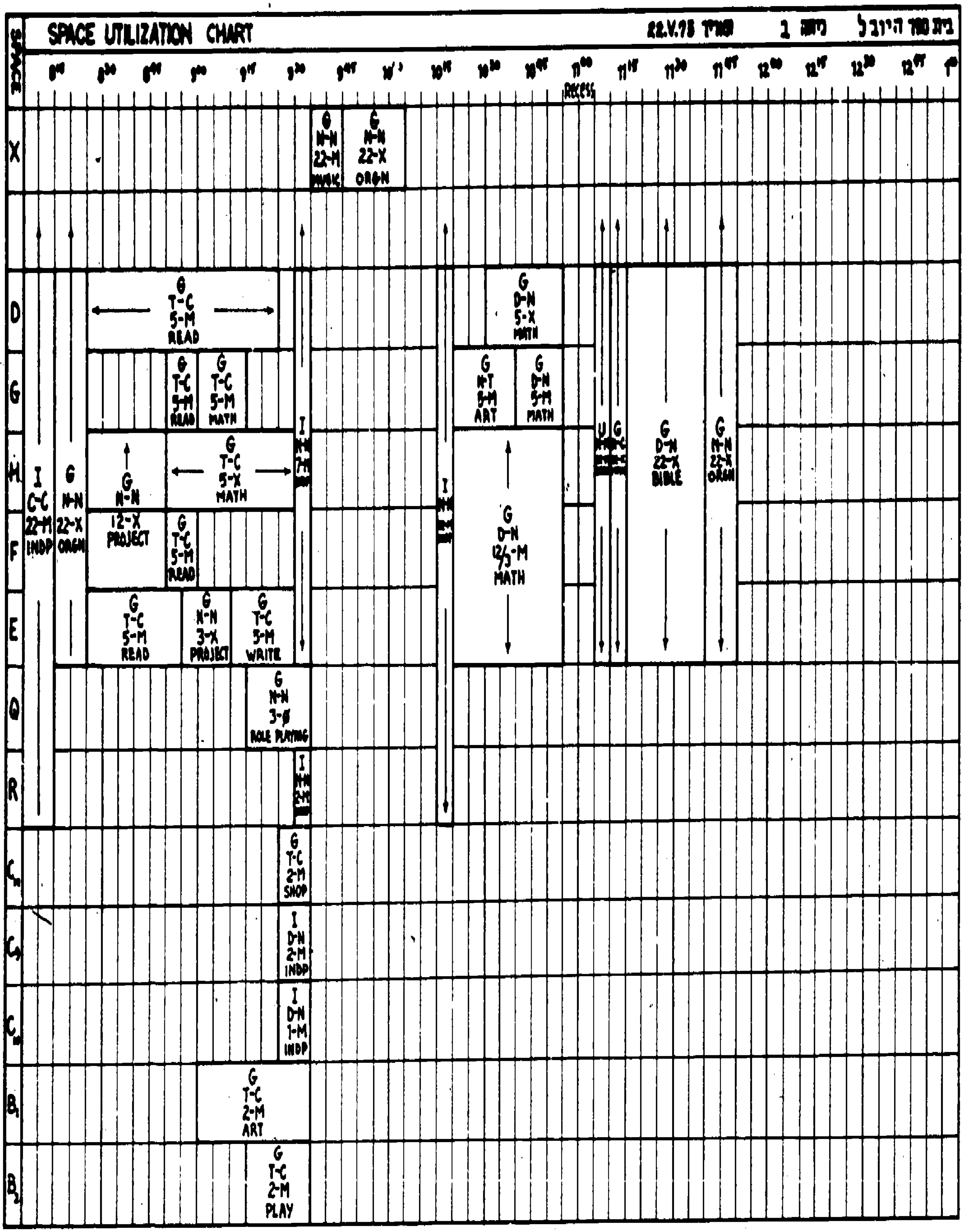


 Figure 8. Space utilization chart.

