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Revitalization of School Facilities

Andrea B. Coffey
East Tennessee State University

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Coffey, Andrea Barlow, Ed.D.

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U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

REVITALIZATION
OF SCHOOL FACILITIES

A Dissertation

Presented to

the Faculty of the Department of Educational

Leadership and Policy Analysis

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In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

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by

Andrea Barlow Coffey

May 1992

APPROVAL

This is to certify that the Advance Graduate Committee of

Andrea Barlow Coffey

met on the

26th day of March, 19 92.

The committee read and examined her dissertation, supervised her defense of it in an oral examination, and decided to recommend that her study be submitted to the Graduate Council and the Associate Vice-President for Research and Dean of the Graduate School, in partial fulfillment of the degree of Doctor of Education in Educational Administration.

Chairman, Advanced Graduate Committee

Signed on behalf of the Graduate Council

Associate Vice-President for Research and Graduate Studies

ABSTRACT

REVITALIZATION OF SCHOOL FACILITIES

by

Andrea Barlow Coffey

The purpose of this study was to analyze current practices in the revitalization of school buildings and assimilate data that can be used by school administrators to make informed decisions about the revitalization of school facilities.

Through a review of literature, elements for planning the revitalization of school facilities were identified and analyzed. These elements were included in an interview guide used during on-site visits to selected revitalized schools. Nine schools renovated since 1985 in Virginia, Tennessee, and North Carolina were chosen to participate in the study. The treatment of data was reported around the use of identified elements of planning for renovating school buildings. Data from the schools were divided by states to make comparisons.

The study indicated that structural soundness, program support, site, and cost are four areas of concern when planning for the revitalization of a school. The specific planning elements included the development of educational specifications; attention to site condition; consideration of playground areas; importance of the exterior appearance of school buildings; space utilization; condition of mechanical and electrical systems; importance of energy efficiency; development of barrier free environments; treatment of thermal environments; consideration of acoustics; management of visual environments; selection of furniture and equipment; and attention to aesthetics.

As a result of the findings of this study, the following conclusions were drawn:

1. Planning for the revitalization of school buildings differs from one school to another even when the schools are in the same system.
2. States do not employ facility planners to help school systems revitalize their school buildings.
3. Many school administrators do not know how to assess the condition of the schools in their districts.
4. Administrators and other individuals involved in revitalizing school facilities want more information on how to systematically plan for the modernization of school buildings.

INSTITUTIONAL REVIEW BOARD APPROVAL

This is to certify that the following study has been filed and approved by the Institutional Review Board of East Tennessee State University.

Title of Grant or Project Revitalization of School Facilities

Principal Investigator Andrea Barlow Coffey

Department Educational Leadership and Policy Analysis

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Institutional Review Board, Chairman Anthony J. DeLuca

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CHAPTER 1

Introduction

National studies in educational facilities indicate that 25% of the public school buildings used to educate students in the United States need major repairs and are not safe; another 33% of the buildings are barely adequate (Educational Writers Association, 1989, p. 1). If deferred maintenance continues to plague the nation's schools, many of the 33% marginally adequate school buildings will become inadequate in the future (p. 1).

Revitalization of school facilities is not a new concept in American education, but it is becoming the best attempt at survival of the public school system in a nation which guarantees a free education to all of its citizens. According to Fricke in Building Education (1990), of the $12.5 billion spent in education construction in 1988, "the biggest areas of increase have not been for new buildings, but for additions and modernization" (p. A1). She stated, "30 cents out of every K-12 school construction dollar goes for modernization of older buildings, and another 34 cents goes for additions to existing structures" (1990, p. A1). Ornstein in "School Finance in the '90s" (1990) warned that money will be even more critical in the 1990s than in the preceding decade. He found that "in some cases, boards are

reopening schools that have been closed or rented to government agencies or civic groups" (p. 39).

It might be assumed with the current percentage of the annual education construction budget already being spent on renovation and modernization, there would be an extensive data base from which school administrators could draw in making informed decisions about these areas of such vital importance to public education. According to the national report by the Education Writers Association, Wolves at the Schoolhouse Door: An Investigation of the Condition of Public School Buildings (1989), there was not an adequate data base about school facilities (p. 3). Historically, school buildings have been a matter of local finance and control. The federal government only comes to the aid of school facilities in times of disaster with a disaster-aid program, and few state departments of education even employ a single person assigned to educational facilities. Furthermore, the Education Writers Association (EWA) apparently could not find one comprehensive university program which addressed the needs of facility planning (EWA, 1989, p. 6).

The Education Writers Association in The Education Digest article, "Public School Buildings: How Long Can They Last?" (1990) summed up the deplorable condition of public schools in the United States: "The composite story that emerges from all of this is one of school buildings of

straw, of wood, and sometimes of solid bricks--and one of demanding future needs puffing ominously at the infrastructure of education" (p. 18). The fact that 25% of the nation's school buildings are "shoddy places for learning" (EWA, 1989, p. 1) demands that school administrators begin a serious study of the condition of the school buildings in their districts. The knowledge that an additional 33% of the school buildings in the United States "are only adequate and because of growing enrollments and deferred maintenance could easily become inadequate" (EWA, 1989, p. 1) requires that administrators become informed planners on the revitalization of existing buildings. At the present time, revitalization is piecemeal; essential elements in the planning process are not identified or appraised. It is difficult to become an informed planner when there is so little information available for the administrator to employ when making decisions about school facilities.

Statement of the Problem

There is no assimilated data base for making informed decisions about the revitalization of school facilities in the United States.

Subproblems

The following subproblems were addressed in order to adequately treat the problem:

1. To trace the development and function of school facilities.

2. To identify and appraise significant elements in planning for the revitalization of public school buildings.

3. To analyze school facility revitalization projects using elements of planning identified in subproblem 2.

Purpose of the Study

The purpose of this study was to analyze current practices in the revitalization of school buildings and assimilate data that can be used by school administrators to make informed decisions about the revitalization of school facilities.

Significance of the Study

The deplorable condition of educational facilities in the United States is serious and widespread. Competent decision making concerning 58% of the nation's schools is urgently needed now. National research indicates there is no assimilated data base in educational facility planning from which administrators can learn to make informed decisions about school revitalization. Hawkins, research editor for the CEFP Journal (1986), reported that "during 1985-1986 no contributions about research related to educational facility planning were received" (p. 23). This lack of research in the field, and the determination of the CEFP Journal to elicit more information, sparked new

articles on educational facilities, but schools are still built by architects and engineers with very little input from educators; most administrators do not belong to the Council of Educational Facility Planners.

This study on the revitalization of school facilities included a review of literature in the field and an analysis of current practices in school revitalization. This educational endeavor culminated in the formulation of a set of planning elements designed to add to the body of knowledge in the revitalization of educational facilities. These elements for facility planning will aid school planners in deciding how existing school buildings can continue to function as educational school facilities.

Research Questions

There were two basic research questions:

1. What information now exists about revitalizing school facilities?

2. Can a set of planning elements for the revitalization of public school buildings be developed to help administrators make informed decisions?

Assumptions

1. Educational facilities are necessary to the educational program of a school.

2. Taxpayers require the most value for the tax dollar spent in educational funding.

3. Teachers desire a place to teach in whatever style they choose. They need school buildings with adequate storage space and modern equipment. Teachers prefer convenient locations of school facilities.

4. Students want schools designed for them. The students need to be safe, comfortable, and able to work in an environment conducive to learning.

5. Parents demand facilities that meet educational needs and are safe for their children.

6. Through the review of literature and on-site visits of selected school buildings, an assimilated data base can be developed to guide school administrators in making informed decisions concerning the revitalization of public school buildings.

7. The assimilated data base, consisting of a set of planning elements for revitalization of school buildings, will aid administrators and others in determining a course of action in revitalizing school buildings in individual localities.

Limitations of the Study

1. This study was limited to information available from related literature and interviews with students, teachers, school administrators, architects, and educational consultants.

2. This study was limited to an analysis of nine revitalized public school facilities located in Virginia, Tennessee, and North Carolina.

3. This study was limited to schools that have been revitalized since 1985.

Definitions of Terms

Modernization

Modernization is the process of bringing an existing school facility up-to-date structurally, environmentally, and educationally. Spaces within a school are reshaped, equipment is replaced, and energy saving materials are used. Castaldi (1987) in Educational Facilities emphasized that "modernization accommodates a forward-looking educational program" (p. 371).

Rehabilitation

According to Castaldi (1987), "rehabilitation is a form of deferred maintenance" (p. 371). A rehabilitated school building is simply put back into the same condition that it was when it was constructed. The improvements make the building look better but do not change the facility to match the educational program.

Remodeling

Remodeling is very much the same as rehabilitation except there may be changes in the size and shapes within

the building. A remodeled school facility can improve the educational program (Castaldi, 1987, p. 371).

Foot-lambert brightness

Foot-lambert brightness refers to the average brightness of any surface or the uniform brightness of a perfectly diffusing surface, emitting or reflecting one lumen per square foot (Webster's New International Dictionary of the English Language, 1980, p. 984).

Revitalization

For the purpose of this study, revitalization constituted any effort by a public school system to modernize, remodel, or rehabilitate a school building.

Procedures

A study of information in the field of educational facilities was made to understand how school facilities developed and presently function as part of the education program. The sources used to trace the development and function of school facilities were books, ERIC documents, government publications and periodicals from the East Tennessee State University Library and from the Inter-Library loan service.

A list of planning elements for revitalization was developed after reviewing the literature. On-site visits were made to modernized and renovated school facilities to

study the planning of the individual projects. An interview guide was developed to aid in the collection of data from individuals involved in the revitalization of the selected school facilities. Interviews were conducted with students, teachers, school administrators, architects, and educational consultants to help identify the planning process in the revitalized schools. An analysis of the planning elements and the use of these elements by the revitalized schools was included in the study.

Organization of the Study

The study was organized into five chapters:

Chapter 1 contains the introduction to the study, the statement of the problem and subproblems, the purpose of the study, significance of the study, research questions, assumptions, limitations of the study, definitions of terms, procedures, and organization of the study.

Chapter 2 contains a review of literature and research relevant to the revitalization of school facilities. This chapter includes the historical development of educational facilities, the relationship between educational facilities and student achievement, the condition of existing school buildings in the United States, the principle areas of concern when planning for the modernization of educational facilities, and specific elements of planning for the revitalization school buildings.

Chapter 3 contains the development and design of the study. This chapter includes procedures for identifying elements in planning the revitalization of public schools. The procedure for the on-site visitation of selected public school facilities is also included. The data checklist used at each school site is described and also the treatment of the data collected.

Chapter 4 includes the data analysis of the information provided by the on-site visits to individual revitalized schools.

Chapter 5 presents the summary, findings, conclusions, and recommendations of the study.

CHAPTER 2

Review of the Literature and Research Relevant to the Revitalization of School Facilities

The purpose of this chapter was to review the literature and research related to the study of school facilities. The first section of the chapter traced the development of educational facilities in the United States from its beginning to the present and analyzed the changing function of the school building in the educational program of the school. The second section in this chapter explored research relating to the effect of school buildings on student achievement. The condition of schools in the United States was recorded using the latest comprehensive government document on this subject. The chapter also included a study of the principle areas of concern in planning for the renovation and modernization of educational facilities. Specific elements in planning revitalization projects were listed and described, and information about selected modernization projects was included.

Historical Development of Educational Facilities

In the study of school buildings and their development, it is of historical value to remember that "in the beginning there were no educational facilities at all" (Castaldi, 1987, p. 3). The church was responsible for the education

of the colonial children, so the church buildings were common places to conduct educational activities (CEFP, 1991, p. A2). In the dame schools of the colonial period, students were educated in private homes by women who took care of household duties while instructing students in counting, Bible study and the alphabet (Pulliam, 1987, pp. 25-26).

Although the nation was quick to understand the value of an education for its citizenry, there was little concern about the actual buildings where this education would take place. School buildings were constructed out of the raw materials available to each individual locality. The school building as an architectural form did not come into existence until the middle of the 20th century (Castaldi, 1987, p. 7).

According to Gilliland and Womack (1973), "the one-room school building was the first facility used for educational purposes" (p. 257). This simple structure paved the way for the school buildings that we have today. The one-room schoolhouse of the Colonial period was a very rough shelter with walls and a roof, equipped with long benches for students. There were boys and girls of all ages in the same room under the direction of a single teacher (CEFP, 1969, p. 11). Even as late as the 17th and 18th centuries, Castaldi (1987) found, ". . . American schoolhouses had progressed very little beyond the ancient notion that they

were simply shelters in which pupils and teachers might come together" (p. 13).

