CHAPTER 6

TWENTY-SEVEN PATTERNS FOR THE DESIGN OF THE NEXT GENERATION OF AMERICAN SCHOOLS\textsuperscript{20}

When the first of us (GTM) was commissioned to review the literature and invited to give a keynote talk at the Second National Conference on Architecture and Education, and invited the second of us (JAL) to assist in the process, we were happy to accept the invitation as we thought it would give us an opportunity to review the educational and architectural literatures looking for communalities and divergences. We also thought it would give us the chance to find out (and communicate) the major findings from the educational research literature on the impacts of school design on educational program effectiveness, and then to translate the major findings into a set of design principles or patterns for the new American schoolhouse. This, at least, is what the conference organizers asked the first of us to do in the invitation, and what we all hoped would be possible. Some years ago, Tom David and Ben Wright edited an excellent book on \textit{Learning Environments} (University of Chicago Press, 1974) and more recently, Carol Weinstein wrote a major review paper on "The physical environment of the school" (\textit{Review of Educational Research}, 1979). We were looking forward to finding the sequels to this comprehensive book and critical review, and to then translating the latest results into design principles and patterns for our discussion.

We scoured the educational, environment-behavior, and architectural literatures in search of new \textit{empirical research}--the 1990s sequels\textsuperscript{21}. To our surprise and dismay, relatively little empirical research has been reported in the educational literature on the impacts of school design on educational performance since those important works (cf. Chapter 2). Yes, there are many studies on the impacts of classroom size and overall school size on performance, as well as on the architectural definition of activity spaces and aesthetic appeal, which we have discussed above, but no empirical literature on the myriad of other design decisions which a responsible architect has to make in the course of designing, renovating, or expanding a school building.

On the second side of what may be conceptualized as a three-way triangle, numerous school buildings have been published in the \textit{architectural press}, but with infrequent critical commentary. As Jeff pointed out in some of his notes to me, many of the buildings look

\footnote{An earlier version of this chapter was presented as the major portion of a keynote address by Gary Moore with considerable assistance from Jeff Lackney at the Prairie School National Invitational Conference on Architecture and Education, Prairie School and Wingspread Conference Center, Racine, Wisconsin, May 16, 1992. Our thanks to the Johnson Foundation for supporting the research effort which led to this chapter.}

\footnote{On-line data-base searches were made of all the architectural, educational, and psychological literature between 1980 and 1992 using the Dialog, BRS Information Technologies, and ERIC data-bases.}

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friendly and non-institutional, massing has been broken down into residential building-scaled forms, with sloped roofs, open and operable windows, and intimate spaces inside, and, in some cases, corridors have become indoor "streets" for incidental socializing and unstructured teaching. But the commentaries in the architectural press, where they exist at all, talk about the uniqueness of the design of these schools, and whether the design (the polychromatic brickwork, intricate stucco details, and cute bell or clock towers, etc.) evoke picturesque or excessively post-modern images, not whether they lead to better teaching/learning environments for the users nor, most fundamentally, whether they have any impact on educational performance.

Most surprising of all are the series of annual "Architectural Portfolios," award-winning and other outstanding school buildings judged by and published in American School & University. Page after page of buildings are published, for the most part with descriptive comments only. There are some valuative commentaries like, "The master plan takes advantage of the natural terrain by locating the building complex on the higher areas of the site.... Bold forms, restrained use of materials and color, precision detailing, the play of sun and shadow, wonderful site and siting ... this is architecture as art! There's more to learn here than the three R's" (American School & University, November 1989, p. 36). The introduction, presumably the most important insights of the jury, was titled "Presentation Quality is Paramount in Communicating Facilities Design."

The third side of the conceptual triangle is the educational reform literature (e.g., Fiske, 1991; Sizer, 1992). Here the literature is proactive, compelling, based on many years of experience of some of the continent's most innovative and brightest thinkers about education. It is not research. It is not architecture. In many cases, there is no discussion of architecture. And yet, when one reads this literature with an architectural eye, much of it is pregnant with ideas, ways in which the appropriate design of educational facilities can set the stage for more easily, efficiently, and productively achieving the latest educational reform ideas.

**Twenty-seven Design Patterns for the New American Schoolhouse**

Despite the lack of comprehensiveness, there is empirical data on the impact of school design on important performance issues (including the effects of school and classroom size, flexible learning facilities, open space, aesthetic appeal, well-defined activity areas, indoor climatic factors, acoustics, and lighting--much of which is reviewed above in Chapter 2 and need only be reviewed briefly here). There also are some clear trends in school design apparent from the architectural literature (the campus-plan concept, the pod school or clusters and suites of classrooms, William Brubaker's "great spaces," and so on). And we have been able to inductively arrive at some working hypotheses about ways in which formal characteristics of design can set the stage for educational reform ideas.
Thus we have developed what we think are a set of the most important 27 design patterns for the new American schoolhouse. Each of our ideas, or \textit{patterns}, is a design principle that we believe may be able to help shape the form of the new American schoolhouse. Two of these patterns, developed in response primarily to the empirical \textit{EB} literature, were presented in Chapter 5; five additional patterns in response primarily to the educational reform movement, were presented in Chapter 6.

A word about what is a \textit{pattern} in architecture (cf. Alexander, Ishikawa, & Silverstein, 1977). A \textit{pattern} is the core of a design solution to an issue or problem that occurs over and over again in the built environment, in this case, in educational facilities. Our attempt has been to state patterns in a way that they can be used over and over again, without ever doing it the same way twice. Important parts of the pattern are the diagram and the title, both of which, if they are good, express the core of the idea visually and verbally. The redundancy between visual and verbal message is intentional. Some people are more visual and will understand and remember the visual image (the hashed circulation arrow meandering between activity areas and children) while others will understand the idea better and remember the verbal title ("supervisable circulation paths"). Because the pattern is the essential idea, but can be used over and over again in many different ways; there is a one-to-many relationship between the pattern (diagram and title) and any particular building examples. The pattern is the idea—the abstraction; the examples are different ways in which one might actually do it—the concrete particular.