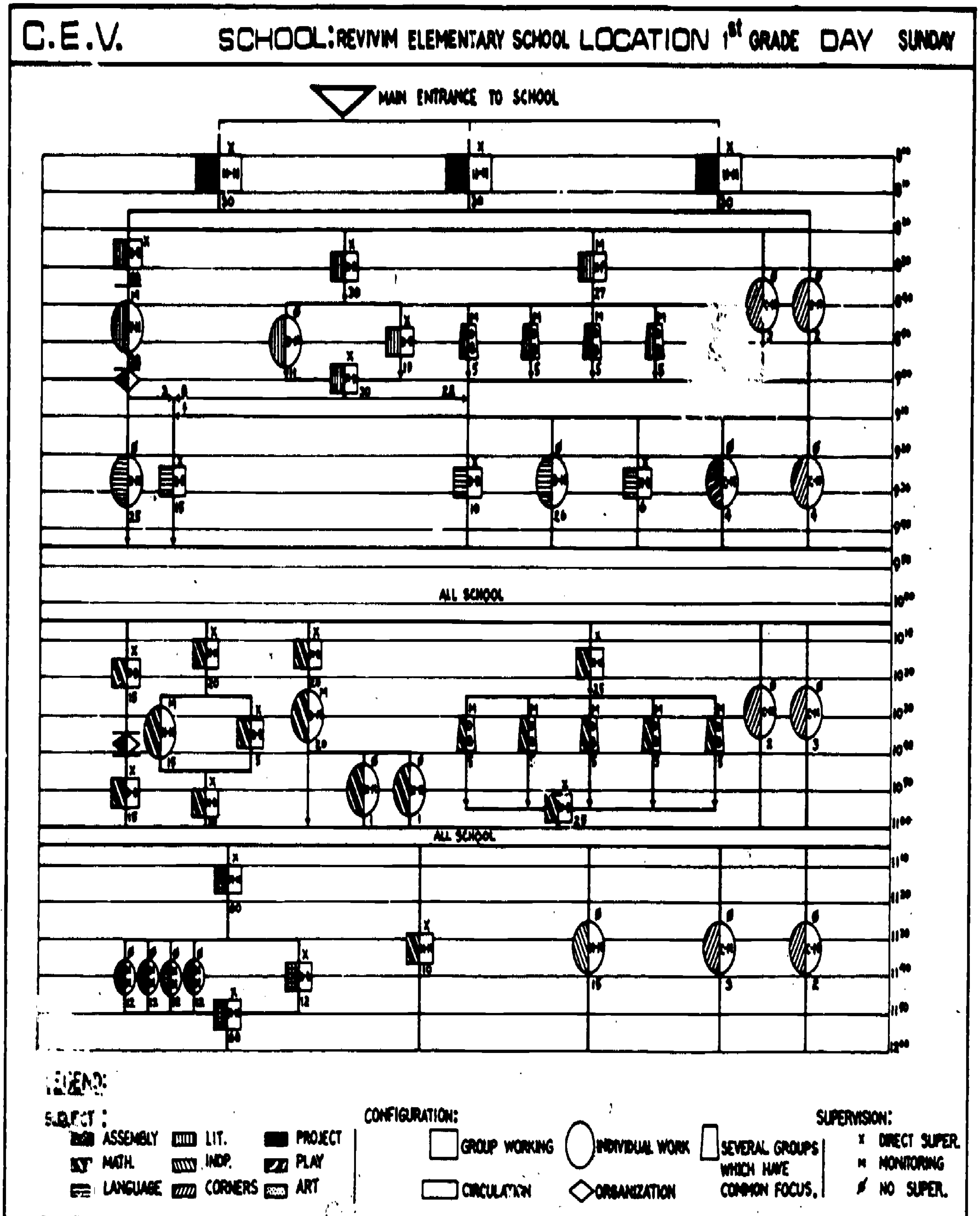


Figure 9 Diagram of activities in a large first grade classroom.