In the one-room schoolhouse, a system of education was developed which could be accommodated in one large room. The Lancastrian system of education was adopted in 1806 in this country, with the first school of this type located in New York City (Pulliam, 1987, p. 57). The Council of Educational Facility Planners (1969) found that this system could educate 500 students at one time in a space 50 by 100 feet (p. 11). The Lancastrian system ". . . demanded the regimentation of a well-disciplined military unit, using one head or master teacher to instruct fifty assistant teachers who, each in turn, passed on the instruction to ten students" (CEFP, 1969, p. 11).

During the 1830s, as a result of the progressive ideas of Henry Bernard and other educators, school buildings were viewed as more than shelters to house students and teachers (CEFP, 1991, p. A2). Bernard stated that students would learn more efficiently from a building that enhanced the educational program. The transcendentalists of this time felt that it was important to ask children not only what they learned at school, but ". . . what they learned from the school house" (CEFP, 1991, p. A3).

By 1873 the concept of the kindergarten made a contribution to the idea of fixed furniture in the school building: "The kindergarten, with its emphasis on the

individual and his development as a social being, quietly started the trend to unbolting furniture from the floor and changing the whole concept of space use, storage, and equipment" (CEFP, 1969, p. 11).

In the latter part of the 1800s, there were some changes in the techniques of education which led to school structures of more than a single room. Educators began to study the needs of the students. With the more liberal approach to education introduced by Dewey, Pestalozzi, James and others, more space was needed for children to learn by doing (Pulliam, 1987, pp. 83-84).

The influence of John Dewey at this time also called for a change in the classroom environment. Educators began to recognize the need for planning a school building to accommodate varied teaching and learning styles. Gilliland and Womack (1973) found that "more creative teaching and using the out-of-doors as an environment for learning stimulated changes in buildings, giving greater emphasis to planning a facility to implement the educational program" (p. 258).

According to CEFP research (1969), however, ". . . much of the answer to this need resulted in merely stacking one-room schoolhouses one upon another, with the addition of an auditorium inside. . ." (p. 11). The most influential design of school structure was the Quincy School building. The Quincy School of Massachusetts contained 12 classrooms

with approximately 800 square feet in each room, an assembly hall on the top floor, and a basement (Gilliland & Womack, 1973, p. 257).

Until the latter part of the 19th century, Castaldi could find no evidence that there was any apparent relationship between schoolhouse design and architecture. Schoolhouse design consisted of the addition of classrooms, each new room exactly like the last (Castaldi, 1987, p. 14). Even when architecture became a part of some school facility planning, there was little regard for the needs of education. One researcher describes the school buildings at that time as "'. . . outsized buildings, characterized by unfunctional and undifferentiated space organization and unfunctional and noncreative design'" (cited in Castaldi, 1987, p. 14).

There were some interesting developments the years between the Kalamazoo Case in 1872 and the onset of World War I. After the Kalamazoo Case and a tax-supported free public education system was established in the United States, there was a demand for new programs of instruction for the older students. By 1900, manual training became a major feature of the secondary school along with attention to physical education, commercial training, and college preparatory instruction (CEFP, 1969, p. 11). Buildings were forced to change in order to meet requirements for courses in machine shop and woodworking. Physical education became

important because the nation realized that a tremendous number of young men were in such poor physical shape that they could not fight in World War I. Indoor and outdoor physical education areas made new requirements on the school facility and its site (CEFP, 1969, p. 11).

Although the construction of school buildings was slowed during the depression years, there was a new federal interest in educational facilities. Between 1933 and 1937, government money, through the Public Works Administration, was used to finance school building construction (CEFP, 1985, p. A-3). This commitment by the federal government led to a move to develop building standards at all levels of control (state, federal, and local). Building schools became an enormous business with new rules and regulations (p. A-3).

The CEFP (1985) found that during the 1950s school buildings began to change: "The Quincy 'box' was broken as single-story, rambling schools were developed featuring cluster, finger and campus plans" (pp. A-3, A-4). School construction made use of the new building materials such as plastic and concrete. There were new types of desks and other furnishings; teaching aids and storage areas became a consideration in school planning and design of schools (CEFP, 1991, p. A6).

In the 1960s school facilities responded to new concepts in education. The idea of open spaces, carpeting,

air conditioning, movable walls, and pods became a factor in planning schools. Also during this period there was a move to use modular construction for schools. The Ford Foundation Educational Facilities Laboratory at Stanford University designed modular schools which could be put together on the site. The project was called School Construction Systems Development (SCSD), and it developed ". . . structural systems, light-ceiling systems, HVAC systems and interior partitions" (CEFP, 1985, p. A-4). School building design and construction was moved into the age of technology (p. A-4).

The most notable change in school facility planning in the 1970s was the attempt to make school buildings barrier-free educational facilities. Renovation and modernization became serious concerns for school planning teams as they coped with making schools accessible to all students. As energy costs soared, school building projects included the use of insulation and new methods for heating and cooling school plants. There was also a concern to humanize the school environment for the students (CEFP, 1985, p. A-5).

Studies by the CEFP (1985) listed four challenges for educational facility planners in the 1980s and 1990s:

* Insuring that facilities respond to programmatic needs and that they are flexible enough to accommodate future programs.

* Achieving new building designs for maximum energy efficiency.
* Coordinating the work of other specialists to achieve an optimal product.
* Engaging the users of educational facilities in the planning process. (pp. A-5, A-6)

Educational Facilities and Student Achievement

As the role of the school building began to change, studies were initiated to investigate the relationship between the educational facilities and actual student achievement. Lilley (1985) in "Evaluating the Effect of Image on the Success of a Facility," began his article with only three words, "Facilities affect people" (p. 7). According to Lilley, a facility is deemed a success or a failure by the image it projects to the people who use it. Students, teachers, staff, administrators, and visitors are affected both on the conscious level and the subconscious level by the appearance of a facility. If a school facility is successful, students and teachers will want to be there. If the facility is unsuccessful, ". . . the failure or partial failure of an educational program may be the result" (Lilley, 1985, p. 7).

Kurent and Olson (1990) concluded in their study that "educators will increasingly perceive that different environments are appropriate for different learning styles

and special kinds of subject matter" (p. 10). The American Institute of Architects Committee on Architecture for Education (1991) reported there is a new appreciation for the educational environment; quality and innovative educational environments help improve the educational program for students (Cited in Christopher, 1991, p. 10). Research concluded that school building design should be a reflection of the needs of the individual educational programs (Kurent & Olson, 1990, p. 1-2).

Keller (1986), a consultant for interior design in Alaska, has studied the effect of interior design on student achievement. She found that students are clearly affected by their immediate surroundings. Keller (1986) concurred with other research studies which found there are decided advantages of the environment enhancement of the school building on the productivity of students and teachers (p. 19). In her evaluation of educational specifications, Keller (1986) concluded, "addressing the interior environment is a common way to show conscientious concern for the total school environment" (p. 19).

An aesthetic environment in an educational facility also affects student learning (Chan, 1988, p. 26). According to Chan, research indicated that student achievement in buildings with higher aesthetic standards is significantly better than the student achievement in buildings with poor aesthetic quality. Because "the

building teaches," by demonstrating values and order in the educational system, ". . . better student learning is achieved as a result of an improved aesthetic environment" (Chan, 1988, p. 26). School building aesthetics also influence student attitudes. Positive attitudes contribute to student achievement and student behavior. Students have more positive attitudes in school buildings with better aesthetic surroundings. According to Chan (1988), creating positive student attitudes provided a powerful source of learning motivation (p. 27).

A study by Bowers and Burkett (1989) found a relationship between school environment and student achievement, attendance, behavior, and self-concept. The research indicated that students in the modern building scored significantly higher in all areas of the study than students from the older facility. Even when differences in the socioeconomic levels of students were taken into consideration, the results remained the same. Students in the modern building performed better on achievement tests, attended school more often, had fewer behavior problems, and demonstrated better self-concept than students in the older facility (Bowers & Burkett, 1989, pp. 28-29).

Goldberg (1991), editor of Radius, recently presented an issue of this publication for the purpose of examining the relationship between the educational visions inherent in the restructuring of schools and the actual physical spaces

in which these visions are being realized (p. 1). One of the questions that he addressed was ". . . does changing the school environment have any appreciable effect on student learning and achievement?" (Goldberg, 1991, p. 2). According to Goldberg, researchers could not draw a tight boundary between what a student learns and the effect of the conditions in which the learning takes place. He also found that the use of multiple choice tests may not be the best way to test what a student has actually learned; testing of this sort measures only what the student knows, not what he or she can do (Goldberg, 1991, p. 2).

In order to test student achievement, it is necessary to have an environment in which a student can be tested both on what he knows and what he can do. This type of testing will require more than a quiet room and a desk which has been the typical testing situation of the past. In order to test the effectiveness of an educational program, methods of testing will have to be restructured, and facilities for supporting the program and testing it will also have to be restructured. Goldberg (1991) concluded, the use of "radically different measures of student achievement . . . might indicate that environmental variables are instrumental in motivating improved performance as well as in assessing it" (p. 3). In the past most research has taken place in traditional school models, therefore, "the link between

environment and learning remains confusing" (Goldberg, 1991, p. 3).

Even though it is difficult to measure environment and learning, researchers have found that "physical structures do affect social environments for learning" (Goldberg, 1991, p. 3). Banning, a Colorado State University psychologist, found that "classrooms created with special attention to seemingly minor environmental characteristics . . . lead to improved student interaction with materials, decreased interruptions, more substantive questioning and the like" (cited in Goldberg, 1991, p. 3).

Chan (1988) found in his research that positive student attitudes are a powerful source of learning motivation that can be improved by upgrading the aesthetic surroundings of school buildings (p. 27). Babineau (1991) predicted ". . . a great need to begin developing along with teachers and other educational specialists environments that will be needed to implement the educational programs of the future" (p. 10). The school is not simply a place or an organization; it cannot separate itself from the learning which takes place within the physical and organizational structure (Crowell, 1989, p. 62).

Condition of Existing School Facilities

The report by the Education Writers Association (EWA) (1989), Wolves at the Schoolhouse Door: An Investigation of

the Condition of Public School Buildings, is a document based on information gathered from a representative sample of approximately one-half of the public school buildings in the United States. The investigation found that:

> * 25% of the nation's school buildings are shoddy places for learning. They lack sufficient space, suitability, safety and maintenance for the students and teachers in them.
>
> * An additional 33% are only adequate and because of growing enrollments and deferred maintenance could easily become inadequate.
>
> * The remaining 42% are in good condition, many of them offering starkly superior environments compared to those in school districts even in the same state because their communities can afford them. (EWA, 1989, p. 1)

The EWA reported that of the 25% of school buildings that are inadequate, "61% need maintenance or major repairs, 43% are obsolete, 42% have environmental hazards, 25% are overcrowded, and 13% are structurally unsound" (EWA, 1989, p. 4). Of the existing school buildings, "61% of the school buildings were constructed during the 1950s and 1960s; 20% are older than 50 years; only 6% have been constructed during the 1980s" (EWA, 1989, p. 4). The EWA predicted that "only 39% of the projected funding needs for construction

and renovation will be met between 1989 and 1992" (1989, p. 2).

Although most states are aware of the condition of their schools, the EWA found that should anyone need to study the problems of existing school facilities from a state or national level, there is not an adequate data base for the investigation of school buildings. The EWA (1989) reported that "very few states have information sufficient for an assessment of school facilities, although all of them bear some responsibility for the safety of their school facilities and set space requirements" (p. 3). The report also found that "of the 38 states covered in the EWA survey, 33% have one employee or fewer in the state education department responsible for facilities" (1989, p. 6). Although states use a variety of ways to educate personnel about school facilities, the EWA (1989) was not able to find a comprehensive university program directed specifically toward facility planning (p. 6).

The EWA found there are five major areas of concern when studying existing school facilities in the nation today:

Construction Deficiencies

One area of considerable interest is the construction deficiencies of school buildings. More than half of the schools in the United States were built during the baby boom

years, during the 1950s and the 1960s. Many of these schools have only a 35-year life span as compared to the 50-100 year life span for schools built from 1900 to 1960 (EWA, 1989, p. 8). Approximately 20% of the school buildings still in use in the United States were built before 1939; many of which are covered by grandfather clauses which allow them to operate below building, health, and safety code levels (EWA, 1989, p. 9).