The patterns are organized into four clusters:

\begin{itemize}
  \item Planning Principles
  \item Building Organizing Principles
  \item The Character of Individual Spaces
  \item Critical Technical Details
\end{itemize}

This list is by no means exhaustive. We hope that your critical reading of them will help us to refine the list, combining or deleting redundant patterns and developing needed new ones. At the present time, the set of 27 patterns includes the following:

\begin{itemize}
  \item Planning Principles
    1 And the Winning School is . . . Smaller
    2 School as a Community Center / Necklace of Community Activities
    3 Safe Location
    4 Contextual Compatibility
\end{itemize}

\textsuperscript{22} Some of these design notions, like Great Spaces, have been directly influenced by Bill Brubaker’s “These 21 Trends Will Shape the Future of School Design”; others have been influenced by Susan Stuebing’s Learning Environments Research and Sara Crumpacker’s phenomenological work on “The Experience of School as Place,” all of whom we thank.
• Building Organizing Principles
  5 Campus-Plan Concept / Schools within Schools
  6 Compact Building Form
  7 Building Core / Community Forum
  8 Team Suites / Clusters of Classrooms
  9 Great Spaces
  10 Modified Open Space
  11 Supervisable Circulation Paths
  12 Flexible/Adaptable Learning Facility
  13 Home as a Template for School
  14 Design Diversity

• The Character of Individual Spaces
  15 Small Classrooms
  16 Variety of Learning Spaces
  17 Well-Defined Activity Pockets
  18 Table Groups
  19 Nested Classroom Groupings
  20 Portfolio Process Studio
  21 Administration in the Mainstream
  22 Cluster of Teacher Offices
  23 Indoor-Outdoor Transition Spaces
  24 User-Friendly / Child-Centered Aesthetics and Scale

• Critical Technical Details
  25 Controlled Indoor Climate
  26 Appropriate Acoustics
  27 Natural/Full-Spectrum Lighting

Planning Issues

1. And the Winning School is ... Smaller

   The first issue to be addressed in educational facility planning is the optimal overall size of school buildings. The Public Education Association has argued for downsizing schools to 500 to 600 pupils per school. The argument goes that smaller is better, that smaller schools will lead to a more humane educational system. But what is the evidence?

   Over 300 studies were conducted on size between 1965 and 1980 (Garbarino, 1980). The findings are quite consistent. In comparison to large schools (over 1000 students), small (400-500 students) and medium-sized schools (900-1000 students) have better educational records. More student are involved in governing decisions. All other things held equal, there is less crime. There is more sense of responsibility. Discipline is higher; for example,
less misconduct was found after one school subdivided its 3,000 students into a number of smaller schools. Large schools have been found to undermine character development and socialization to adulthood (Garbarino, 1980) by not providing a full range of participatory activities. Conversely, students in smaller and medium-sized schools take more part in extra-curricular activities, there is more overlapping of roles, they are more satisfied with the participation, and overall they have more positive self images (King & Marans, 1979).

So what is the optimal overall size of school buildings? The Public Education Association recommends downsizing schools to 500 to 600 pupils per school, arguing that smaller schools will lead to a more humane educational system [our diagrams show two schools for ca. 720 students]. Small and medium schools have better educational records, more students are involved in governing decisions, there is less crime, there is more sense of responsibility, and discipline is higher (Garbarino, 1980).\textsuperscript{23} As Paul Goldberger’s review of the design competition for "New Schools for New York" concluded, "Educators have begun to suggest that the real sin in contemporary school design is size ... and the winning school is ... smaller" (Goldberger, New York Times, May 27, 1990).

![Diagram of school buildings](image)

**Figure 6.1.** And the winning school is ... smaller.

2. School as a Community Center / Necklace of Community Activities

Though we have found no environment-behavior research on the topic, a wide number of commentators (e.g., Janet Felsten of the Baltimore Foundation for Architecture) have suggested that one of the important new educational directions for the 21st century schoolhouse is integration of the school with other community functions, the development of a community center as part of the normal operations of the school, and making the

\textsuperscript{23} From over 300 studies conducted on size between 1965 and 1980 (Garbarino, 1980).
school a community hub. Several new schools and ones on the drawing boards for New York City have taken this position. The *American School Board Journal* of May 1990 reported that the construction of community recreation centers as part of schools has been found to be a solution for building community support for public education among a growing number of community residents who do not have children of their own in school. Centers are schedule so everyone in the community can use them. In some cases, an adult education program is set up as well as a "Top 55 Club" for senior citizens. Schools are becoming expected to house child care centers. Other examples of including continuing and job-training educational programs, youth programs, programs for parents and families, administration offices, social services, and facilities for community and town hall meetings abound. As done in the Desert View Elementary School (*Architecture*, 1989, 78(5), 139), a multipurpose pavilion and cafeteria which is shared by the community is oriented towards a public entry plaza. In the Lago Lindo School in Edmonton (*Canadian Architect*, 1991, 369, 17-25), a simple urban piazza connects the school to a future community building, effectively ordering both the building and its site. The piazza, a major gathering spot for the school, has also become a focal point for the community. It is only a short step from the school as a community hub to using the school year round, both for primary education and for community functions.

Architecturally, in many cases, the building wraps around the community functions, as around a "town square." In others, the community functions are a necklace around the school. In either case, parking obviously needs to be located near the public use facilities (gym, library, performing arts facility, etc.).