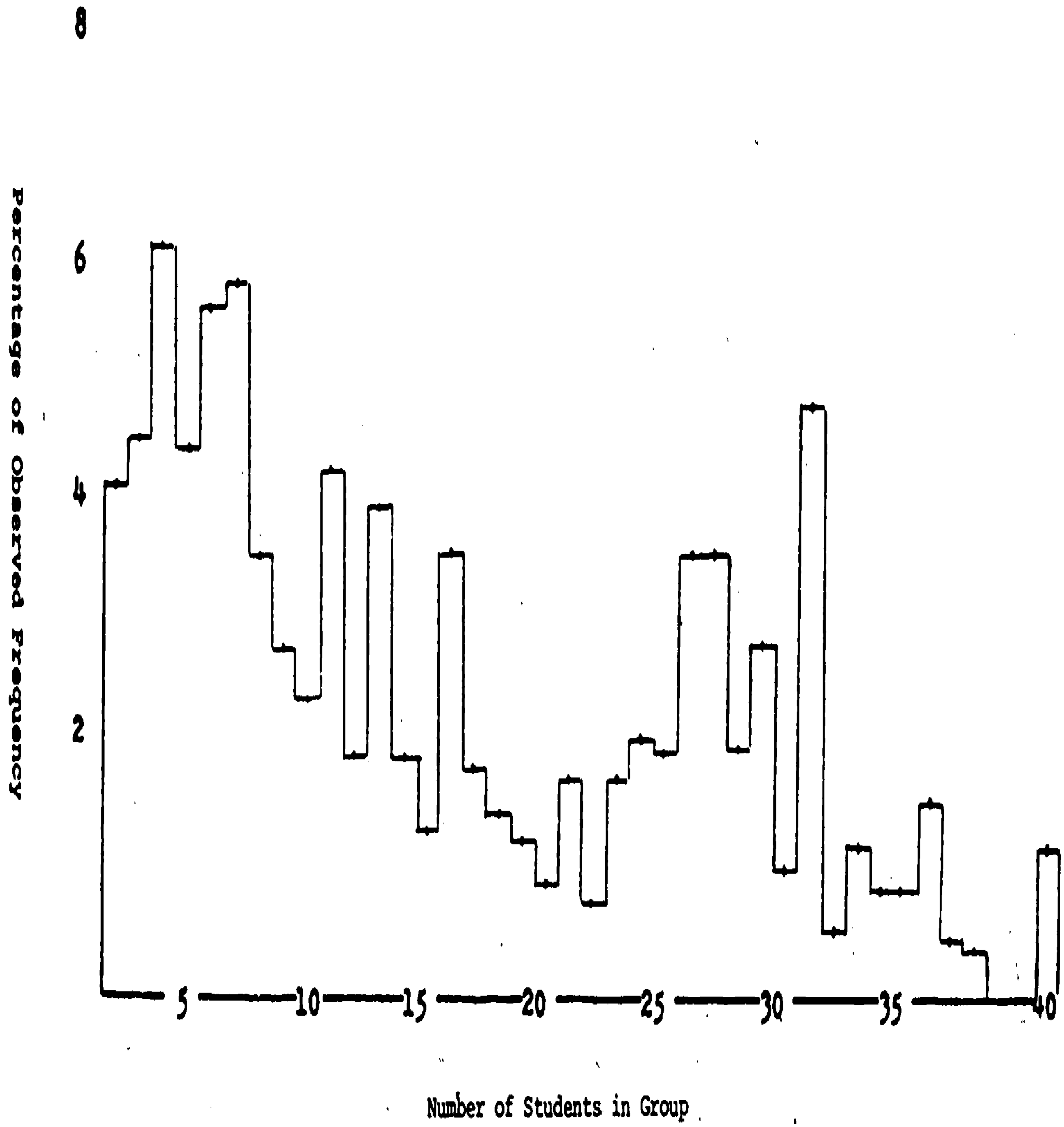


Figure 10. Percent of observed frequency of group sizes.