Growth

Growth is another major area of concern because it is often difficult to predict and in many cases even much more difficult to fund. The EWA studied growth patterns and the problems of the school construction process throughout the nation. They found that some areas will need more schools than others in the near future. California predicts that it will need 800 new schools by 1993, and Florida needs 816 new schools in the next 10 years (EWA, 1989, p. 2). In order to meet the demands of increasing enrollments, school districts are having to build additions and retrofit existing buildings. The EWA found that since 1982, more money has been spent on additions and modernization than on new construction. Research indicated that the process for any kind of school construction is very bureaucratic. In California it can take up to five years to complete the approval process for school construction (EWA, 1989, p. 14).

Maintenance

Many of the statistics in the EWA investigation were the direct result of deferred maintenance by school districts across the nation. A look at maintenance practices and principles as presented by the EWA report helps to clarify the condition of school buildings in the 1989 investigation. According to Benjamin Handler of the University of Michigan, there are five phases of school buildings:

* Phase one, the first 20 years of a building's life. Maintenance costs normally are limited to minor repairs and small improvements to reflect changes in the instructional program.

* Phase Two, the period between 20 and 30 years. Facilities require increasing amounts of annual maintenance and more frequent replacement of worn-out equipment.

* Phase Three, from 30 to 40 years. General maintenance needs increase rapidly. Most of the original equipment should have been replaced, and major items, such as roofs and lighting fixtures, will need replacing during this time period. These should not be viewed as emergencies but as necessities arising from the natural aging of the building.

* Phase Four, from 40 to 50 years. This is a time of accelerated deterioration. In most instances, the

needs, neighborhood or community have changed, and the school, for instance, may no longer be located where the children are. A 50-year-old building frequently is too new to abandon (if well-constructed) but too old to be an effective resource of the district.

* Phase Five, more than 50 years old. Usually, the building should be completely reconstructed or abandoned. (cited in EWA, 1989, p. 17).

The statistics reporting the actual age of schools in the nation along with the information about the life cycle of a school building combine to produce a bleak picture of the maintenance concerns for school districts today. The EWA (1989) reported that "20% of the nation's school buildings are at least 50 years old; 34% are between 30 and 50 years old; 40% are between 10 and 30 years old; and only 6% were built less than 10 years ago" (p. 16).

The percentage of school budgets spent on maintenance has dropped from 11% in 1950 to 3.3% in 1986. Of the amount of money designated for maintenance, approximately 85% is actually spent on emergency repairs, not routine maintenance (EWA, 1989, p. 16). There is an effort now by the National Research Council to develop a model for diagnosing the condition of public school buildings. The model will allow administrators to assess the projected cost of maintenance for the schools in their districts, and it will let the

administrators know the long-range impact of neglecting prescribed maintenance (EWA, 1989, p. 19).

Safety

The safety issues in the EWA report are confined to asbestos removal, lead, lead in water, radon, and playground equipment. The asbestos problem is the most critical concern of the schools at this time. The EWA identified the major issues dealing with asbestos removal:

* If removal is done improperly, the level of exposure could be increased, rather than decreased.
* Disposal is expensive and sites are limited. If school buildings are demolished or turned over to other groups/agencies, asbestos must be removed first.
* The costs have been underestimated generally.
* If emergency repairs on school buildings involve asbestos, the repairs will need to be done by those trained and certified to remove asbestos safely. The same is true for renovations or simple plans for rewiring school buildings.
* Asbestos removal represents an on-going cost to school districts because of the required periodic inspections and continual training of employees. (EWA, 1989, p.21).

If state education departments act wisely by systemizing all information, blueprints from schools and frequent updating, there is a potential for the development of state educational facility data bases (EWA, 1989, p. 21).

Changing Programs and Philosophies

Programs and philosophies in education continue to change as more state and federal mandates are issued to schools. The EWA considered several federal regulations which require more space in the existing schools. Some of the areas included are education of the handicapped, Chapter I and bilingual education, and sex equity for girls (EWA, 1989, p. 21). In addition to these space requirements due to federal mandates, states impose new demands on school facilities by requiring special gifted and talented classes, remedial classes, relevant vocational education courses, courses on drug and alcohol abuse prevention programs, sex education, and many other newer programs (EWA, 1989, p. 23-24). The EWA predicted that interdisciplinary team teaching, flexible space use, and cooperative learning are strategies that may become popular again as more research indicates the effectiveness of these methods. The EWA also noted that the winners of the Architectural Portfolio awards of American School and University recognition were schools designed for long-term, flexible use. The winning schools

were built with an eye on the future when the buildings could no longer be used as a school (EWA, 1989, p. 24).

Principle Concerns in Renovation and Modernization

School facility modernization is much more difficult and takes more planning time than designing a new school building. It is easier to erase lines on the planning board than it is to actually remove walls in an existing building. When school districts are confronted with the problem of modernizing or replacing a school, however, there seems to be a stronger desire to save the old building rather than build a new one. English (1987) found old schools to be excellent examples of period architecture (p. 32). Castaldi (1987) maintained that citizens choose to modernize for two reasons: they feel a sense of loyalty to the old school, and they think that it will be less expensive than to build a new school building (p. 377). Research indicated that there are four basic areas of consideration when deciding whether or not to modernize an educational facility. Each of these areas is discussed in detail.

Structural Soundness

It has been found that school buildings generally become obsolete (can no longer serve the educational program) before they become structurally unsound (CEFP, 1985, p. C-11). Any school facility under consideration for modernization must meet federal, state, and local building

codes. Cracks in walls and floors, sagging, and moisture penetration demand investigation. Floors must be examined in terms of floor load capacities and future load requirements. The framework and the roof should be inspected for stability. Structural soundness cannot be ascertained by a cursory visual examination of the building. The building must be opened up in several places to understand the actual structural condition of the school (CEFP, 1985, p. N-4). Some older buildings are actually stronger than necessary, with safety features far greater than required by modern building regulations (Milner, 1989).

Program Support

Program support is one of the most complex of the basic issues when considering the modernization of a school building. An architect with experience in developing educational specifications is essential in this phase of decision making. Although the decision to modernize is made in good faith, it is almost impossible to modernize a school building without making compromises in program expectations (Castaldi, 1987, p. 390). The educational program support takes into consideration more components than the courses to be taught and the location of the classroom spaces. Program support includes the identification of activity areas such as classrooms, labs, shops, food service areas, etc., and the recognition of the experiences planned for the spaces.

Knowledge of program support requires that the architect understand how many students and teachers will use each space, what activities they will perform while in the space, what type and size of groups will be using the space, what they will be doing as a group, how many groups will operate at the same time and many other considerations necessary for the intended educational program (CEFP, 1985, pp. E-5, E-6).

The modernized facility may be required to support program areas where the utility needs are very different. Labs may need natural gas, and shops may require compressed air. Utilities include hot and cold water, telephones, closed circuit television, electrical requirements and even vacuum systems (CEFP, 1985, p. E-6).

Storage and display areas must be envisioned in the program support of the building. The architect should know approximately how many square feet are necessary in order to determine how the program needs for more storage and display areas can be met in the existing structure (CEFP, 1985, p. E-6).

Program support also includes the circulation of students both in and out of the building and their safety in moving about from one area to another. The needs of handicapped students are sometimes difficult to accommodate in an older school building (CEFP, 1985, p. E-7). Many schools have added elevators to allow handicapped students to move freely from one floor to another.

Site

The adequacy of the site of an existing building is crucial to the decision to modernize the structure. The CEFP (1985) maintained that the site on which a building is located is as important as the building itself (p. F-2). The site determines the success of the school facility to support the educational program. Site affects the cost of modernization, the transportation needs, the number of students that can be accommodated, and many other factors.

The modernization of a school building demands that the site must be viewed in terms of the play and athletic areas for the school, and the safety of these areas for the students who use them (CEFP, 1985, N-6). Planners have traditionally tried to build schools on land that is accessible, well-drained, and pleasing. In addition to these requirements, sites now have become important in light of social, political, and ecological issues (CEFP, 1985, p. F-2). The site of a building may be the determining factor of a racially balanced enrollment, or the site may lend itself to school and community use years into the future (CEFP, 1985, F-2).

Sites purchased during the 1950s and 1960s were chosen on the basis of projected need because steady growth was common; therefore, many of the schools constructed at that time were located on relatively large areas of land (CEFP,

1985, p. F-3). It is sometimes possible to buy additional land adjacent to the original site when addition to an existing school building is a possibility (CEFP, 1985, p. N-6). The results of the testing laboratory engineer can determine water seepage and assess the load-bearing capacity of the soil in the original site and of adjacent areas under consideration (CEFP, 1985, p. F-4).

Cost

To estimate the cost for the proposed modernization of an existing school facility, the CEFP (1991) advocated using the life-cycle technique and benefit/cost analysis (p. N4). The life-cycle technique adds up all of the expenses anticipated during the life of the modernized building. This includes not only the initial cost of the modernization, but interest on the financing and the projected costs of maintenance and operation (CEFP, 1991, p. K7). The cost of operating a school building includes all of the expenses to maintain daily activities, such as heating, cooling, lighting, and insurance (CEFP, 1991, p. K7). When some part of the school building must be repaired, it is considered a maintenance cost.

The cost/benefit analysis expresses in monetary terms the value of the modernized building compared to the actual cost of the modernization. This type of analysis is more difficult because it is hard to place a dollar value on an

intangible factor such as beauty. Benefits are also given different values by different people. One way to overcome some of the difficulty of making a cost/benefit analysis is to cancel out the benefits which will be the same regardless whether the school is modernized or replaced (CEFP, 1991, p. K8). Research suggested that when the modernization of a school building approaches 50% of the estimated costs of replacing the building, it is wise to reevaluate the condition of the existing school facility (CEFP, 1991, p. N5).

Structural soundness, program support, site, and cost are the four broad considerations when making decisions involving possible modernization of existing school facilities. Should a school building be unable to meet the requirements of any one of these areas, the situation should be reviewed again. A school building may be modernized for another function instead of continuing to operate as a school.

Elements in Planning Revitalization Projects

Once the decision has been made to revitalize a school building, many factors must be considered in the planning process. Although the educational specifications must always be one of the first elements to be considered, there is no specific order to the elements in this study. Research indicated that each element should be part of the

overall planning process in revitalizing an existing school building.

Educational Specifications

The educational specifications serve to link the educational program and the technical requirements of the school building. The specifications outline what the educational planners want to accomplish regarding people, activities, and relationships within the school (Affleck & Fuller, 1988, p. 10.) The document is a way for the educator and the architect to communicate. The architect uses the information in the educational specifications document to base decisions about the building and its ability to comply to educational program needs (CEFP, 1985, p. E-2).

Site Condition

Even though the site may be large enough to accommodate the educational program of a school, there are still many factors to consider during the modernization process. It is necessary to be aware of any existing structures on the site, such as buildings, walls, fences, rock outcroppings, cisterns, wells, and other areas which may prove to be dangerous or obstruct construction (CEFP, 1985, pp. F-12, F-13). The architect must know the locations, type and size of all meter boxes, gas and water mains, and hydrants. He must also know where the power lines are, as well as,

utility poles and telephone lines (CEFP, 1985, p. F-13).

A land-use plan should be in place indicating roads, walkways, parking areas, athletic fields, and outdoor learning spaces (CEFP, 1985, p. F-13). These areas should be evaluated in terms of safety, circulation, and accessibility. Planned lighting of the site is essential for the safety of the people who will use these areas (CEFP, 1985, p. F-15).

Outdoor learning spaces take advantage of the site as a learning resource. Planners should preserve any site features that will enhance the educational program (CEFP, 1985, p. F-16). If possible, natural features including streams, trees, and meadows should be reserved for the school (Stoneman, Broady, & Brainard, 1949, p. 178).

Pleasant landscaping is a visible indication of the importance of the school building and the educational program. There is a national movement toward creating inviting school grounds (Stoneman, Broady, & Brainard, 1949, p. 178). A good landscape architect can lay out the plans for landscaping the grounds (Stoneman, Broady, & Brainard, p. 184).