Schools of the future will be highly integrated with other community functions. One of the important new educational directions for the 21st century schoolhouse is integration of the school with other community functions, the development of a community center as part of the normal operations of the school, and making the school a community hub. Ted Fiske, in *Smart Schools, Smart Kids* points out a number of innovative "learning communities," turning schools into centers for child advocacy, including some 70 community organizations dealing with health, social services, recreation, and housing. In some cases, an adult education program is set up as well as a "Top 55 Club" for senior citizens. Schools are becoming expected to house child care centers, continuing and job-training educational programs, youth programs, programs for parents and families, administration offices, social services, and facilities for community and town hall meetings. Architecturally, the school may wrap around the community functions, as around a "town square." Or the community functions can be a necklace around the school. The school as a life-long learning community.

This pattern is in response to a wish for a broadening and deepening sense of community, to the school as a life-long learning community.
3. Safe Location

Other physical planning and design variables are important for student performance. For instance, the location of new schools is now known to be critical. A series of studies in this country between 1980 and 1986 reviewed by our colleague Gary Evans in *New Directions in Health Psychology Assessment* concluded there are significant increases in blood pressure associated with schools being near noisy urban streets. Other findings related to location include German and Russian studies indicating increased systolic and diastolic blood pressure in middle-school children in schools close to noisy urban streets and abnormally high blood pressure in children residing around nine different Soviet airports. Exposure to traffic noise at school also has been associated with deficits in mental concentration, making more errors on difficult tasks, and greater likelihood of giving up on tasks before the time allocated has expired among elementary school children. Furthermore, as found by Sheldon Cohen and his colleagues in Los Angeles, elevated blood pressure does not habituate or decline with continued noise exposure over time—children don’t get used to it. The correct location of new schools, and their proper architectural design can alleviate noise and other problems.
4. Contextual Compatibility

Contextual Compatibility is the notion of trying to fit the school into the character of the local community. For example, California and the west have a particular style of design; what is appropriate there in terms of contextual comparability, e.g., a campus centered around a plaza, may not be relevant for the rest of the country. Pitched and visible roofs may be very appropriate in suburban areas of the country, but the more general pattern is emerging is the general notion of contextual comparability. While a valid concept architecturally, we know of no evidence linking this notion to school performance.
Building Organizing Principles

5. Campus-Plan Concept

As reviewed above, there is considerable empirical evidence and public support for the notion of smaller school sizes, around 500 to 600 students for elementary and middle schools and 1,000 for high schools. Research has mounted that quality education is highly dependent on small-group sizes (Ruopp, 0000). The two critical sizes are the number of children in a primary group (which influences class size) and the total number of children in a school. On the other side of the issue is cost containment, that larger programs are less expensive resulting from an economy of scale. One way of handling the dilemma of cost to quality is what we previously have called the village or Campus-Plan Concept,\(^24\) i.e., decentralized the building plan into an interrelated set of pods, modules, or houses.

The basic pattern is that whenever and wherever a school is to house more than 600 elementary or middle school students or more than 1,000 high school students, plan the center (both in terms of program philosophy, administration, and facilities) as a village, campus, or articulated multi-faceted building comprises of a series of interconnected schools-within-a-school for 500-600 elementary or middle school students and not more than 1,000 high school students. The essence is the idea of separated yet related schools-within-a-school, separated yet related administratively and architecturally.

In some cases, the architectural form is a series of academic wings or specialized program functions around a media or resource center or a large multipurpose, community facility. In one example, the building is divided into two main clusters (K-2 and 3-5), each cluster having its own commons and entrance. A main core space is placed between the clusters, the resulting design successfully breaking down the scale of the building. In a case published in the *Architects' Journal* (1990, 192(6), 13), a series of low buildings are grouped around a field in the tradition of the British comprehensive school. A building reviewed by Brian Allsopp in Edmonton (*Canadian Architect*, 1991, 36(9), 17-25), the massing of the building has been broken down into appropriated scaled residential building forms, with sloped roofs, open windows, and intimate spaces inside. In another example, the Calling Lake Elementary and Junior High School, an arcade was added to the original building and the exteriors of each new classroom were articulated as a row of small unties each with its won front door. The result reminds us of a group of small traditional single room schoolhouses, breaking down the scale of the school into a village or campus plan.

Research has mounted that quality education is highly dependent on small-group sizes. Small schools work better. The two critical sizes are the number of children in a

primary group (which influences class size) and the total number of children in a school. On the other side of the issue is cost containment, that larger programs are less expensive resulting from an economy of scale. One way of handling the dilemma is what we previously have called the village or campus-plan concept—a decentralized building plan. The idea is separated yet related schools-within-a-school, separated yet related administratively and architecturally, a series of academic wings or even separate "houses" (K-2, 3-5) for approximately 210 to 360 students (Sizer, 1992), each with its own commons and entrance, the resulting design successfully breaking down the scale of the building.

Figure 6.5. Campus-plan concept.

6. Compact Building Form

In his excellent and influential article on trends in school design (American School Board Journal, April 1988, 175(4), 31-33, 66), Bill Brubaker suggests that the campus plan in which a school consists of a number of separate but related buildings, makes good sense in places where the weather is warm year-round. In contract, he argues, a single, compact, multi-floor building might be more appropriate where the winters are cold. The most compact plan imaginable would be a sphere, but for its difficulty in laying out spaces on earth (as opposed to lunar or Martian design situations), a cube is the earthly equivalent. He mentions a high school in Chicago which is a cube-shaped high-rise--140 feet (42.68 m) wide, long, and high.
7. Building Core / Community Forum

A design pattern relating driven by the economic use of limited resources with implications for facility design is the Building Core concept. Berg and Apostle (1991) report on how a bond issue campaign helped build new schools, and the use of prototype designs to capitalize on economies of scale. As with other buildings, the resulting design consisted of a Building Core comprised of common-use spaces such as the library, multi-purpose rooms, special education classrooms, administrative complex, and mechanical and electrical spaces. In many cases, traditional classroom wings branch off from the core as required by the program (see the following pattern, Clusters/Suites of Classrooms).

