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ABSTRACT

The paper summarizes findings from an applied research programing and design project for children with learning disabilities. Information was collected and analyzed from the literature, interviews, observations, participatory games, consultants, and a building type analysis. Findings are reported along 14 developmental goals (such as perceptual and gross motor development) to which environments for exceptional children should respond and along 13 design principles (including orderliness and consistency) to facilitate the goals. Three main products are discussed: the development of new methods in production and communication of design relevant environmental research; the development of a generic program document using an experimental format and stressing developmental goals and design principles applicable to a wide range of indoor and outdoor environments for exceptional children; and the production of a detailed design proposal for an outdoor learning environment. (Author/CL)

EXCEPTIONAL EDUCATION AND THE PHYSICAL ENVIRONMENT:

TOWARD BEHAVIORALLY-BASED DESIGN PRINCIPLES

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Abstract

This paper summarizes the substantive findings from an applied research, programming, and design project for children with learning disabilities. Information was collected and analyzed from existing research literature, interviews, observations, participatory games, consultants, and a building type analysis. Findings from the project are reported in the form of fourteen developmental goals to which environments for exceptional education should respond, and in the form of thirteen design principles which suggest ways in which the physical environment may be designed to respond to and facilitate these developmental goals. The project resulted in three main outputs: (1) the development of new methods for the extraction and organization of design-relevant environment-behavior research information and for the translation and communication of it to designers; (2) the development of a generic program document using an experimental format and stressing developmental goals and design principles applicable to a wide range of indoor and outdoor environments for exceptional education; and (3) a detailed design proposal for an outdoor learning environment on a 1-1/3 acre site for the client group.

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Abstract

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EXCEPTIONAL EDUCATION AND THE PHYSICAL ENVIRONMENT: TOWARD BEHAVIORALLY-BASED DESIGN PRINCIPLES[1]

This paper reports on part of an applied research, programming, and design project on environments for exceptional education. Exceptional children are those with mild or severe learning disabilities and developmental lags which limit their full involvement in the mainstream of public education. These disabilities may be in motor, perceptual-motor, cognitive, social, and/or emotional functioning; they may vary from mild hyperactivity to severe autism, or from mild perceptual or reading disabilities to severe retardation; and they may vary from disabilities in one realm of functioning to general syndromes like broad mental retardation across many functions.

Although there is an extensive body of literature on exceptional children, on development, therapy, education, family relations, etc., and though there is a considerable literature on general environment-behavior relations and on child-environment relations, little is known about the particular relations between the physical environment and the behavior of exceptional children, how they use the environment, how it affects them, and what environmental designs will facilitate development and help overcome developmental disabilities.

The purpose of this project was to explore critical environment-behavior relations for exceptional children, to develop new methods for communicating this information to designers, to generate a generic building program structured around developmental goals and design principles which would facilitate development, and to show the application of the principles to a detailed design solution for a particular site.

The project involved a new approach to extracting and communicating design-relevant environment-behavior research information to designers. The methods developed have been reported in another paper[2] and will not be discussed in detail here.

The present paper reports on the substantive findings about exceptional children and the physical environment. The results are presented in terms of developmental goals to which environments for exceptional education should respond, and in terms of design principles which suggest ways to design the physical environment to facilitate these developmental goals.

EXISTING LITERATURE ON EXCEPTIONAL EDUCATION AND THE ENVIRONMENT

A search of existing literature on research and environmental design for exceptional children confirmed the need for a generic program guide which would be more comprehensive, more research-based, updated, and more applicable to design than the literature presently available.

There are a few sources that have provided useful information. Most frequently mentioned as "design sourcebooks" are Abeson and Blacklow (1971), Bayes and Francklin (1971), and Waligura (1969).

There is a large literature on development and education for exceptional children, of which Dunn (1965) and Kirk (1972) are well-known references, but these and similar books fail to discuss the role of the physical environment. On the other hand, the literature on child-environment relations has yet to look at the needs of exceptional children (e.g., Coates, 1974; Pollowy, 1977). There are completed design projects in the architectural literature, of which Shaw's (1970) Orlando project is one of the best, but these publications fail to behaviorally evaluate the completed projects or to discuss the developmental rationale--if it existed--underlying the project.

There are several other publications that relate to the environment and disabilities. These include Goldsmith (1967), Nellist (1970), and Mace and Laslett's (1974) illustrated handbook for the North Carolina Building Code. The scope of these sources and many others like them is limited, however, to physical handicaps and does not address the environment and learning disabilities.

There are several useful "sources to sources" such as Malloy (1972), Kliment (1975), Bartholomew (1977), and Aiello (1976). These are action-oriented references, but their programming content is essentially bibliographic listings of publications such as those outlined above.

The most recent addition to the literature was Bednar's Barrier-Free Environments (1977). Its primary objective is to establish philosophical and practical directions intended to aid in coordinating various research, planning, design, administrative, and legislative efforts on behalf of the physically handicapped.