Playground Areas

Well designed playground areas provide safety for children and can enhance student development physically, perceptually, emotionally, and intellectually (Hawkins,

1986, p. 18). In the history of school facilities, prior to 1870 there was little consideration given to areas for children to play. Playground design now stresses the age of the students who will use the equipment and the location of the playgrounds. Schools and communities are beginning to construct school-community playgrounds. Research indicates there is better use of playgrounds and fewer incidents of vandalism, both of playground equipment and school buildings, when community parks are adjacent to school sites (Hawkins, 1986, p. 18).

Exterior Appearance

The school building is seen, sometimes daily, by the members of the community who pay taxes to support the operation of the school. Most people will have a more positive attitude toward a school that appears to be taking care of their investment (Davis & Loveless, 1981, p. 222). There are many factors which compromise the exterior appearance of a school building. Walls, windows, and doors are most obvious to people who use the facility. Outside walls need to be cleaned, especially when modernization calls for new walls joining the existing walls. Masonry walls below the grade level should be damp-proofed and waterproofed (Stoneman, Broady & Brainard, 1949, p. 197).

Windows present a number of problems in older facilities. Stoneman (1949) cited the lack of glass area as

a frequent defect in older school buildings. He found that the glazed area in many older buildings was often less than 10% of the floor area. According to Stoneman, glazed area should be at least 16% and up to 25% of the floor area (Stoneman, Broady, & Brainard, 1949, p. 201).

For many years there was a standard plan of left-hand lighting based on the assumption that most students were right-handed (Stoneman, Broady & Brainard, 1949, p. 199). Unilateral lighting practices resulted in classroom design in which all the windows are located on one side of the room only, with light coming from the left. These windows in older buildings are also often inaccessible for cleaning and require some type of repair or replacement (Stoneman, Broady & Brainard, p. 201). Castaldi (1987) advised that it is desirable and possible to control natural light by "overhangs, horizontal or vertical louvres, and externally mounted slats or venetian blinds" (p. 256). Stoneman (1949) recommends caulking and weatherstripping as soon as windows are repaired and painted (Stoneman, Broady, & Brainard, p. 202).

Exterior doors in school buildings are both visible and subject to heavy use by the building's occupants. Davis (1981) reported that "a problem often found in older buildings is that the hardware is not of duty construction and cannot take the jolts and slams of continuous usage" (p. 206). He advised replacing older hardware with new

heavy hardware and checking the operation of door holders and door closers often to prevent damage to the door or the wall (Davis, 1981, p. 207).

The roof is also a very important consideration when modernizing the exterior of the school building. According to Ornstein (1990), the number one expense to the nation's schools in repair bills during the 1988-89 school year was spent on roofs; roof repairs cost America's school systems $189.4 million (p. A2). The purpose of any roof is to protect the interior of the building, provide protection against the spread of fire, and prevent dampness (Stoneman, Broady, & Brainard, 1949, p. 189). One of the most difficult problems in repairing a roof that leaks is finding the place where the water is entering. A leak can develop around a drain pipe, vent stack, ventilator, chimney, or flashing (Stoneman, Broady, & Brainard, p. 191).

There are five types of roof membranes which are presently used on school facilities, (1) built-up, (2) single-ply, (3) seamed metal, (4) shingle and felt, and (5) tile. Each type of roof membrane is repaired differently (Hubert, 1987, p. 11). There is no one best method of repairing roofs, so it is necessary to take the advice of people who are experienced in roof repair (Stoneman, Broady & Brainard, 1949, p. 192). Since the roof membrane is a consumable building element, it is necessary to establish a roof management program to protect this investment (Young,

1987, p. 14). A brief description of Young's roof management program is included in Appendix A.

A final element in the modernization of the exterior of a school building is painting. Both wood and metal exterior surfaces should be painted as often as necessary with the best quality paint available for the particular surface. A school building will deteriorate rapidly if the exterior is not maintained (Stoneman, Broady, & Brainard, 1949, p. 205).

Space Utilization

Learning spaces should support the educational program. If space is used effectively, the use can contribute substantially to the realization of the school's mission. Space which is not used costs the school. Stanton Leggett (1985) calculated that the expense to a typical elementary school which fails to use a classroom is approximately $14,750 a year, or "one room, provided and not used well, equals the price of a starting teacher" (p. 4).

The Council of Educational Facility Planners (1991) reported that a learning space "should effectively contain the types of learning activities planned and yet be versatile enough to accommodate other learning situations if necessary" (p. G2). General learning spaces refer to spaces that serve a large segment of the student population in a variety of content fields and activities. In planning general learning spaces, the number of students using a

space must be a planning factor, both for activity space and storage (CEFP, 1991, p. G3). Spaces for elementary students and early childhood learning should use surfacing materials suitable for center activities, such as, resilient floors, washable vinyl walls, carpet, personal areas which include corners, lofts, and pits (CEFP, 1991, p. G3). Classrooms in high schools should respond to spacial requirements including specialized learning spaces. There should also be areas for socialization for this age student. The commons area is now found in many high schools (CEFP, 1991, p. G4).

Learning areas for computer instruction present unique planning problems in both elementary and high schools. Computer laboratories require more space than a regular classroom. Factors especially relevant for this type of area include dust-free boards, many separate electrical circuits and outlets, more than the usual number of cabinets, storage spaces and shelves, and a temperature control unit that is independent of the rest of the building (CEFP, 1991, p. G9).

Other specialized learning spaces include areas for visual arts, performing arts, music, science laboratories, distributive education areas, business education spaces, areas for home arts, and industrial art spaces. Both elementary and secondary schools also require indoor facilities for physical education activities. Each of these areas are in addition to general learning spaces, and there

must be individualized planning for each school situation. The CEFP (1991) recommended that "for all program areas it is highly essential to have staff participation in the planning for each of the specific programs" (p. G2).

Basil Castaldi (1987) stated that "the least costly conversion from one space use to another is one that requires only a change in room label" (p. 390). Research indicated school planners should actively look for spaces that can be used as they are in the existing building. Castaldi cited examples of how rooms can serve new space demands: a classroom could become a drafting room; a typewriting room could be used for large-group instruction (p. 390). Sometimes a cluster of rooms can be modernized to fit new educational functions with very little cost because the rooms do not require major changes in the spaces.

It is also possible to save money by converting existing large spaces into smaller ones (Castaldi, 1987, p. 391). Castaldi suggested computing the total area of each existing large space and the total area of desired clusters of related spaces to see if there is a match. Obsolete assembly halls and outmoded gymnasiums offer a number of options when modernizing an existing school building (Castaldi, p. 391).

Although it is much easier to convert a large space into many smaller spaces, it is sometimes possible to house large-space functions in a cluster of small spaces. The

conversion of a wing of small rooms into the school learning resources center was cited by Castaldi (1987) to show how this modernization technique can be effectively applied (p. 392). Areas not visible to the librarians were monitored by television cameras.

Castaldi (1987) cautioned facility planners about load-bearing walls: "from the standpoint of cost and structural considerations, the removal of load-bearing partitions should be kept to the absolute minimum" (p. 393). He suggested vision strips or closed-circuit television as an alternative to removing load-bearing walls. The removal of nonbearing walls, however, does not usually present a problem when modernizing for space utilization (Castaldi, p. 393).

Conditions of Mechanical and Electrical Systems

The mechanical and electrical systems in an existing building require analysis during the modernization process. All equipment within a school must be rehabilitated when an existing building is modernized (Castaldi, 1987, p. 394). In some schools the heating system may need to be replaced, or there may be reason to change from one heating source to another. Plumbing fixtures and lighting fixtures may need to be replaced, and ventilation equipment may need new motors and control systems (p. 394-95). It is necessary to bring all electrical systems up to code. There should be

provisions for fire alarms, clocks, telephones, television, additional electrical outlets, and lighting (CEFP, 1991, p. N4). Both interior and exterior lighting are included in the electrical system (Stewart, 1984, p. 9). Some modernized schools will be able to take advantage of computer based energy management systems to control for heating, ventilation, and air conditioning (Ray, 1989, p. 66).

Energy Efficiency

A report on the school energy crisis by Neill (1977) stated, "the FEA estimates that approximately 25 million barrels of oil -- out of the 170 million barrels consumed annually by schools -- could be saved if 30% of the nation's elementary and secondary schools were renovated or 'retrofitted'" (p. 6). In the same report, Stephan, Deputy Director of Industry/Association Programs for the Department of Commerce's Office of Energy Programs, asserted that "schools can reduce their energy consumption 5 to 25% with no capital modifications by changes in operating methods" (Neill, 1977, p. 6).

There is no single method to conserve energy in a school. Air quality should not be sacrificed for energy conservation, but most schools are not in a sealed building situation (Keith, 1985, p. 20). Stephan listed seven main

energy problems of schools and how to correct for these particular problems:

1. Excessive air brought into the system. States are now requiring 10 to 20 cubic feet per minute per student. The National Bureau of Standards indicate that they will lower the required cubic feet per minute which will mean that less air will be heated and cooled.
2. Inefficient boilers. Boilers should be modified or replaced.
3. Poorly maintained and poorly operated unit ventilators. Filters should be cleaned and ventilators should be serviced.
4. Fenestration (windows). Reduce infiltration and exfiltration.
5. Insulation. Insulate the school roof.
6. Vestibules. Build vestibules.
7. Lighting. Use quality lamps and keep them clean.

(Neill, 1977, p. 40-41)

The Educational Facilities Laboratories advised all school districts to review operations and maintenance procedures each year. If operating costs are high in comparison to maintenance costs, there may be a serious loss of energy. The EFL advised as a general rule the operating costs of a school district should range between three to

four times as much as the maintenance costs. A higher ratio should be investigated (Neill, 1977, p. 45).

Neill reported that "the United States, with 6% of the world's population, consumes about one-third of its energy" (1977, p. 9). Schools are commercial users of energy. Colleges, hotels and motels, hospitals, stores, apartments, supermarkets, offices, and schools are the eight building types that consume 90% of the energy in the nation's commercial market (Neill, p. 59). The National Petroleum Council listed 15 energy conservation measures that should be used in these buildings. These measures are listed in Appendix B. Gardiner (1985) documented energy savings and cost-effectiveness of energy conservation measures in 150 schools and colleges (p. 19). She found that "commercial building retrofits are saving energy, and most have short payback periods" (Gardiner, p. 21).

Research indicated some schools are trying to cut energy consumption by using relatively simple modifications to existing school buildings. The Topeka High School in Kansas simply replaced windows and insulated pipes for an almost instant savings of 8% to 10% in energy consumption costs (Clark, 1984, pp. 21-22). The Kansas report confirms that all capital improvements, including maintenance and modernization, should contain as many conservation techniques as possible (Clark, p. 22).

Barrier free environment

Approximately 10% of public-school-age children in the United States are handicapped (Brooks, Conrad, & Griffith, 1980, p. 211). In order to plan a facility for handicapped students, the program activities must be analyzed and the building must then accommodate the educational functions (Davis & Loveless, 1981, p. 229). There are several very basic considerations when modernizing a school building to meet the needs of the handicapped population:

1. Special consideration should be given to providing elevator services if it is a multi-story facility.
2. Ramps for wheelchairs or students with walking problems must be designed.
3. Door widths should be wide enough to allow passage of wheelchairs and other transportation aids or devices.
4. Doors should be designed to be opened very easily. See-through doors are necessary so that handicapped students can see beyond the door and anticipate problems that might arise when someone else is about to open the door.
5. Wider corridors are needed for wheelchairs and greater walking space.
6. Safety features must be designed for use of the bathroom, playground, and multi-use areas so that students with a variety of handicaps can participate

in a logical sequential manner. (Davis & Loveless, 1981, p. 229-30).

P.L. 94-142 stated that all handicapped children regardless of the type or severity of their handicaps shall receive a free public education in the least restrictive environment (Heward & Orlansky, 1988, p. 43). The least restrictive environment means that a child should be removed from a regular classroom only when there is clear evidence that removal is necessary for the child to receive appropriate instruction (p. 44). School facility planners must anticipate the needs of the handicapped and design school buildings which will not prevent handicapped children from their legal right to an education (p. 45).

Thermal Environment

Facility planners recognize that "there is more to the thermal environment of a school building than the HVAC system operating within it" (CEFP, 1991, p. 114). A number of interrelated factors affect air temperature and quality. These factors include the building orientation, trees, color of building, climate, shading devices, insulation, lighting, and number of students and their activities (CEFP, 1991, p. 114-115). The thermal environment also depends upon the orientation of windows, the number and size of windows, and the insulative qualities of the windows (CEFP, 1991,

p. 114). Although there has been some speculation about windowless schools, the "Architects' Consensus" (1964) found most architects do not advocate windowless schools (p. 63). Research findings also indicated there may be a relationship between absenteeism and windowless schools: "the rate of student absenteeism was higher in the windowless school than in schools with windows" (Harting & Delon, 1990, p. 9).