The aesthetic aspects of several of these schools built around a core are worth mention—the differences in ceiling heights, use of color, exciting shapes and forms, and, in one case, an amazing centralized 2-1/2 story library space (where does the money come from?)!
The notion of a building core or community forum is a shared community space as the center or core to the school building. Common-use spaces such as the library, multipurpose rooms, special education classrooms, administrative complex, and mechanical and electrical spaces can be in this core. More fundamentally, the core is a community forum for school-based management, for shared decision making, and as a community forum for other community functions (town hall meetings, etc.)—the core of the school becoming the core of the community.

![Diagram of Building Core and Community Forum](image)

Figure 6.7. Building core / community forum.

8. Team Suites / Clusters of Classrooms

A common trend, analogous to and driven by the same reasoning but not the same as the Campus-Plan Concept, is the Classroom Suite, sometimes called the "Self-Contained Classroom Community" or "The Pod School." The basic notion here is to create a series of small suites of classrooms and support facilities around the central core functions. Variations on this theme include cooperative learning, new versions of team teaching, teachers as team coaches, and the school as a mirror of the emerging workplace (another
variation on the school-within-a-school notion). One interpretation is the Koln-Holweide model as summarized by Ted Fiske: "Teachers divided into small, relatively autonomous teams, with each team responsible for one group of students; the teams, usually six to eight teachers [we show 4-5], stay with their students from the fifth grade until ... the tenth grade" (Fiske, 1991, p. 103). In this layout, the school can accommodate different team/community philosophies. Among the support facilities may be lounges, informal learning spaces, a small computer hub, office space for teachers, etc.

Strickland & Carson Associates' design for School Site Number 1 in the Bronx (reported in the New Schools for New York article in Teachers College Record, Winter 1990, 92(2), 248-285) designed suites for an inner-city school including classrooms, lounge space, office space for teachers, lockers, private bathrooms, window seats, terraces, hallway display cases, and smaller seminar rooms.

The philosophy behind the design prototype, and this pattern, is that teachers and students together constitute a small community (another variation on the school-within-a-school notion) and that this can be articulated architecturally.

Figure 6.8. Team suites / clusters of classrooms.
9. Great Spaces

With our next pattern, we again could find no empirical support that the following idea contributes to or detracts from educational performance, but as pointed out by Bill Brubaker, it is definitely an architectural trend in late 1980s and early 1990s school buildings. Large spaces recognize the need for community identity within a school. They also afford connections to the community at large and may act as a symbolic connection of school to community. Large spaces, or as Brubaker calls them, Great Spaces, offer opportunities for large groups within the school to gather (the see-and-be-seen phenomena so important among middle school and especially high school students). Lobbies and corridors which are wide enough to accommodate and encourage a variety of student social interactions, internal "streets," malls, commons, and atria, each perhaps with higher ceilings, interesting views, and spaces for informal social gatherings come under this design principle.

In several schools reviewed by Brian Allsopp in northern Alberta (Canadian Architect, 1991, 36(9), 17-25), corridors became indoor streets for incidental socializing and unstructured teaching. In a Royal Institute of British Architects Gold Medal Exhibition (Architects' Journal, 1989, 190(5), 69-70), the Birr Community School is seen as being analogous to a town; instead of corridors, there are "streets' linking sequences of houses or Suites of Classrooms at the perimeter.

Figure 6.9. Great spaces.
A Great Space may be a courtyard, either enclosed, or it does not have to be enclosed to still serve as a major social space and focal point. The John Paul II Collegiate (high school) in Edmonton uses an outdoor courtyard from the 1950s that was not being used; during renovation it was roofed in with a skylight and made into a student commons area. In the Fox Chapel Area High School, a two-story student commons was created in the renovation by filling in another existing courtyard. A cafeteria was provided which was modelled after a fast-food restaurant, with booths for eating, rather than long impersonal, dining-hall tables. In another example, the renovation of a turn-of-the-century urban high school, the school's library atrium was created by enclosing a little-used outdoor service courtyard (latter two reported in *American School Board Journal*, February and November 1990, 38-40 and 38-39 respectively).

10. Modified Open Space

*The* building issue, by far, that has been the most controversial and has received the most attention and debate in the educational research literature, in school magazines, and in the architectural press is open space.

Starting with the first open plan schools in the 1950s, the construction of open plan schools passed its peak between 1967-70. But by 1970, over half of all schools built were constructed with open patterns (George, 1975). Critical reviews of the enormous amount of research, and rhetoric, have been written by Carol Weinstein (1979), Gary Evans and Barbara Lovell (1979), and Gump (1987). The contrast, of course, is open plan schools versus conventional, self-contained classrooms—the open school versus the egg-crate school.

The overwhelming evidence in the empirical research literature is that while there is considerable disagreement among building users and administrators, open plan schools have been found to positively impact teacher attitudes and behavior and student attitudes and behavior (Weinstein, 1979), the results vis a vis achievement and overall educational performance are equivocal (George, 1975; Weinstein, 1979; et al.). The two best studies have shown, contradictorily, that conventional classrooms outperform open classrooms on achievement tests (Beck, 1979), and that there are no consistent findings on achievement (Traub et al., 1976). Many open plan schools achieve the objective of exposing children to a wider variety of learning opportunities, but visual and auditory distraction are common complaints in these settings. The volume of open, undifferentiated spaces and the openness of classroom perimeters have been found to be positively correlated with visual distraction (Ahrentzen & Evans, 1984; Moore, 1987). While children are more focused in open plan settings when they are involved in activities, there is more off-task time in such settings in comparison with conventional classroom settings. A type of space division that resolves the dilemma and allows the best of both extremes while minimizing the problems is what we have previously called Modified Open Space (Moore, 1987)—a mixture of several open areas with smaller, enclosed spaces (Weinstein, 1979; Evans & Lovell, 1979; Gump, 1987; D, 1982,
p. 275; George, 1975; Beck, 1979; Traub et al., 1976; Ahrentzen & Evans, 1984; Moore, 1987; cf. Evans, Kliewer & Martin, 1991).