Although the focus and purpose of each publication were different, our main review criterion was their usefullness as a source book of information for designers. As such, each reference was affected by some problem or omissions. These included the following:

1. Being out-of-date, which critically affected their content as related to other subjects mentioned below.
2. Lack of environment-behavior theories, concepts, and research information.
3. Missing emerging trends, such as recent legislation, emerging concepts, like mainstreaming, and their implications for design.
4. Narrow focus, usually concentrating on some of the more obvious and visible physical handicaps, while neglecting the broader scope of all handicaps, including learning disabilities.
5. Single disciplinary focus, even in those few which are a product of team effort; missing especially is a link between educational needs and the physical environment.
6. Presentation in a language understandable by one but not both of researchers and designers.
7. Lack of first-hand empirical research explicitly on exceptional education

and the physical environment.

Lack of environment-behavior information. "Throughout the field of education there is a growing awareness that the physical environment can enhance or inhibit the daily operation of the educational program" (Abeson and Berenson, 1970, p. 11). Despite this recognition, the study area of human behavior, experience, and values, and their relation to the physical environment was poorly represented in the literature reviewed. As Abeson and Blacklow (1971) noted, this field was ". . . in a stage of development. The emerging sophistication in this field must lead to increased attention to the learning space as an experimental variable and its effect on the learning process" (p. viii). The field, which still can be described as a developing discipline, has much more to offer now than is reflected in the reviewed references from the late 60s.

PROCEDURE

In the autumn of 1976 we were asked by the St. Francis Children's Activity and Achievement Center in Milwaukee to assist them with some design ideas for an outdoor learning center. The St. Francis Center is an early childhood development facility for children with exceptional educational needs and learning patterns which limit their full participation in the mainstream of public education. Approximately 100 children attend the center as full-day or half-day students. They range in age from birth to twelve, though most are between four and ten years of age. Another 50 older children and retarded adults attend after-school and weekend programs. The core day programs are staffed by 50 full-time professionals plus volunteers, students-in-training, and part-time paraprofessionals.

Together with a group of nine graduate and undergraduate students in environment-behavior studies, environmental psychology, and architectural design, we undertook the project. As shown in Figure 1, our approach had five basic

phases. Each of these phases and the methods used in each are fully described in another paper[2] and only the first two applied research phases will be reviewed here.

Insert Figure 1 about here

Problem-Definition and Information Gathering

The principal sources of information were the following:

1. Research literature. Over 240 published books, reports, and articles were assembled on learning disabilities, strategies for exceptional education, and general child-environment relations from which we could extrapolate design-relevant environment-behavior relations for exceptional education. Design-relevant information was extracted using techniques developed by Brolin and Zeisel' (1968) and Cohen (in press).

2. Interviews. Focused interviews (Merton and Kendall, 1946) and information seeing games (Sanoff, 1977) were conducted with representative staff members and the program directors, were recorded, and were content analyzed.

3. Observations. Children were observed at the Center, especially during times they were in a self-initiated learning center, and observations were recorded and informally analyzed.

4. Consultants. Outside experts in exceptional education, educational psychology, and design for handicapped children were brought in at various times, both to input information and to review progress and solutions.

5. Building type analysis. A review of the design literature was made to determine the range of existing and innovative environments designed for exceptional children and to see if any post-occupancy evaluations had been conducted on them.

Each bit of behaviorally-based design-relevant information uncovered from any of these sources was recorded on specially prepared format sheets, organized, and translated into design implications using methods described

elsewhere (Moore, Rose, and others, 1976; McGinty, Moore, and Cohen, 1977; Cohen, in press; Note 2). Over 1000 bits of information was extracted, organized, and translated. Though no direct or controlled experimentation was conducted as part of this project, an attempt was made to balance methods which are precise, though perhaps limiting, with those which are open-ended and non-directive, though perhaps less precise. We see this study, therefore, as raising questions and formulating initial concepts, principles, and testable hypotheses about the relations between architectural form and the development of exceptional children.

Behaviorally-Based Architectural Programming

The collected sheets of information were clustered into larger conceptual groupings. Two types of clusters were found useful: by developmental goals and by derived design principles. Most of the information was therefore classified in two ways. One of the findings from the literature and interviews was a set of hierarchically-related developmental goals underlying exceptional education (see Findings below), and the first clustering of information was in terms of the articulation of these developmental goals. The second clustering was an organization based on and in support of the derived design principles, that is, information which led to and was supportive of different design principles. This two-way classification of information, and in particular the summary written and graphic descriptions of it, comprised what we refer to as a generic behaviorally-based architectural program. The two-way classification is illustrated in Figure 2 below.

Design Application of the Program: Schematic Designs, Design Development, Evaluation

To complete the project, a number of alternative schematic design proposals were prepared by members of the team and were evaluated against the program in consultation with the staff and administration of the St. Francis Center and our

consultants. The best of various solutions were combined, gaps and remaining problems were identified, and a final integrated solution was developed for the outdoor learning environment. Drawings were prepared for particular areas of the site (the "Sand Hill", the "Hedge Maze") and a 1/2 inch to 1 foot model was constructed for the "Built Environment" (see Figure 6 later in the paper). A simplified post-occupancy evaluation strategy was devised, based on a series of Likert-type scales, and was used as part of the evaluation of the project.