The CEFP (1991) stated, "an important goal in creating a thermal environment that does not make excessive energy demands is to minimize uncontrolled or unwanted heat transfer through the building shell" (p. 115). This means that facility planners must use insulation wherever possible to keep heat in the areas that are being heated, and to keep heat out of the areas that are being cooled. Door and window treatments are necessary when considering a building shell. The open space design of school buildings has caused problems in the use of thermal equipment because of the decrease of wall space for ducts and because of the changing educational spaces created by moveable walls (CEFP, 1991, p. 115).

Acoustics

There are two factors involved in designing a good acoustical environment in a school:

1. controlling sound within a particular space so that sound that is to be heard can be heard well, and

2. preventing the intrusion of unwanted sounds from outside the space. (CEFP, 1991, p. I10)

The acoustical treatment of an area attempts to amplify wanted sound and reduce unwanted sound. Since sound travels not only through air, but through solid substances as well, the success of an acoustical treatment depends largely on the types of materials used on the space surface. A hard surface tends to reflect sound, while a soft surface tends to absorb sound (CEFP, 1991, p. I11).

Even though facility planners recognize the importance of acoustical materials, they must also know how to distribute these materials within the school for maximum acoustical control. According to Castaldi (1987), "acoustical materials are not as effective when applied over an entire ceiling as when they are applied in other locations" (p. 246). Castaldi (1987) reported that in some classrooms where the entire ceiling is treated, the quality of hearing conditions is poor because there is excessive sound absorption (p. 246). The main points to remember when trying to produce good hearing conditions in a school are, there must be sufficient sound-absorption materials to achieve the optimum number of reverberation times within the room consistent with the function of the room, and the sound-reflective properties of the ceiling should be retained in order to improve the transmission of sound from

one end of the classroom to the other (Castaldi, 1987, p. 246).

Carpeting is an acoustical material that prevents as well as absorbs unwanted sound (CEFP, 1991, p. I13). Although carpet was once viewed as a luxury item in a school building, it is now a very important consideration in school facility design. Studies show that the pay-back period for carpeting in schools is less than 12 years (Castaldi, 1987, p. 250). Other functions of carpeting in schools are listed in Appendix C.

Facility planners try to reduce intruding sound to a minimal level of interference in school buildings. Unwanted sounds may be controlled by:

1. Selecting a school site that is removed from sources of unwanted sounds.
2. Suppressing them at the source.
3. Isolating noisy areas from quiet ones.
4. Acoustically (not necessarily physically) isolating noisy equipment from the rest of the structure.
5. Designing partitions possessing the proper sound transmission loss. (Castaldi, 1987, p. 247)

Background noise is made by sounds which come from within and outside of a space (CEFP, 1991, p. I11). Some of the components of background noise are coughing, chairs scraping on floors, water in the pipes, the hum of ventilating systems, and footsteps (CEFP, p. I11).

The CEFP (1991) findings indicated that certain types of background noises are not undesirable and that "a degree of generalized background noise is actually beneficial in that it masks objectionable sounds within the space" (p. I12). Acoustical problems can be solved by using effective sound insulation where needed, by creating optimal reverberant conditions in school spaces, by reducing sound interference from external sources, and by reducing unwanted sound (CEFP, p. I12).

Visual Environment

Frohreich (1986) stated, "perhaps the most violated environmental condition in classrooms is poor lighting" (p. 10). The visual environment of a school should promote the visual health of the students. Factors which affect the quality of the visual conditions in school spaces include natural and artificial lighting, brightness differences, fenestration, reflection coefficients and interior decoration (Castaldi, 1987, p. 251). According to Castaldi (1987), "research is still inconclusive regarding the absolute value of the level of illumination that should be maintained in various instructional spaces" (p. 252). One study did predict that "daylight, while more difficult to control than artificial illumination, is obviously going to look more attractive in the future than in the recent past" (King & Marans, 1979, p. 11). It is generally accepted that

the visual environment in a school should contribute to the learning environment.

Brightness ratio refers to the difference in brightness and intensity of illumination existing in a space (Castaldi, 1987, p. 254). In order to determine brightness ratios, the brightness of the visual task is compared with that of the surrounding field of vision (Castaldi, 1987, p. 254). The National Council on Schoolhouse Construction presented a criteria for creating an optimal visual environment on the basis of brightness goals (cited in Castaldi, 1987, p. 254). The criteria is listed in Appendix D.

The visual environment in a school is also affected by the light reflection characteristics of interior surfaces. An effective visual environment involves control of three factors: color and texture of interior surfaces, the intensity and quality of the light within the instructional space, and the shape, design, and orientation of the space (Castaldi, 1987, p. 255). There have been many studies confirming that much of the fatigue experienced by students in the classroom is caused by poor light and illumination conditions (White, 1990, p. 5). Castaldi (1987) suggested a number of ways to make dark areas brighter and to reduce high brightness areas:

1. Floors should be as light in color as possible.
2. Walls, including the wainscoting, should be quite reflective.

3. Ceilings should diffuse as much light as possible.
4. Chalkboards should be as light in color as possible.
5. Furniture surfaces, such as desk tops and chairs, should possess a light-reflecting factor of about 40%.
6. Adjoining surfaces should be finished in colors that create a minimum brightness difference.
7. High brightness should be controlled electronically, mechanically, or architecturally. (p. 255)

School lighting must also be flexible in response to the various activities that take place within the instructional spaces. Computers, audiovisual equipment, and other learning tools require different amounts and types of lighting. With the extended use of schools by the community, it may be necessary to reexamine lighting standards based on the age of the occupants within the space (CEFP, 1991, I10). In response to the need to conserve energy, facility planners must design illuminating systems that are effective and efficient (p. I10).

Furniture and Equipment

The furniture and equipment in a school are indispensable in providing an environment for learning (CEFP, 1991, p. J2). The CEFP reported, "it has been established that there is a direct correlation between effective instructional systems and the kind and quality of

furniture and equipment" (p. J3). The selection committee must study the curriculum to determine what types of furniture and equipment are needed and approximately the cost that will be involved. The budget for furnishing the school building should be established concurrent with the construction budget: "good functional specifications must include a description of all furniture and equipment for the new or remodeled facilities" (Brooks, Conrad, & Griffith, 1980, p. 114).

The basic criteria for the selection of furniture and equipment includes many considerations. The CEFP (1991) lists "appearance" as its first element in the criteria (p. J2). Furniture should harmonize with the architectural environment and be pleasing in terms or color, form, and texture (CEFP, p. J2).

Furniture is not pleasing to the student if it is not comfortable. Desks should match the size of the intended users so that students will not find themselves using furniture that is too small or too large for comfort. Adjustability, scale, texture, form, and light reflected are all considerations when selecting furniture that will be comfortable for the user (CEFP, 1991, p. J3).

Flexibility is another consideration when selecting furniture and equipment. Educational programs grow and change, and it is important for the support system which includes furniture and equipment to satisfy the needs of the

changing activities in the school (CEFP, 1991, p. J2). The need for flexible school furniture was recognized by the Educational Facilities Laboratories (1972) which in a national report concluded that in the future school furniture "will be simple in shape, light in weight, mobile and have multiple purposes" (p. 62). Schools are now demanding posture chairs in computer rooms, and desks and chairs that can be adjusted to be suitable for keyboarding by many different sizes of students (Phillips, 1986, p. 8).

In terms of safety, furniture and equipment must meet strict requirements. The design of the furniture should prevent injury by rounding edges and corners and by the use of hardware that does not pinch the students. Furniture must not have dangerous protrusions nor tip over easily. It is usually required that furniture and equipment be fire retardant and not produce toxic gases or smoke should there ever be a fire in the building. It is also possible to buy furniture and equipment that is non-toxic and composed of non-allergenic substances (CEFP, 1991, p. J2).

Furniture and equipment must be structurally sound and made of long-lasting materials. In schools, furniture is often used in ways for which it was not intended. Test data of furniture and equipment items can often be obtained to more accurately assess the durability of the products available for purchase (Brooks, Conrad, & Griffith, 1980, p. 119).

Regardless of the durability, furniture and equipment will require maintenance and repair. If an item is constructed in such a way that it is impossible to repair, then maintenance for that item will be too expensive to consider its purchase. Most facility planners agree that "it should be possible to obtain parts at reasonable costs and to replace them easily" (Brooks, Conrad, & Giffith, 1980, p. 120).

Although guarantees vary from one manufacturer to another, most furniture and equipment is guaranteed against defects in materials and workmanship for one year (CEFP, 1991, p. J3). Some suppliers are more willing than others to work with the schools when there is a need for modification or training in the care of furniture and equipment. In many instances, "customer services provided by suppliers may be as important as written guarantees" (Brooks, Conrad, & Griffith, 1980, p. 119).

The purchase of furniture and equipment for a school should never be based on price alone (CEFP, 1991, p. J3). Furniture and equipment should meet the demands of the building codes and those of the basic criteria for its selection by the facility planning committee. The CEFP stated, "the most efficient product and the one that can be maintained at less cost is ultimately less costly" (p. J3).

Aesthetics

The importance of aesthetics in school buildings is now recognized by many facility planners. Chan (1988) stated, "aesthetics in school buildings is achieved by an accumulative effect of outstanding design in structure, smart use of materials, wise choice of colors, distinguished methods of lighting and attractive landscaping" (p. 26). Chan (1988) maintained that a building teaches its occupants and that "an aesthetic environment is inducive to student learning" (p. 26).

Lilley (1985) also found that the appearance of the school building is a deciding factor in how the students and teachers feel about the school (p. 7). The educational program may be seriously affected if people do not want to be in the school building. Attending school in a pleasant environment encourages students to come to school and take part in the educational program.

In a book on elite boarding schools, the authors demonstrated how students were stimulated by the beautiful school campuses and exposure to art and culture (cited in Piccigallo, 1989, p. 406). Studies have shown that even the use of light and color can affect the ways students behave in the classroom. Students in blue rooms appear to have fewer inappropriate behaviors, and teachers perceive the blue rooms to be more pleasing than rooms painted white (Sydoriak, 1987, p. 19).

The EWA (1989) report on the condition of public school buildings in the United States stated that school buildings "should reflect community values that regard the education of children as vitally important to community life" (p. 45). It is possible to design schools that will reflect local cultural themes as well as stimulate learning. Keller (1986) challenged facility planners:

> If your district is to provide a healthy, stimulating and fun environment for learning, one where the overall livability of the facility is enhanced through proper coordination of colors, materials, furnishings and equipment, then, interior design must become a priority in your planning for new and renovated facilities. (p. 21)

Modernization Projects

As the educational program demands change, older school buildings may be able to continue to serve students effectively through the comprehensive planning of modernization projects. To clarify the direct relationship between facilities and learning, Hawkins and Overvaugh of Texas A & M University developed the Interface Project which was an investigation of the interface between facilities and learning. The results of the study have been recorded in The Interface Profile (See Appendix E) which includes six major areas of interface between facility and learning. The

findings categorize relationships between community and facility, school building and user's needs, and facility and individual learning styles (Hawkins & Overvaugh, 1988, p. 4-7).

A modernization project that illustrated the interface profile is located in the Fox Chapel Area School District just outside of Pittsburgh, Pennsylvania. The Fox Chapel Area High School was built during the 1950s and needed significant work to accommodate the new educational program. The economy in the area was failing, but board members felt that renovating the high school could maintain property values and attract newcomers to the Fox Chapel area (Rist, 1990, p. 38).

The project began in 1984 and was completed in October of 1989. The new design was based on the philosophy that the high school would meet the individual needs of students and be a place where the kids would feel they belonged (Rist, 1990, p. 40). The modernization included a cafeteria modeled on a fast-food restaurant, science facilities that featured a planetarium, resource rooms for each academic department which offered tutorial services during students' free time, a sophisticated computerized language laboratory, a central television studio for the students, and computer hookups in every classroom (Rist, 1990, p. 40). The project was successful in making a positive contribution to the

community and in meeting the needs of the individual students in the high school (Rist, 1990, p. 40).