GROUP SIZE		ART	ACTIVITY* LANGUAGE ARTS	MATH	SCIENCE	OTHER
1-6	Count	11	82	13	3	11
	% Col	25.00	40.00	33.33	5.26	13.25
	Mean Groupsize	3.6	3.6	4.1	3.6	3.75
7-16	Count	8	70	8	14	17
	% Col	18.18	34.15	20.51	24.56	20.48
	Mean Groupsize	12.5	11.4	11.3	10.3	10.7
17-35	Count	15	43	12	33	22
	% Col	34.09	20.98	30.77	57.89	26.51
	Mean Groupsize	28.09	25.2	24.1	25.8	24.0
35+	Count	10	10	6	7	33
	% Col	22.73	4.88	15.38	12.28	39.76
	Mean Groupsize	52.9	96.2	46.0	106.3	96.4

*Enough observations or art were made at School A to be included in the figure.

Figure 11. Observed frequencies of group size/activity for School A.

Figure 10 shows percent of observed frequency of group sizes, summed over activities and days. Figure 11 shows a summary of group sizes by activity. Figure 12 shows a plot of observed frequency of square feet per student for three different types of schools, and for the open pod school represented by Figures 10 and 11. These figures are presented here to represent types of summaries which have been done with observational data. They are not meant to be meaningful within themselves.

The final type of data analysis, which has yet to be worked out, is an estimation of the maximal space needs for a school, based on observational data. One approach to this problem is to simulate a variety of possible activity schedules and abstract the space allocations for maximal utilization of each space type. For example, if a preliminary design had six basic types of spaces, then from a number of simulations, the maximum number of spaces utilized at the same time for each space type would be identified. Then, for the times during which these maxima occurred, an analysis would be done to determine whether or not the maximum could be reduced by a redistribution of space assignments.

Finally, a total configuration would be developed from the adjusted maxima and scheduling constraints specified so that conflicts would not occur. This would be done iteratively so that adjustments could be made in both the activity schedule and the physical properties of the school design. The next phase of the work described here will be an exploration of this direction.