However, having said that about overall educational achievement, the evidence is however clear that certain aspects of open plan schools outperform conventional classrooms, while certain aspects of schools organized in terms of conventional classrooms outperform open schools. Many open plan schools appear to achieve the objective of exposing children to a wider variety of learning opportunities, but visual and auditory distraction are common complaints in these settings. The volume of open, undifferentiated spaces and the openness of classroom perimeters have been found to be positively correlated with visual distraction (Ahrentzen & Evans, 1984; Moore, 1987). While children are more focused in open plan settings when they are involved in activities, there is more off-task time in such settings in comparison with conventional classroom settings.

Figure 6.10. Modified open space.
A type of space division that may resolve the above empirical dilemma and allow the best of both extreme alternatives while minimizing the problems is what we have previously called Modified Open Space (see previous page; Moore et al., 1979). It consists of a mixture of several open areas with smaller, enclosed spaces. The open spaces can be subdividable for smaller-group use; the smaller areas can be opened up to each other to provide a large-group area. Indeed, evaluations that we and other researchers have conducted of open plan classrooms modified to become Modified Open Space with separated yet connected activity areas have found improved utilization of space, more involvement and engagement in educational activities and less passive behaviors, fewer classroom interruptions and nonsubstantive questions, and more child-initiated behaviors and exploration (Evans, Kliwer & Martin, 1991; Moore, 1987).

11. Supervisable Circulation Paths

A pattern arising out of the practical experience of educators is that of the "Supervisable Circulation Paths."

Almost a corollary to Modified Open Space is the notion of clear yet Supervisable Circulation Paths. Ambiguous circulation patterns impede children's use of schools and create unnecessary chaos and disorganization. The central issue with regard to circulation patterns is "substance" time versus "non-substance," "transitional," or "preparatory" time. Studies by Gump (1975) have found that more so-called non-substance time is spent by children in open-plan schools than in closed-plan schools, with much of this being transit time between activities. Various design researchers (e.g., Osmon, 1971; Taylor & Vlastos, 1975; our own work, Moore et al., 1979/1989) have suggested that circulation patterns surrounding activities may encourage children to look around and see what is available, that fluid traffic patterns provide a means for better communication. Studies conducted at UW-Milwaukee have found more teacher-teacher communication and a wider variety of interaction among students and between students and learning materials in early childhood education centers when circulation was clear and not disruptive of activities.

There are two aspects of Clear Circulation. One is overall building circulation between and among classrooms. The other is individual classroom circulation, well-defined spaces, clear circulation which overlooks and connects activity areas, and implied boundaries with material changes. Circulation can also be used a social breakout space, providing spaces for students to socialize outside of class.

On the other side of the issue, however, supervisability is a major problem for teachers and administrators in Milwaukee's inner city schools, as it is in most other major city school systems, and must be addressed in some fashion—in a larger context, there is certainly not enough focus in literature on the problems faced by urban school settings.
There is a desire by educators to provide circulation corridors which provide passing opportunities for learning through the use of activity pockets for free-standing display cases, wall-mounted tack-boards, and pockets off the main corridor which contain vision glass into a specialty classroom. Corridors have been traditionally a convenient location for lockers. Architects often recess classroom entrances and stagger corridors to cut down on the excessive corridor lengths. However, in certain settings, the need for supervision and frequent occurrence of vandalism override the desire for circulation which responds solely to educational or functional needs. Children, in these circumstances, can hide in various nooks and crannies located off the corridor out of the sight of teachers or safety supervisors.

When possible, therefore, the circulation path should be cleared of visually obstructing objects to facilitate effective supervision. The need for clear circulation paths takes on a different meaning when supervisability is taken into consideration in the planning of a school facility.

Figure 6.11. Supervisable circulation paths.

12. Flexible / Adaptable Learning Facility

There is some, though limited, evidence that flexible learning facilities lead to higher attendance and more participation in schools. In reviewing the results of the New Schools for New York project, Rosalie Genevro (1990) suggested the value of schools having rooms in a variety of sizes to accommodate classes and smaller discussion groups as well as large assemblies and community events. This is flexibility. Schools need also to be adaptable to
be able to adjust to changing enrollment patterns, educational philosophies, and community needs over time. This is adaptability.

Bill Brubaker has suggested that built-in flexibility can be achieved if newer buildings would minimize interior load-bearing walls, use long-span structural systems, and incorporate a range of room sizes to allow for adaptability and flexibility.

Flexible learning facilities may lead to higher attendance and more participation in schools (find source?). Rosalie Genevro, in reviewing the results of the New Schools for New York project, suggested the value of schools having rooms in a variety of sizes to accommodate classes as well as smaller discussion groups as well as large assemblies and community events (Genevro, 1990). In the prototypical designs we will show in Chapter 7, we have recommended and designed project rooms, and the "portfolio process studio." This is architectural flexibility, for flexibility of education. Schools need also to be adaptable to be able to adjust to changing enrollment patterns, educational philosophies, and community needs over time. This is adaptability.

![Diagram of flexible/adaptable learning facility.](image)

Figure 6.12. Flexible/adaptable learning facility.