Another high school built in the 1950s was renovated to correct a problem that had been in existence since the building opened 30 years ago. During the baby boom years it was difficult to build schools fast enough to meet the number of students enrolling in the schools. Some districts adopted generic building designs that had been successful in other parts of the country. Forest Hills Central High School in Grand Rapids, Michigan was built using an open-air school design developed in California. The California campus type plan consisted of several freestanding buildings which served a variety of functions. The four-season climate in Michigan limited the number of days that students enjoyed walking in the open from building to building during class changes. There was only minimal wall insulation which made buildings hard to heat and expensive to operate. Condensation in the single-pane window walls caused the floors to be wet and dangerous much of the time. Although the school opened in 1959, the community still considered the building relatively new and did not want to abandon it (Bleke, 1988, pp. 35-36).

The school district used a team approach to design the modernization of the Forest Hills Central High School. With the use of berming and connecting buildings into one structure, the complex became energy efficient and

comfortable for the students. The interior was tastefully decorated to look more like an expensive office building, and the very latest educational technology was employed, including satellite linkup in every classroom. The addition to the high school was placed in front of the old entrance to create a visually pleasing appearance to the complex (Bleke, 1988, p. 36).

Bleke, the principal of Forest Hills Central High School, said that the greatest satisfaction that he personally felt was in the vastly improved morale in the school. He felt that the students, teachers, and staff finally had a workable building that was also a joy to be in. The community felt good about their investment in this modernization project (Bleke, 1988, p. 37).

The American Association of School Administrators included a number of modernization projects in To Re-Create A School Building. Some of the projects reviewed the modernization of very old school buildings. The philosophy of the organization is that "when an old school is of good quality and handsome, when associations with it are pleasant, and when it has historic importance, then there is good reason to preserve, restore and reuse it" (AASA, 1976, p. 50). Modernization projects in the AASA report represent solutions that have been successful in many parts of the United States when districts have had to modernize older school buildings. The AASA concluded, "with proper

planning, using the appropriate talent, upgrading of existing facilities can be rewarding and need not be as complicated as we were often led to believe in the past" (AASA, 1976, p. 34). Salmon, the Executive Director, stated, "but wisdom, careful and creative planning, efficient use of what we have and firm determination to evolve something better may be as critical as the dollars" (AASA, 1975, Foreword). The American Institute of Architects Committee on Architecture for Education stated, "our premise is that quality and innovative educational environments help improve the educational program (Christopher, 1991, p. 10).

Summary

The importance of educational facilities is the subject of a growing number of research investigations. In the review of the literature and research relevant to the revitalization of school facilities, the first section of this chapter presented the historical development of school buildings. Until the latter part of the 19th century, the traditional school house was nothing more than a shelter where students and teachers could meet. The progressive ideas of Bernard, Dewey, Pestalozzi, and others placed demands on the school building and caused educators to view the actual structure as a function of the educational program of the school.

The second section of this chapter examined the effect of school facilities on student achievement. There is a consensus among educators that school buildings do affect the people who use them. Studies have been found which relate student and teacher productivity to the environment of the school building. Student attendance, behavior, self-concept, and attitudes have been connected to the condition of the school facility.

The status of school buildings in the United States was reported in the third section of this chapter. Over half of the school facilities in the nation are not adequate in terms of physical structure or educational program support. In the 1990s, more school construction dollars will be spent on the revitalization of existing school buildings than on new school construction.

The last sections of this chapter included the study of principle areas of concern when modernizing public schools and actual practices in educational facility planning today. From this information, two additional sections were added to the chapter. One section contained the specific elements in planning for the revitalization of school buildings. The last section reviewed modernization and specific projects.

Chapter 3 will be a description of the procedures and methodology that will be used in the study to develop a set of planning elements for the revitalization of public school buildings.

CHAPTER 3

Development and Design of the Study

This study was designed to explore the planning practices for the revitalization of selected public school buildings in Virginia, Tennessee, and North Carolina. Through the review of literature, elements for planning the revitalization of school facilities were identified, analyzed, and used in the study of planning practices in selected public schools. On-site visits and interviews were conducted to determine if the planning process in the selected public schools included the use of identified planning elements for the revitalization of school buildings. The specific elements of facility planning developed as a result of the study will give school administrators an assimilated data base for use in planning for revitalization of school buildings in their individual school districts.

Procedures for Identifying Planning Elements for School Facility Revitalization

The computer services of East Tennessee State University were used to search ERIC documents on educational facilities. The online searching librarian conducted a search of doctoral abstracts on renovation and modernization

of public schools. The review of literature included available information from governmental agencies, educational organizations, and building associations. The Inter-Library loan service was used in securing information from other universities.

Selection of Revitalized Public School Facilities

Letters were sent to superintendents in Virginia, Tennessee, and North Carolina requesting permission to visit revitalized public school facilities in their districts. From these responses, nine revitalized public school facilities were selected for the study.

On-Site Visitation of Selected Facilities

Once the nine schools were selected, contact was made with the principals requesting their cooperation in the study. After confirmation from these individual school administrators, times and dates of visitations were arranged. Information was gathered from the principals, teachers, students, and staff. Central office planning personnel and architects involved in the revitalization of the selected schools were consulted.

Description of the Planning Elements

Upon visiting the selected schools, the consideration of the following principle areas of planning were examined: (a) structural soundness, (b) program support, (c) site, and

(d) cost. Additionally, questions about the planning elements, such as educational specifications, space utilization, and energy efficiency were analyzed. There was a total of 13 specific elements from which numerous questions were addressed. A checklist of planning elements identified in the review of literature as essential to effective planning was developed before visiting the selected school facilities and used as an interview guide during the visits.

Data Checklist of Planning Elements

The checklist was used during the on-site visits to determine the principle areas of planning and the specific number of planning elements that were utilized in the revitalization process of each school. Respondents were given the choice of yes and no responses when applicable. In addition to the checklist items, the interview guide included open-ended questions to address information useful in the analysis of the individual revitalization projects.

Treatment of the Data

After on-site observations, the data from the nine schools were analyzed to determine which general areas of planning were considered and which specific elements were most often included in the revitalization process. Data from the schools were divided by states to make additional

comparisons. The most frequently overlooked planning elements were also included.

Summary

This chapter presented the development and design of the study. The procedures for identifying principle areas of planning and specific elements for the revitalization of school facilities were examined. In addition, selection procedures for on-site visitation of revitalized facilities were discussed. There was a review of the data checklist used in the study. The treatment of the data was examined before the summary remarks.

Chapter 4 will include an analysis of the data collected from the review of literature and from the on-site visits to the selected revitalized schools.

CHAPTER 4

Analysis of Data

This study was designed to explore the procedural practices for the revitalization of selected public school buildings in Virginia, Tennessee, and North Carolina. The purpose of this study was to analyze current practices in the revitalization of school buildings and assimilate data that can be used by school administrators to make informed decisions about the revitalization of school facilities. Three subproblems of this study were identified. Subproblem 1 was designed to trace the development and function of school facilities. Subproblem 2 was designed to identify and appraise significant elements in planning for the revitalization of public school buildings. Subproblem 3 was to analyze school facility revitalization projects using identified elements of planning. Analysis of the data collected is presented in this chapter.

Analysis of the Data

An interview guide containing a checklist of elements for school planning was used to gather data in nine selected schools in Virginia, Tennessee, and North Carolina. The interview guide used is included in Appendix F of this dissertation. Visits were made to the selected schools for the purpose of collecting data by observation and through

interviews with personnel involved in school revitalization. The analysis of the data has been systemized by the treatment of the subproblems.

Subproblems

The analysis of the data was reported around three subproblems:

Subproblem 1

To trace the development and function of school facilities. The review of literature concluded that school revitalization efforts should be based on the preliminary study of four areas of development and function of school facilities. These areas were structural soundness, program support, site, and cost. All nine schools in this study reported that these areas were considered in a preliminary facility study. In each of the three states, however, the preliminary facility studies were conducted by different members of the educational organization. In two states, the selected schools within the state also differed in who conducted the preliminary facility studies.

In Virginia, facility studies were conducted by special committees formed for the purpose of addressing the areas of structural soundness, program support, site, and cost of revitalization. There was no specific knowledge of how individuals were selected to serve on facility committees, nor was there a facility planner included in the preliminary

facility studies conducted in the three Virginia schools in this study. Principals in the individual schools were consulted in the area of program support, although they did not serve on the facility committees. Only one Virginia school reported that a teacher was directly involved in the area of program support; this teacher was not part of the facility committee.

Tennessee schools included in this study reported that preliminary facility studies were conducted by the superintendent, the educational facility planner, and the architect. Principals and teachers were asked to submit suggestions in the area of program support, but were not part of the facility study team. The architect was responsible for information in the areas of structural soundness, site feasibility, and cost. The superintendent and facility planner reported on program support and reviewed the information collected by the architect. The facility planner translated program needs to the architect.

North Carolina was the only state to report that the State Department of Education conducted preliminary facility studies. In each school visited in North Carolina the superintendent had asked for, and received, a report on the existing schools in his system. The North Carolina State Department of Education issued reports which included information on structural soundness, program support, site feasibility, and cost. The school superintendents were

responsible for the use of the reports and for employing individual architects and facility planners. Schools in North Carolina employed architects for school revitalization planning, but only one school reported the use of an educational facility planner.

The cost of the revitalization of a school was not a major factor in the planning process in any of the three states included in this study. This was one area in which the data collected during the on-site visits to the schools differed from the information found in the review of literature. All nine schools reported that the desire to retain a specific building as a school outweighed any consideration of the difference in cost between building a new school or continuing to use an existing school.

Subproblem 2

To identify and appraise significant elements in planning for the revitalization of public school buildings. The review of literature concluded that there are 13 specific elements in planning for revitalization. These elements are centered around four areas of concern in the preliminary facility study of a school building. The principle areas for consideration are structural soundness, program support, site, and cost.

The elements identified in the actual planning of the revitalization of a school are educational specifications;

site condition; playground area; exterior appearance; space utilization; conditions of mechanical and electrical systems; energy efficiency; barrier free environment; thermal environment; acoustics; visual environment; furniture and equipment; and aesthetics.

The data collected on the areas of consideration in the revitalization of school buildings were reported under Subproblem 1. The analysis of the data collected on the elements of planning in the selected schools in the study is reported in the treatment of Subproblem 3.

Subproblem 3

To analyze school revitalization projects using elements of planning identified in Subproblem 2. Data were collected around the following 13 elements which were used to treat Subproblem 3.

1. Educational specifications: The first element considered in this study was the preparation of educational specifications. Only one school out of the nine schools studied reported that the actual document containing the educational specifications was developed at the school by the principal and teachers. Formal documents of educational specifications at eight of the schools studied were generated by central office personnel and the architect employed by the superintendent.

Principals, teachers, and librarians at all nine schools in the study reported an active role in the creation of educational specifications regardless of where the formal document was designed.

2. Site condition: Site condition was the next element identified and considered during the on-site visits. All schools reported some type of site improvement. If there were existing modular structures, they were removed from the sites. Only one principal chose to keep a modular unit for storage.

All schools reported improved parking areas, circulation, accessibility, walkways, safety, and landscaping.

3. Playground area: All nine schools reported that the playground areas received the least amount of consideration in planning when the schools were revitalized. The location of the playground was the primary concern in planning, but there was no other concern identified by the individuals interviewed.

It was reported that the lack of planning in this area resulted in numerous oversights. One elementary school principal said that the playground at his school did not have necessary blacktop nor a walkway to the play area. A high school science instructor reported that she was concerned because the playground for the school childcare

center was in the area of the gas valves for the science labs.

Three schools reported that the playgrounds were very well planned, however, the planning was community originated and not part of any overall facility planning by the educational administrative planning teams.

4. Exterior appearance: Efforts were made in eight of the nine schools to improve the exterior appearance of the schools. Schools reported the replacement of windows, doors, and frames. The outside entrances were upgraded, walks were replaced, and the buildings were chemically cleaned. Outside trim work was painted, window walls were added, and five schools reported the addition of patios or courtyards. Exterior glass blocks were used in six of the schools, and two Virginia schools used special glass for adding greenhouses and for creating new entrances in the schools.

All but one school reported that the roof was replaced during modernization. The facility planner interviewed reported that the school needed a new roof, but the funding was not available.

There was an effort to landscape at each school site; some landscaping was incomplete at the time of this study.

5. Space utilization: The area of space utilization included additions to the original structure as well as changes in load-bearing and nonload-bearing walls. Eight of

the nine schools reported additions to the original structure during the renovation process. A change in load-bearing and nonload-bearing walls was found in each school in the study.