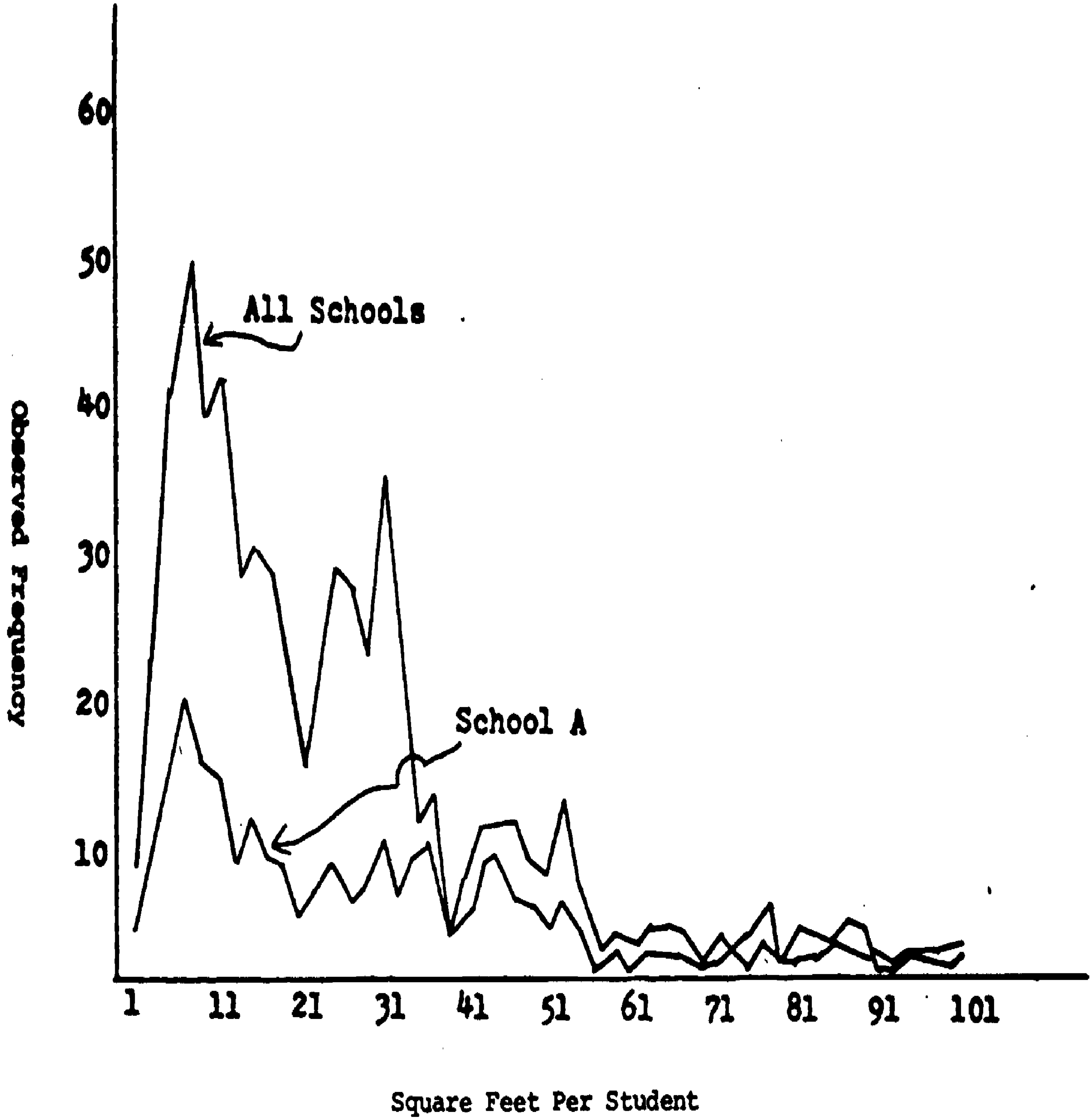


Figure 12. Observed frequency of square feet per student.

V

CONCLUSIONS

School architecture has progressed considerably from the state described by Henry Barnard in his classic School Architecture of 1848 (Barnard, 1848/1970).

> They [the school houses] are, almost universally, badly located, exposed to the noise, dust and danger of the highway, unattractive, if not positively repulsive in their external and internal appearance, and built at the least possible expense of material and labor.
>
> They are badly lighted. . . . They are not properly ventilated. . . . They are imperfectly warmed. . . [and] there are. . . no places of retirement for children of either sex, when performing the most private offices of nature [Barnard, 1848/1970, pp. 31ff].

Although the problem of finances remains, state, federal, and local legislation, plus more enlightened attitudes toward the relationship between physical discomfort and learning have eliminated most of the problems relating to safety, lighting, ventilation, and sanitation which Barnard faced in the last century. But a new problem has arisen since the late fifties when Sputnik drove the government to question the efficiency of American educational methods. Where there was once nearly universal acceptance of a teacher-centered, age-graded, closed-classroom approach to educational organization, now a variety of alternate forms have found acceptance. And while the former organization could be accommodated in the eggcrate design which has dominated school architecture for almost 100 years, most of the latter plans could not.

The procedures proposed here for designing modern educational facilities are based on the notion that form should follow function, and not vice versa. But they also require that those who will use the facilities be involved in the design procedure, viz, teachers, curriculum planners, and even parents. This notion has little acceptance today, either in concept or in practice.

The data collection procedure is not intended for use in every design project. Its application is primarily for establishing norms for different organizational plans, and of course for research on classroom activities.

The data analysis techniques which were suggested are for the most part descriptive procedures only. More sophisticated uses of quantitative methods and heuristics in architectural design are employed in such programs as MATRAN (Miller, 1971), SPACES 2 (Th'ng & Davies, 1972), and CORELAP (Lee & Moore, 1967).