13. Home as a Template for School

A new educational direction that is emerging on the American scene is making schools look more like and feel more like homes. Is there any hard evidence that this matters, or leads to measurable educational gains? We haven't been able to find any. But
the phenomenological work of Sara Crumpacker combined with the environmental psychological work on transitions by Seymour Wapner at Clark University suggests the possible importance of minimizing the abrupt transitions between home and institutionalized educational facilities, especially for very young children. Our own previous work advocated the creation of home-like front yards and front porches, and a friendly entry sequence, for child care centers and other early childhood education facilities as a possible way of reducing anxiety about school and reassuring both child and parent that the facility will be home-like in overall functioning (Moore et al, 1979). The use of pitched and visible roofs is another design response to this general pattern of the Home as a Template for School.

There are many examples appearing in the architectural literature—in the US, Canada, and overseas—of schools that are using home-like elements in their design. Pitched and visible roofs, residential scaled and colorful and aesthetically pleasing entrances, shutters on windows reflecting neighborhood homes, and many good examples of residential looking design, even to the extreme of a 1991 school which literally resembles a residential neighborhood with one-story sloped roofs, classrooms engaging the surrounding landscape, and enclosed "backyard" space for outdoor learning activities.

Figure 6.13. Home as a template for school.
14. Design Diversity

Highly related to the Home as a Template for School is Design Diversity. Schools of the 1950s and 1960s were very institutionalized in character, some even being industrialized construction "boxes" with no exterior windows looking for all the world more like warehouses than interactive learning environments for our next generation. Such buildings won't disappear from the school scene, but we can welcome the design diversity that has emerged with the new interpretation of high-tech design elements and post-modernism and the use of traditional design details and materials. The use of vaulted ceilings in kindergarten and special education settings within comprehensive schools adds to the variety and interest of the spaces (and maybe contributes to effective acoustics as well) of classroom settings.

![Figure 6.14. Design diversity.](image)

The Character of Individual Spaces

15. Small Classrooms

Considerable research on density and crowding in classrooms leads to an unmistakable conclusion—that smaller is better. Higher absolute density and greater perceived crowding have been found to be associated with decreased attention, lower task performance, some behavioral problems like increased aggressive behavior, and social withdrawal. As Carol Weinstein noted, "Nowhere else are large groups of individuals packed so closely together for so many yours, yet expected to perform at peak efficiency on different learning tasks and to interact harmoniously" (1979, p. 585).

Other research on classroom size has found a number of very stable, corroborating findings. Classes under or equal to 20 children, in comparison to ones over 25, have been found to lead to better learning attitudes, different and varied instructional practices, higher teacher satisfaction and morale, and, most importantly, higher achievement scores (Bourke,
1986). As was said some years ago in the National Day Care Study, the size of group in which the child spends the most time makes an incredible difference in the quality of education and development.

Research on density and crowding in classrooms leads to an unmistakable conclusion—that smaller is better here too. Higher absolute density and greater perceived crowding are associated with decreased attention, lower task performance, some behavioral problems like increased aggressive behavior, and social withdrawal. As Carol Weinstein noted, "Nowhere else are large groups of individuals packed so closely together for so many years, yet expected to perform at peak efficiency on different learning tasks and to interact harmoniously." Classes under or equal to 20 children, in comparison to ones over 25, have been found to lead to better learning attitudes, different and varied instructional practices, higher teacher satisfaction and morale, and, most importantly, higher achievement scores. As was said some years ago in the National Day Care Study, the size of group in which the child spends the most time makes an incredible difference in the quality of education and development (Weinstein, 1979; Bourke, 1986).

![Diagram of small classrooms]

Figure 6.15. Small classrooms.

16. Variety of Learning Spaces

Interesting ecological research was completed a few years ago by David Berliner at the University of Arizona on the activity structures and patterns of children in elementary schools (Berliner, 1983). A taxonomy and description of 11 activity structures was derived from observations of over 1200 activity patterns in elementary classrooms. The implication of this research for architecture is the necessity of the creation of settings appropriate for
(we might say "synomorphic" with) the activity structures. Allsopp (1991) and other commentators have similarly called for the provision of a variety of learning/teaching areas throughout a classroom and/or school. He suggested that a prototypical elementary classroom has three teaching areas: a flexible traditional main area, a "wet" area for occasional art or science, and a cozy corner, sometimes a loft or window seat area for more quiet study or one-on-one teaching. Berliner's research on what actually goes on in classrooms, however, points out the need for a number of additional activity areas for group reading, what he called "seatwork," one-way, two-way, and mediated presentations, silent reading, construction, games, free play, transition activities, and housekeeping activities.

Several examples of schools with a rich variety of activity areas appear in the architectural press. Several schools in Alberta, as well as ones premiated in the annual awards program of American School & University illustrate examples of a reading pit within a classroom, lofts and sunken story pits to give a sense of the variety of built-in spaces possible in a classroom setting, a story-telling amphitheater, electronic library carrels, etc.

As with the above pattern, the prototypical designs we will show in Chapter 7 will illustrate the necessity of the creation of settings appropriate for ("synomorphic" with) learning activity structures (Berliner, 1983). Provision for a variety of learning/teaching areas throughout a classroom and/or school. A prototypical elementary classroom may need three teaching areas: a flexible traditional main area, a "wet" area for occasional art or science, and a cozy corner, sometimes a loft or window seat area for more quiet study or one-on-one teaching. Need also for a number of additional activity areas for group reading, what he called "seatwork," one-way, two-way, and mediated presentations (Allsopp, 1991). All of these are important ways of creating a variety of learning places.

Figure 6.16. Variety of learning spaces.
17. Well-Defined Activity Pockets

Concordant with the notion of a Variety of Activity Areas is the architectural definition of these areas. Research conducted out of our Center has discovered that architecturally well-defined behavior settings (in contrast with partially and poorly articulated settings) contribute to significantly greater degree of engagement with learning activities, more teacher involvement with children, less teacher interruptions, and more exploratory behavior, social interaction, and cooperative behaviors among the children (Moore, 1986). Other research on classroom design has found that smaller clusters lead to increased use of learning materials (Weinstein, 1982), to increased substantive, content questions (Evans & Lovell, 1979), less non-task-oriented movement, less loud conversations, longer attention spans, and overall greater satisfaction. Sound absorbing partitions used to create Well-Defined Activity Pockets redirect traffic, demarcate class boundaries, and create small areas for privacy (Evans & Lovell, 1979).