Room function also changed in all of the schools. Storage areas were increased; there were additions in teacher work areas; all classrooms were wired so they could use computers; hall areas increased in storage capabilities for students; restrooms were renovated, or added, to accommodate students; and classroom sizes changed according to function and code requirements.

Teachers in all nine schools in the study said they had requested more classroom storage space in planning for renovations.

The addition, or modernization, of media centers was also found in all of the schools represented in the study.

The researcher observed that the amount of space allocated for cafeteria and dining areas was not satisfactory in eight schools in this study. Only one school in Tennessee reported having enough space to serve the students in two shifts.

One school that converted from the use of coal to gas heat divided the coal storage room into a storage room and an additional bedroom in the custodian's apartment.

State codes in Virginia, Tennessee, and North Carolina mandated special areas for speech, music, art, computers,

science, etc. All schools in this study included these areas when planning for space utilization.

6. Condition of mechanical and electrical systems: Planning in the area of mechanical and electrical systems was present in all of the schools in this study. Only one school did not add air conditioning when renovating. The schools reported new heating and ventilating systems, new wiring, and new plumbing throughout the modernized buildings. Schools also reported the addition of new plumbing fixtures, lighting fixtures, ventilation equipment, fire alarms, clocks, telephones, televisions, computers, and electrical outlets.

In Virginia, central office personnel and the architect planned the type and extent of mechanical and electrical systems renovation. Both in Tennessee and North Carolina, the planning in this area was the responsibility of the local facility planner and the architect.

Code compliance was necessary in each state. Mechanical and electrical systems were planned according to local, state, and federal building codes, and in compliance with the fire marshal's office.

7. Energy efficiency: New HVAC systems and the use of energy efficient windows and doors represented the single most obvious planning for energy efficiency in the renovated schools in this study.

There was no information on insulation or insulation values available; however, the use of lowered ceilings, insulative tiles, rolled insulation, caulking, and weatherstripping was observed by the researcher in each of the nine schools in this study. The insulative qualities of the individual modernized schools were not available and not reported in terms of R factors.

8. Barrier free environment: Each school in the study planned for some type of barrier free implementation. This was accomplished by the use of ramps, see-through doors, wider corridors, and elevator service.

Only one school in Tennessee contained a second floor which was not handicap accessible. Another renovated school in Tennessee, however, was designated as the city school handicap accessible facility, and this school met all handicap accessibility standards and codes.

In Virginia, Tennessee, and North Carolina, the use of state and federal handicap accessibility codes determined the planning by the architect in each school.

9. Thermal environment: Planning for an efficient thermal environment was accomplished by the use of insulated windows, new heating systems, and blinds in the windows. One Virginia school used insulated windows with the blinds contained between two panes of insulated glass.

An architect interviewed in Tennessee felt that the use of windows should be limited so that climate control could

be more efficient. Another architect in the same state did not find insulated windows to be a detriment to the thermal environment in a school building.

Temperature control in the renovated school buildings was centralized and zoned in all of the schools in this study. Temperature control was the responsibility of the principal or teachers in seven of the schools, and it was controlled by the central office in two of the schools. Neither principals nor teachers reported satisfaction with the climate controlled by the central office.

10. Acoustics: Planning for the acoustical environment in the renovated buildings was limited to the use of acoustical tiles, acoustical wall treatment, carpet, and the separation of noisy areas from quiet areas. In addition to these common means of planning for the acoustical environment, all schools reported the use of acoustical room dividers in guidance areas, computer areas, and media centers.

Only two schools reported special use acoustical tiles in music rooms and dining areas.

Six of the schools located music rooms adjacent to dining areas or activity (gym) areas. Only one school planned the acoustics in the music room and located this room away from noisy areas.

11. Visual environment: The visual environment in the renovated schools was enhanced by the use of lighter

interior colors and by the addition of new artificial lighting, mainly drop-in fluorescent lighting.

New sources of natural lighting were also planned in the renovated schools. Seven of the schools reported the use of new window walls either in dining areas, hallways, or in the media centers. Window walls were planned by architects or facility planners, but not designed by principals or teachers. With the exception of a single librarian, all individuals interviewed, including students, appreciated the new window walls.

A Virginia school also made use of lighted art walls throughout the building. All the Virginia schools in the study featured unique lighting of hallways.

All schools were supplied with new chalkboards and tack boards.

12. Furniture and equipment: Teacher input on furniture and equipment was strongest in the planning of the Tennessee revitalization of schools. Facility planners in Tennessee were able to translate the needs of the teachers into the specific selection of desks, storage areas, and both permanent and mobile casework. There was no reported substitution of ordered furniture in Tennessee. Two of the schools in Tennessee were able to save money in the furniture allowance by paying the central office carpenters to build specific storage areas instead of using carpenters hired by the architects.

Virginia schools reported a limited choice in furniture and equipment, and one Virginia science teacher complained of substitutions in furniture and equipment made by a particular furniture company.

Architecturally designed storage areas for children proved to be inadequate in all of the North Carolina schools in the study. The storage areas for the primary students in one North Carolina school were out of reach for any of the children to use.

The sinks and cabinet areas in two of the Virginia schools were too tall for use by the elementary children.

There was no evidence in any of the nine schools that student comfort entered into any decision in furniture selection.

Initial cost was reported to be the main consideration in the final decision concerning furniture and equipment.

13. Aesthetics: The aesthetic qualities of each of the nine schools in the study were attributed to the architectural designs by the individual architects. Seven of the schools in the study were designed with a central theme and a continuation of colors throughout the buildings.

Regardless of the design, in every school in the study, the teachers expressed appreciation of classroom windows, hall windows, and window walls. Teachers interviewed in the study had asked for classrooms with windows.

Principals and teachers in all nine schools reported that student and teacher morale improved with the modernization of their schools. Teachers and principals also reported fewer discipline problems after the renovations were completed. All students interviewed said they liked the way their schools looked.

Choice of colors and methods of lighting influenced the aesthetic appearance in each school in the study.

There was no evidence that principals, teachers, students, or staff were asked for any suggestions on the aesthetic designs for the schools. Only one facility planner in Tennessee was involved in the actual designing and choice of colors in planning the renovations.

One architect in Tennessee said that he spent time in the elementary schools trying to see the buildings through the eyes of the students. This architect lowered the windows in one of the schools as a result of his observations.

Research Questions

There were two basic research questions which guided the development of this study. Both questions were answered by a review of literature and on-site visitations. The data analyses were reported around the research questions.

Research Question 1

What information now exists about revitalizing school facilities? The review of literature found there is very little information available to school administrators about revitalizing school facilities. There are a few selected writers in the field of educational facilities, but most of the articles are limited to publication in very specialized journals. It was found that most major universities do not offer even a single course in the study of school facilities, and the researcher could find only two textbooks in this area of study. Interviews in selected schools confirmed that in the specific area of school renovation, school administrators are dependent on information from architects and from state building code guidelines.

Research Question 2

Can a set of planning elements for the revitalization of public school buildings be developed to help administrators make informed decisions? Through a review of the literature and on-site visits to nine schools in Virginia, Tennessee, and North Carolina, 13 elements were identified for planning the revitalization of public school buildings. The elements were developed around the areas of (1) structural soundness; (2) program support; (3) site; and (4) cost.

The following elements for planning were identified:

1. Educational Specifications
2. Site Condition
3. Playground Area
4. Exterior Appearance
5. Space Utilization
6. Conditions of Mechanical and Electrical Systems
7. Energy Efficiency
8. Barrier Free Environment
9. Thermal Environment
10. Acoustics
11. Visual Environment
12. Furniture and Equipment
13. Aesthetics

Each element was developed to provide basic direction in the planning of the revitalization of public school buildings. A basic assumption underlying the study stated that the assimilated data base, consisting of a set of planning elements for the revitalization of school buildings, would aid administrators and others in determining a plan of action to revitalize school buildings in individual localities. The elements of planning developed in this study should serve to execute this objective.

Summary

The analysis of data was reported in this chapter. The treatment of the data included an analysis of each individual element as to its use by school planners. Data from the on-site visits were identified by states to make additional comparisons. Frequently overlooked areas in planning were also included in the treatment of the data.

The two research questions were answered through the review of literature and through on-site visits and interviews with individuals who were involved with the planning of the selected revitalized schools.

Chapter 5 contains a summary of the study, findings based on the analysis of data, conclusions of the study, and recommendations for further studies.

CHAPTER 5

Summary, Findings, Conclusions, and Recommendations

This chapter includes a summary of the study, findings based on the analysis of data, conclusions, and recommendations for further studies.

Summary

The purpose of this study was to analyze current practices in the revitalization of school buildings and assimilate data that can be used by school administrators to make informed decisions about the revitalization of school facilities. The subproblems identified included: (1) To trace the development and function of school facilities; (2) To identify and appraise significant elements in planning the revitalization of public school buildings; (3) To analyze school facility revitalization projects using planning elements identified in subproblem 2. The study included two research questions:

1. What information now exists about revitalizing school facilities?

2. Can a set of planning elements for the revitalization of public school buildings be developed to help administrators make informed decisions?

Through the review of literature, elements for planning the revitalization of school facilities were identified,

analyzed, and included in the interview guide used during the on-site visits to selected revitalized schools. Nine schools were selected for study. The schools were located in Virginia, Tennessee, and North Carolina. Information was gathered from the principals, teachers, students, and staff in the selected schools. Central office planning personnel and architects involved in the revitalization of the schools were also consulted.

The information gathered by the on-site visitations provided specific data relative to actual existing facilities. Strengths and weaknesses in the planning of facilities were noted from those who had experienced the revitalization of school buildings since 1985. The data added to previous information gathered through a review of related literature, and assisted in determining the comprehensiveness of planning elements included in the interview guide.

The treatment of the data was reported around the identified elements of planning for the revitalization of school buildings. Treatment of data included an analysis of each individual planning element as to its use by school administrators. Data from the schools were divided by states to make additional comparisons. Areas that appeared to be neglected in the planning of school revitalization were also reported.

Findings

Based on the review of literature, on-site visits, and interviews, the findings were reported around the following principle areas of concern and included specific elements in planning for school revitalization:

Principle Areas in Planning for Revitalization

Structural soundness.

1. This study found that structural soundness is determined by preliminary facility study teams or committees. There was no specific formula for determining who would serve on the teams.

2. It was found that facility study teams did not practice opening up existing buildings in several places in order to understand the actual structural condition of the schools involved in the studies.

Program support.

3. Program support included the identification of classrooms, storage areas, labs, shops, food service areas, etc., and the recognition of activities planned for the spaces.

4. The study found that architects were essential in this phase of planning and decision making.

Site.

5. It was found that site affected the cost of revitalization, the transportation needs, and the number of students that could be accommodated in the revitalized school.

6. The study found that the school sites were important in light of social, political, and ecological issues.

Cost.

7. It was found that the desire to retain a specific building as a school outweighed the consideration of the difference in cost between building a new school or continuing to use the existing school.

8. Cost was found to be important in light of social, political, and ecological issues.

Planning Elements

Educational specifications.

9. It was found that principals, teachers, and librarians were active in the planning of educational specifications.

Site condition.

10. Planning for school revitalization included site improvement in the areas of accessibility, walkways, safety, circulation, parking, and landscaping.

Playground area.

11. It was found that location was the primary concern when planning for the playground area.

12. The study found that schools with strong community support spent more time and money on playgrounds for their schools.

13. It was found that most schools do not plan for barrier free playgrounds.

Exterior appearance.

14. Plans for revitalization of the exterior appearance of existing schools included window and door replacement, upgrading of outside entrances, painting, landscaping, replacement of walks, and roof repair or replacement.

Space utilization.

15. The study found that plans for space utilization included a change in load-bearing and nonload-bearing walls, additions to existing structures, and changes in room functions.

16. Teachers requested more storage space when planning for space utilization.

17. The study found that the use of minimum state codes for planning dining areas was not satisfactory in the revitalized schools.

Condition of mechanical and electrical systems.

18. The planning for renovation of mechanical and electrical systems was in compliance with the local, state, and federal building codes, and with the fire marshal's office.

Energy efficiency.

19. Planning for energy efficiency included new, energy efficient HVAC systems, insulated windows and doors, lowered ceilings, caulking and weatherstripping, and the use of insulative tiles and rolled insulation.

Barrier free environment.

20. The planning of barrier free environments in the revitalized schools included the use of ramps, see-through doors, wider corridors, and elevator service.