But whatever techniques are employed for school design, the best possible outcome is not improved education, only a facility which does not inhibit the use of certain educational practices. However grand the facility, the quality of instruction will still depend primarily upon the qualitv of the school personnel and the resources made available to them.

APPENDIX

INSTRUCTIONS FOR RECORDING EDUCATIONAL ACTIVITIES

INSTRUCTIONS FOR RECORDING EDUCATIONAL ACTIVITIES

The data entered on the Educational Activities Record are to be used in designing new types of classrooms and schools. It is imperative, therefore, that sufficient data are recorded so that at a later time the organization of the observed classroom, including all of its groups and activities, can be reconstructed and fitted to a different physical environment. The most important question which must be answered about each observed activity is "In what other space could this same activity be assigned?" This requires the recording of not only the size of the group, its current place in the room, and the activity it is doing, along with its starting and ending times, but also certain information about the relationship of the group members to each other, the type of supervision, and the kinds of working surfaces which the group needs. These various forms of data are described below. The section headings refer to columns on the recording form.

PLACE

A Label or Series of Labels for One or More Subspaces in which a Single Activity Occurs. These labels are assigned on the architect's drawing of the room (or rooms). If two or more separately labeled subspaces are frequently used together, a single label should be assigned to them and the definition of the label recorded in the Comments.

TIME

Record STARTING TIME and ENDING TIME to the nearest minute. If either falls exactly between two minutes, record the higher number.

Very often an activity begins with students wandering into a space over a period of a few minutes and ends with the same gradual exiting. Starting time should be recorded from the point you detect preparation for an activity; e.g., teacher begins to arrange materials, students begin to find their seats. An activity ends whenever the group clearly switches to a new activity or when it has completely exited from a space. ORGANIZATION TIME is the total number of minutes spent in preparation, organization, and cleanup for an activity. It may be recorded as a single figure, or as separate figures for the initiation and conclusion of an activity. In the latter case, the two numbers are separated by a slash, e.g., 2/6.

Some activities will undergo changes in organization before they terminate. For example, a reading/writing lesson begins with the teacher explaining a topic on the blackboard; the students watch, but have no materials of their own. Then the students take their copybooks and begin to write. Finally, when everyone finishes, the students go to recess. For such an activity, two phases are recorded, but only the second phase shows a terminating time. To show that the activity does not end after the first phase, a horizontal line is entered in the space for its terminating time.

Another common example of a phase change is when a lesson begins with the teacher lecturing to an entire class for a short time, and then the students divide into small groups to pursue the subject matter.

There may be cases of even three or four phases to the same activity; if so, only the last phase should show a terminating time.

It is imperative that all phases of an activity take place in the same space and have the same subject. If the location or subject changes, then a new activity begins.

If an activity begins with a short lecture at one point on the floor of a large area, and then the students move to desks in another part of the area to pursue the same activity, the two parts should be recorded as separate activities.

STUDENTS

Total

The Total Number of Students who are Engaging in the Activity. Record minor changes which occur during an activity in the COMMENTS only.

Interaction

The Type of Interaction which Students in the Activity Have with Each Other.

N - None. Each student works independently without planned (intentional) interaction with other students. In addition, the students are not required to attend to a common focus. This means that the students could be assigned to physically separate spaces if they are not monitored by a single teacher (see below for INSTRUCTOR ROLES). Students sitting in a Center who do not work cooperatively are also coded N.

G - Group. All students interact with each other in a single group as a planned part of the activity. Thus, six students sitting together building a single model or building separate models from shared materials are coded G. However, if six students sit together, but each does his/her own work independently of the others, the interaction is coded N.

F - Focal point. Students in a single group (or class) do not interact with each other as a regular part of an activity, but must all attend to a common focus, as for example in watching a movie. In general, the interaction for a lecture is coded F, but for a discussion, G.