Well-Defined Activity Pockets is a clear EB issue with considerably supporting research that many designers have picked up on with lecture pits, lofts, well-articulated activity nooks, and various other measures to isolate noise, dirt, and congestion from the primary learning centers.

The architectural definition of learning areas. Architecturally well-defined behavior settings contribute to significantly greater degree of engagement with learning activities, more teacher involvement with children, less teacher interruptions, and more exploratory behavior, social interaction, and cooperative behaviors among children (Moore, 1986). Smaller clusters lead to increased use of learning materials, to increased substantive, content questions, less non-task-oriented movement, less loud conversations, longer attention spans, and overall greater satisfaction (Weinstein, 1982; Evans & Lovell, 1979). How?--sound absorbing partitions, small areas for privacy, lecture pits, lofts, well-articulated activity nooks.

Secluded study spaces within classrooms are also important to students' development, and have been found empirically to be related to performance. Creating small learning centers within classrooms reduces classroom visual and auditory interruptions, makes learning materials more accessible, increases privacy, and leads to more questions asked by students. A study some time ago in the 1982 Elementary School Journal reported that structured reading areas significantly increase literature use by students. Some of our own research, reported in the Journal of Environmental Psychology, has also shown that for preschool children attention span is longer in architecturally well-defined activity settings within classrooms than it is in totally open classrooms.
18. Table Groups

"There is now considerable evidence that students working in small cooperative groups can master material better than can students working on their own" (Slavin, as cited in Fiske, 1991). This pattern architecturally articulates the Köln-Holweide model (Fiske, op. cit.), and the model of several reform schools around the country as part of the "smart classroom": multi-age grouping, children working in cooperative groups, teacher-as-coach and student-as-worker, all in cooperative table groups.
19. Nested Classroom Groupings

This pattern further supports individual study and activity, table groups, and large-group instruction, all in the same "smart classroom" (e.g., California Department of Education, 1990).

![Diagram of Nested Classroom Groupings]

Figure 6.19. Nested classroom groupings.

20. Portfolio Process Studio

Howard Gardner argues that people have at least seven interwoven intelligences (Gardner, 1983). As schools move beyond traditional testing, one model is the "portfolio," authentic testing not only of product but also of process, what one has learned, and how they can apply it to real-life situations. Ted Sizer refers to student "exhibitions." The central architectural notion is the provision of appropriate space for working on portfolios, and exhibiting them, including but not limited to A/V studio, dance and performance studio, individual project work space, large open project tables, a gallery to display work, a staging area.
21. Administration in the Mainstream

Shared decision making, the principal as leader and "facilitator," remaining close to the day-to-day functions of the classroom, to the students, to the teachers all argue for administration to be in the mainstream of the action, not isolated or removed in an "administrative wing." Some efficiency is sacrificed in the service of communication; administrative functions can even be separated into two mini-administrations in the mainstream, in the core of each house.
22. Cluster of Teacher Offices

A new professionalism needs to be allowed to arise among our nation’s teachers. If we believe that teachers should be involved not only in direct classroom teaching, but also in selecting textbooks and other aspects of shared decision making, then we must recognize their need for quality, private working space with telephones, fax machines, computer terminals, etc., all networked throughout the school and maybe the district. To support the idea of shared decision making, and a community of learning, not isolated teachers with isolated classrooms, these offices may be clustered and share a common seminar space, meeting room, staff back-stage.

Figure 6.22. Cluster of teacher offices.

23. Indoor-Outdoor Transition Spaces

A particular type of Well-Defined Activity Space is Indoor-Outdoor Transition Spaces. In earlier work, for younger, preschool children, we have called this pattern Porches and Decks as Activity Spaces. While the idea is similar, the scale and size must necessarily be different for older children. Post- occupancy evaluations we conducted in the mid-1970s found how important these transitional spaces are for educational programs that like to use the outdoor environment not only as a place for recess (the old Germanic educational idea of burning off energy before studying) but also as a laboratory for learning.
The basic architectural notion is that elements of the building reach out into outdoor spaces and create an additional transition space for class activities. An example published in the *Architects' Journal* (1990, 192(6), 13) shows a gently pitched roof with a wide "eyebrow" for undercover teaching in slightly inclement weather (outdoor teaching is a tradition of this progressive English school). Other examples include a timber board walk beneath a fabric canopy to link the classroom units and double as an external teaching area or shaded loggias formed at each end of the building which can be used as outdoor project spaces ("Appraisal" by David Jenkins in the *Architects' Journal*, 1990, 192(7), 40-55).

The importance of transitional spaces for educational programs that use the outdoor environment not only as a place for recess (the old educational idea of burning off energy before studying) but also as a laboratory for learning. Outdoor teaching as a tradition of many progressive English schools. Ways schools have done it: Elements of the building can reach out into outdoor spaces and create an additional space for class activities. A gently pitched roof with a wide "eyebrow" for undercover teaching in slightly inclement weather. A timber board walk beneath a fabric canopy to link classroom clusters and double as an external teaching area. Shaded loggias formed at each end of the building which can be used as outdoor project spaces.

![Diagram of indoor-outdoor transition spaces](image-url)

Figure 6.23. Indoor-outdoor transition spaces.
24. User-Friendly / Child-Centered Aesthetics and Scale

There is some evidence, though limited, that soft classrooms are related to higher levels of voluntary participation, and that overall aesthetic quality in educational facilities is related to students’ task persistence. No one would doubt that child-scaled and user-friendly spaces are more pleasant for children. As Doxiadis once said, "What would the city look like if it were designed from the child's point of view?"