21. The use of state and federal handicap accessibility codes determined the planning of the barrier free environments.

Thermal environment.

22. Planning for an efficient thermal environment included the use of insulated windows, blinds in windows, and improved HVAC systems.

23. The study found that architects differ in their planned use of windows when considering the thermal environment of a school building.

24. It was found that principals and teachers were least satisfied with the thermal environment when it was controlled by the central office.

Acoustics.

25. The study found that planning for the acoustics of the school included the use of acoustical tiles, acoustical wall treatment, carpet, and the separation of noisy areas from quiet areas.

Visual environment.

26. Planning for the visual environment included the use of new artificial lighting, additional sources of natural lighting, painting with lighter colors, and the use of new chalkboards and tack boards.

27. Window walls were planned by architects and facility planners.

28. The study found that teachers appreciated window walls in their classrooms.

Furniture and equipment.

29. It was found that initial cost was the main consideration in planning for furniture and equipment.

30. There was no evidence that student comfort entered into any decision in furniture selection.

Aesthetics.

31. The study found that architects created the aesthetic designs of the revitalized schools.

32. It was reported that student and teacher morale improved after the schools were aesthetically redesigned.

33. Teachers and principals reported fewer discipline problems in the revitalized schools.

34. Choice of colors and methods of lighting influenced the aesthetic appearance of the renovated schools.

Conclusions

As a result of the findings, the following conclusions were drawn:

1. Planning for the revitalization of school buildings differs from one school to another even when the schools are in the same system.

2. States do not employ facility planners to help school systems revitalize their school buildings.

3. Many school administrators do not know how to assess the condition of the schools in their districts.

4. Administrators and other individuals involved in revitalizing school facilities want more information on how to systematically plan for the modernization of school buildings.

5. Structural soundness is generally ascertained by a cursory visual examination of a school building.

6. The condition of a school building has an impact on the people who use the building.

7. School environment and learning are connected.

8. School building aesthetics influence student attitudes.

9. Planning is weakest in the areas of food service satisfaction and playground needs.

10. The planning elements put forth in this study are applicable to any school modernization effort and can be used by school administrators as a basic guide in their planning.

Recommendations

In view of the findings of this study, the following recommendations were made:

1. States should consider the feasibility of state facility planners who assess the condition of all schools in the state and help plan for modernization in school districts that cannot afford school facility planners.

2. There should be more research on school environments and learning.

3. Research should be conducted on the impact of school buildings on the morale of students, teachers, principals, and staff.

4. There should be a reevaluation of the importance of furniture to the educational program.

5. Research should be conducted on the relationship between windows, or lack of windows, on the morale of students, teachers, principals, and staff.

6. There should be more studies about the planning of barrier free playgrounds.

7. Research should be conducted in the area of food preparation and dining services in public schools in an effort to reduce the number of shifts necessary to feed students.

8. There should be more studies on the feasibility of solar energy systems in school plants.

9. Research should be conducted on student discipline problems and the condition of the school facility.

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APPENDICES

APPENDIX A

Appendix A

ROOF MANAGEMENT PROGRAM

STEP ONE: Establish roof information files.

Design Section:

* Project records, roof drawings, and specifications and applicable addendums.
* Roof plan(s) showing location of all penetrations and roof top equipment.
* Approved submittals of material manufacturer's product data specifications and components utilized in the construction of the new roof.

Installation Section:

* Field reports related to the roofing installation.
* All correspondence between parties (i.e. general contractor, roofing subcontractor, architect/engineer, etc.) involved in the installation of the roof.

Warranty Section:

* Roof bonus guarantees from the roof and/or manufacturer with telephone numbers and addresses for contacting in case of problems.

Inspection Maintenance Section: (these items are filed chronologically)

* Periodic Inspections Reports (with photographs).
* Reports of maintenance repairs (with photographs).
* Record of any construction changes/modifications made to and/or on roof surface decks.
* Record of roof top equipment services and/or replacements made on roof and firm involvement.

STEP TWO: Implement a roof inspection program with periodic inspections. Roof inspections should be made twice a year, spring and fall. Additional inspections should be made after any roof top equipment service call or after major storms. A roof checklist should be developed for all roof systems.

STEP THREE: Maintain schedule and implementation.

* Immediate basis: storm damage repairs.
* Yearly basis: pitch pan filling.
* Multiple-year basis (i.e. five year planning: base flashing repairs).

APPENDIX B

Appendix B

NATIONAL PETROLEUM COUNCIL: ENERGY CONSERVATION MEASURES

GROUP 1 (conservation measures requiring no capital investment)

1. Establish a 65° F temperature level.
2. Establish a night setback level 10° F below the daytime level.
3. Reduce lighting levels to a minimum acceptable level, where possible.
4. Establish a cooling comfort level of 78° F.
5. Cease cooling the building at least one hour before occupants leave.
6. Reduce temperature of general purpose hot water by 20° (120° F minimum) except where dishwashers require otherwise.

GROUP 2 (conservation measures requiring some investment in time and money)

1. Caulk and weatherstrip around all windows and between building walls and window frames.
2. Schedule maintenance on equipment and systems.

3. Establish minimum ventilating air requirements for occupancy periods and zero ventilation during unoccupied periods, where possible.
4. Use restricted flow shower heads (2.5 gallons per minute maximum).
5. Use automatic shutoff faucets in lavatories.
6. Reduce water distribution pressure to a maximum 25 p.s.i. (pounds per square inch).

GROUP 3 (conservation measures requiring substantial investment)

1. Insulate ceiling, above or below roof, using insulation having an equivalent "R" factor of 19.
2. Insulate sidewalls using insulation having an equivalent "R" factor of 11.
3. Install storm sash or high efficiency glass.

APPENDIX C

Appendix C

FUNCTIONS OF CARPETING IN SCHOOLS

1. ELIMINATES COLD FLOORS AND CONSERVES ENERGY
2. REDUCES THE SEVERITY OF INJURIES DUE TO FALLS
3. ELIMINATES FLOOR-GENERATED NOISES DUE TO THE MOVEMENT OF CHAIRS, DESKS, AND THE LIKE
4. ABSORBS NOISES AND IMPROVES THE ACOUSTICAL ENVIRONMENT
5. CREATES AN ATMOSPHERE THAT IS QUIET, AESTHETICALLY PLEASING, AND CONDUCIVE TO EFFECTIVE LEARNING

APPENDIX D

Appendix D

THE NATIONAL COUNCIL ON SCHOOLHOUSE CONSTRUCTION BRIGHTNESS GOALS

(a) The foot lambert brightness of any surface viewed from any normal standing or sitting position in the schoolroom should not exceed ten times the foot lambert brightness of the poorest-lighted task in the room.

(b) The foot lambert brightness of any surface viewed from any standing or sitting position in the schoolroom should not be less than one-third the foot lambert brightness of the poorest-lighted task in the room.

(c) The foot lambert brightness of any surface immediately adjacent to the task should not exceed the brightness of the task and should be at least one-third its brightness.

(d) The brightness difference between adjoining surfaces should be reduced to a minimum.

(e) The brightness goals stated above assume a lighting system that provides from 30 to 50 foot-candles on the poorest-lighted task.

(f) Light distribution from any source should be such that direct and specular glare are eliminated for the observer to the greatest possible degree.

(g) These objectives or goals should be achieved without the loss of a cheerful, friendly, and aesthetically pleasant classroom environment or of a balanced and acceptable thermal and auditory environment.

APPENDIX E

Appendix E

THE INTERFACE PROFILE

STUDENT LEARNING IS ENHANCED WHEN THE FACILITY:

IS AN INTEGRAL PART OF THE COMMUNITY REFLECTING

- community pride
- community involvement
- broad utilization

IS ADAPTABLE TO THE USER'S NEEDS THROUGH

- a controllable physical environment
- provision for varied and ample storage
- flexible instructional space for teaching and learning styles
- walls, floor, fenestration serving and learning process

PERMITS TEACHERS TO FUNCTION AS PROFESSIONALS WITH

- reasonable control of the learning environment
- space which permits work related dialogue
- appropriate space for preparation for instruction
- motivational environment conducive to professionalism

FOSTERS COMMUNICATION

through the appropriate use of technology

through the use of "learning surfaces"

about the school at points of entry

that emphasizes student achievement

that is demonstrated as important to students

CREATES AN APPROPRIATE BEHAVIORAL SETTING

with an emphasis on aesthetics

which encourages student interaction

which provides a stimulating atmosphere for learning

that is a comprehensive laboratory for learning

ACCOMMODATES A VARIETY OF LEARNING STYLES

through hands-on experiences resulting from building design

which fosters fine arts appreciation

resulting from student interaction

through well designed and equipped space

related to individual needs and interest

APPENDIX F

Appendix F

REVITALIZATION OF SCHOOL FACILITIES: INTERVIEW GUIDE

Name of School _____

Position of Individual Interviewed _____

Date Visited _____

1. What year was the school revitalized?

2. Who were the key people involved in the decision to revitalize the school?

3. Was there a preliminary facility study to determine the condition of the building?

4. Who conducted the preliminary facility study?

5. Were each of these areas covered in the preliminary facility study to determine feasibility of school revitalization:

   a. structural soundness

   b. program support

   c. site

   d. cost

6. At what phase in the planning was an architect selected?

7. Was there any information available from the state to guide the school revitalization process?

8. Was there a state facility planning person to contact for information about school revitalization? Was this person contacted?

9. Who was responsible for the educational specifications?

10. Were each of these elements considered in planning the revitalization of the school:

    a. site condition: existing structures, rock outcroppings, cisterns, wells, meter boxes, gas and water mains, power lines, safety, circulation, accessibility, lighting, outdoor learning spaces, parking areas, athletic fields, walkways, landscaping, etc.

    b. playground areas: safety, age of students, school-community playgrounds.

    c. exterior appearance: walls, windows, doors, roof, painting.

    d. space utilization: general learning spaces, specialized learning spaces, computer instruction space, visual arts, performing arts, music, science laboratories, home arts, industrial art spaces, spaces for physical education activities, room changes, clusters, consideration of load-bearing walls when creating spaces.

    e. conditions of mechanical and electrical systems: heating system, plumbing fixtures, lighting fixtures, ventilation equipment, fire alarms, clocks, telephones, television, electrical outlets, lighting, air conditioning.

    f. energy efficiency: caulking, weatherstripping, scheduled maintenance on equipment and systems, restricted flow shower heads, automatic shutoff faucets, reduced water distribution pressure, insulation, high efficiency glass.

    g. barrier free environment: elevator services, ramps, door widths, see-through doors, wider corridors, safety features.

h. thermal environment: orientation of windows, number and size of windows, insulative qualities of windows, insulation.

i. acoustics: acoustical materials, carpeting, isolating noisy areas, isolating noisy equipment, designing partitions, sound insulation.

j. visual environment: natural and artificial lighting, brightness differences, fenestration, reflection coefficients, interior decoration.

k. furniture and equipment: budget allowance, functional specifications, appearance, comfort, adjustability, flexibility, safety, durability, maintenance and repair, guarantees, cost.

l. aesthetics: design, use of materials, choice of colors, methods of lighting, landscaping.

VITA

ANDREA BARLOW COFFEY

Education:	Appalachian State University, Boone, North Carolina; English, B.S., 1967. East Tennessee State University, Johnson City, Tennessee; English, M.A., 1973. East Tennessee State University, Johnson City, Tennessee; Educational Administration, Ed.D., 1992.
Professional Experience:	Librarian, Yancey Elementary School; Esmont, Virginia, 1967-1968. English Instructor, Niceville High School; Niceville, Florida, 1969. Remedial Reading Instructor, Altus High School; Altus, Oklahoma, 1970-1972. English Instructor, Spotsylvania Elementary School; Spotsylvania County, Virginia, 1973-1974. Reading Improvement and Verbal Studies Instructor, J. Sargeant Reynolds Community College; Richmond, Virginia, 1974-1975. Private Business, Waynesboro Opticians; Waynesboro, Virginia, 1976-1989. Adjunct Faculty, East Tennessee State University, College of Arts and Sciences, 1990-1991.
Professional Organizations:	Member, Phi Kappa Phi Member, Phi Delta Kappa
Awards and Honors:	Phi Kappa Phi National Honor Society Graduated Summa Cum Laude, East Tennessee State University, 1973 Doctoral Fellowship, East Tennessee State University, 1989-1992 Graduated Summa Cum Laude, East Tennessee State University, 1992