M - Multiple groups. Two or more groups exist for a single activity; students interact within their own groups, but not across groups. In addition, no common focal point or common materials exist.

C - Complex. Two or more groups exist; students interact within their own groups, and also all groups attend to a common focus or share a common set of materials. This code is used only when the interaction within the small groups is an essential (i.e., planned) part of the activity. The physical placement of students in small groups does not guarantee this type of interaction. If, for example, 12 students who are divided among 3 tables are all participating in a discussion with the teacher, and no special significance is given to the interactions within the small groups, the interaction is coded G and not C.

On the other hand, the same small groups might have a single instrument each (e.g., microscope) which the teacher is explaining how to use. If the students must interact within their own groups and at the same time attend to the teacher's instruction, the interaction is type C. If small groups are working on different activities, even though a single teacher monitors them, each different activity should be coded separately. Note in the COMMENTS, however, that a single teacher monitors all of the groups.

U - Irregular and unorganized interaction, bordering on chaos and characterized by very little stability in group composition or activity.

SUBJECT

A Curricular Subject, Recess, Eating, Free Play, etc. Codes for the most common subjects are listed below. For other subjects, choose an appropriate abbreviation and define it in the COMMENTS.

MATH	Mathematics
SCI	Science
NAT	Nature
READ	Reading
WRIT	Writing
SPEL	Spelling
GEOG	Geography
HIST	History
LIT	Literature
ART	Art
MUS	Music
DRAM	Dramatics
BIBL	Bible
GYM	Gymnastics, sports, etc.
ORG	Any organizational meeting connected with a specific subject (that is, curriculum subject)
FOOD	Eating
REC	Recess
REST	Rest period
CIV	Civics
SHOP	Woodworking, metal working, etc.
INDP	Unspecified independent work. (Generally used when students are doing different types of independent work at the same time and in the same place.)

INSTRUCTOR ROLES

Teacher/Aide

What Role the Teacher or Aide Plays in an Activity.

I - Direct instruction (including participation as a member of a group).

A - Assists or monitors the group or individual students, but does not control directly what each student does.

N - None.

The instructor role may change during an activity. If so, record the various roles on one line, but separated by a diagonal line. This occurs often when an activity begins with a brief explanation by the instructor of some activity (e.g., how to do a worksheet). Then, the students work on their own as the instructor monitors their work and provides assistance to those who request it. In this situation, the coding is I/A.

These columns may also be used to record instructor activities which are not associated directly with student activities, such as grading papers. In this case, include only PLACE, STARTING TIME, ENDING TIME, and INSTRUCTOR ROLE. All other columns should remain blank. Codes for these cases are:

P - Paper work (grading papers, preparing reports, etc.).

M - Preparing or cleaning up instructional materials for student activities.

V - Meeting with visitors to the room (including principal, other teachers, and parents).

B - Break.

RESOURCES

<u>Space</u>

<u>The Type of Space (Average) Required for a Single Student and His/Her Materials.</u>

S - Seat only (use also for situations in which students stand, but do not use any personal materials, e.g., books, writing paper).

D - Desk top.

T - Table top.

O - Other (specify what is required in the COMMENTS column).

This is not necessarily the type of space actually used, but the observer's judgment of the minimum space which is appropriate for each student.

Other

Special Equipment Required by Individual Students or by an Entire Group.

N - None.

B - Blackboard, projection screen, display board, or equivalent.

P - Projection equipment or sound recorder (over-head or slide projector, movie projector, cassette recorder, etc.).

C - Center materials.

L - Laboratory.

A - Art materials (if extra-large, specify amount in COMMENTS).

M - Musical instrument.

T - Other materials which fit on a table top, such as a game board or contour map.

O - Other (specify in COMMENTS).

COMMENTS

Note here any problems which occur in recording an activity and any extra notes which would be helpful in deciding what other kinds of spaces might be reserved for the activity. If extra space is needed, continue comments on the succeeding sections, leaving the non-comments spaces (time, etc.) blank.

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