Schools over the past few years have been characterized by attention to detail and thoughtfulness of design. Efforts have been made to minimize the institutional character with small dining rooms, small bathrooms adjacent to classrooms, and, in general, the exploration of friendly, less institutional, and distinctive personalities to buildings. Other examples of this user-friendly aesthetic appeal include the creation and use of natural materials and colors (e.g., cedar channel siding), extensive landscaping coming right up to the school, interesting and engaging spaces, forms, textures, etc., child-scaled spaces, rounded corners and Waldorfian angles, and the use of friendly symbols. In one example, a school complex centers on an old farm pond for exploration. There are many examples of small, child-scaled spaces using common residential wood construction and the vernacular of rural areas and farms, with views scaled to children and even one case of fossils embedded in accent tiles in a lobby floor. An article on user-friendly school additions published in Architecture (1989, 78(5)) discusses design inspired by forms and allusions to "storybook castles," considered user-friendly in the sense that the architecture is intended to accommodate the "expanding psyches" of children and fire their imaginations. All of these are examples of User-Friendly/Child-Centered Aesthetics and Scale.

Figure 6.24. User-friendly / child-centered aesthetics and scale.
Critical Technical Details

25. Controlled Indoor Climate

There is a range of human factors and physiological research on the effects of various indoor climatic factors (temperature, humidity, and air movement) on student's performance. The findings, not surprisingly, are that levels of comfort, attention span, level of productivity, performance, an overall achievement declines as temperature or humidity increase (King & Marans, 1979). Indoor climatic factors are a major problem in many schools.

![Figure 6.25. Controlled indoor climate.](image)

26. Appropriate Acoustics

Noise has been extensively studied in all types of educational environments. The overwhelming finding is that teachers complain about noise more than do students, that students with disability are more affected by noisy environments (King & Marans, 1979), but that there are no demonstrable effects of short-term noise from inside or outside the classroom on average students on speed or accuracy of performance. On the other hand, there is incontrovertible evidence that there are significant and profound effects of external, long-term noise on lost time, lower reading test scores, greater distraction, lack of task persistence, and higher blood pressure.
27. Natural/Full-Spectrum Lighting

Human factors and physiological research has been conducted on lighting, and in particular on the possible effects of windowless classrooms and fluorescent lighting in schools. The predominant finding from studies on windows versus windowless schools is that students have both positive and negative attitudes toward windowless schools, but the negative attitudes increase over time, whereas teachers, for the most part, have positive attitudes, believing that windowless schools cut down on distractions. The empirical evidence is that there is no behavioral impact one way or the other on performance (King & Marans, 1979). There is some evidence (though criticized and conclusions must be taken as tentative) that fluorescent lighting increases stress and hyperactivity (King & Marans, 1979) in comparison with full spectrum or incandescent lighting and natural light.
Origins and Status of Design Patterns

The table below presents the "origins and status" of all 27 patterns generated to date. First the table identifies the origins of each pattern by referencing the disciplinary sources which are the basis for the pattern (the architectural, educational reform, or EB research literatures, and/or the practical experience of educators). Each pattern must be considered a working hypothesis, subject to further test and refutation or corroboration. In the meantime, these working hypotheses are offered for consideration for implementation in schools. The table also reports overall confidence ratings in the validity of each pattern based largely on the strength of its current support from these three sources.

Table 6.1. Patterns: Origins and status

<table>
<thead>
<tr>
<th>Planning Issues</th>
<th>Evidence Level</th>
<th>Status Level</th>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>And the Winning School is...Smaller</td>
<td></td>
<td>***</td>
<td>Magnitude of Justification</td>
</tr>
<tr>
<td>School as a Community Center/</td>
<td></td>
<td>**</td>
<td>Strong</td>
</tr>
<tr>
<td>Neighbors of Community Activities</td>
<td></td>
<td></td>
<td>Some</td>
</tr>
<tr>
<td>Coessential Compatibility</td>
<td></td>
<td>*</td>
<td>Non</td>
</tr>
<tr>
<td>Safe Location</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Building Organizing Principles                       |                | **           | Confidence Rating                |
| Campus Plan Concept/Schools within Schools           |                |              | Very Confident                   |
| Compact Building Form                                |                | *            | Moderately Confident            |
| Building Core/Community Forum                       |                |              | Slightly Confident              |
| Team Status/Clinics of Classrooms                   |                | ***          |                                  |
| Great Spaces                                        |                | *            |                                  |
| Modified Open Space                                 |                | **           |                                  |
| Supervised Circulation Paths                        |                |              |                                  |
| Flexible/Adaptable Learning Facility                |                | **           |                                  |
| Home as a Template for School                       |                | *            |                                  |
| Design Diversity                                    |                | *            |                                  |

| Character of Individual Spaces                      |                | ***          |                                  |
| Small Classrooms                                    |                |              |                                  |
| Variety of Learning Centers                         |                | **           |                                  |
| Well-Defined Activity Area                          |                | **           |                                  |
| Table Groups                                        |                | **           |                                  |
| Nested Classroom Groupings                           |                | **           |                                  |
| Portfolio Process Studio                             |                | **           |                                  |
| Administration in the Mainstream                    |                | *            |                                  |
| Cluster of Teacher Offices                          |                | **           |                                  |
| Indoor-Outdoor Transition Spaces                    |                | **           |                                  |
| User-Friendly/Child-Centered Aesthetics and Scale   |                | **           |                                  |

| Critical Technical Details                          |                | **           |                                  |
| Controlled Indoor Climate                            |                |              |                                  |
| Appropriate Acoustics                                |                | ***          |                                  |
| Natural Full-Spectrum Lighting                      |                |              |                                  |