FINDINGS: DEVELOPMENTAL GOALS AND DESIGN PRINCIPLES

The findings of the study to be reported here focus on the developmental goals which can be facilitated through designed settings, and the design principles which suggest critical environmental factors and characteristics of those settings in order to facilitate the goals.

Developmental Goals, Hierarchies, and Priorities

An important part of environment-behavior programming for building design is the generation of basic goals to which the designed environment should respond. Information from interviews, the literature, and our own familiarity with theories of development and their application to learning disabilities led to the following results:[3]

1. Table 1 shows an unordered set of 30 developmental goals which are important to educational intervention with exceptional children and which are thought to be at least partially influenced by the character of the built environment. These goals range from very specific goals (like eye-foot coordination) to broad inclusive goals (like cooperation).

Insert Table 1 about here

2. While realizing that we are dealing with an organic unit--the whole child--it is possible for the sake of analysis to classify these goals into

three broad categories (motor, cognitive, and social development) and their overlaps, as illustrated in Figure 2:

a) motor development (e.g., large muscle development)

b) cognitive- or perceptual-motor development (e.g., eye-hand coordination)

c) cognitive development (e.g., exploration and discovery)

d) cognitive-social development (e.g., social communication)

e) social development (e.g., social interaction)

f) social-emotional development (e.g., self-initiative)

g) social-motor development (e.g., social play)

Insert Figure 2 about here

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3. The 30 goals were collapsed into a more manageable set of 14 major goals which in turn it was possible to relate to the three broad categories in a hierarchy from broad to specific goals, as shown in Figure 3. This hierarchy should hold no surprises for developmental psychologists, but it was found to be a useful way of communicating the conceptual relations between broad and specific goals to both educators, designers, and students.

Insert Figure 3 about here

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4. Priorities were established for the 14 major goals on the basis of two criteria: importance of the goal to exceptional education, and potential for impact through changes in the physical environment. The final priorities are shown in Figure 4. This matrix represents initial hypotheses about the possible impact of the physical environment on exceptional patterns of development (e.g., it is hypothesized that the physical environment plays a much more crucial role in the development of social interaction than it does in the development of language, speech, and hearing, but it may play some role here too). We are not implying a one-to-one cause-effect relationship, but rather that there

is evidence to suggest that the environment may be designed to support and encourage activities depending on social interaction, and thus through the mediation of these activities, the development of social interaction skills may be enhanced (see Moore, Rose, and others, 1976).

Insert Figure 4 about here

Information collected on each of the 14 major goals was summarized in a mini-chapter of the final program document. It is impossible to summarize all of this information in this paper. We did, however, find some interesting environment-behavior relations which informed the next phase of generating design principles, three of which may warrent brief discussions here.

Gross motor development. Most exceptional children are not generally "retarded" across all domains of development--a common stereotype--rather most have disabilities in one or two very specific developmental areas. There is therefore more variation among exceptional children than among "average" children. With regard to gross motor development, not all exceptional children have the same difficulties. A wide range of activities and environments must be provided. The most common problems are endurance, either physiological or induced by overprotection (Gordon, 1972), as well as balance and posture, locomotion, and muscle tone (Kephart, 1960), and coordination of rhythm, agility, and balance (Gratty, 1970). Though motor activities are overemphasized on traditional and most contemporary playgrounds (Moore, Rose, and others, 1977), considerable evidence makes it clear that gross motor activity is the basis for all further development from perception to cognitive structuring of the child's world (Kephart, 1960; Piaget, 1963; cf. review in Hart and Moore, 1971). For example, it has been found that the development of posture is not only important for the development of locomotion, but also for the development of

the understanding of spatial relations (Ayers, 1972). Environments are called for which stimulate motor development, and in particular which call upon, and therefore provide "aliment" or practice for endurance, balance, locomotion, coordination, agility, rhythm, and perceptual-motor coordination.

Perceptual development. To operate successfully in a building, whether it be a school, playground, or the home, a child needs to be able to read that environment. With regard to visual perception, this includes depth perception, size and shape discrimination, color recognition, and recognition of spatial relationships such as above, below, next to, behind. The exceptional child may experience distortion of visual input or some impediment to the normal processing of this information. But it was observed and reinforced through our interviews at the Center that when a learning disabled child experiences one change in sensory cues, such as distinctly different colors in adjacent carpets, he or she expects another physical change, such as a change in floor level. These findings begin to suggest that to support these perceptual developmental processes, two qualities of the physical environment are important: that visual stimuli be presented in an orderly and consistent manner, and that there be a repitition of multiple (and non-conflicting) cues so that if color is discriminated by a child before depth, it can be an aid (and not a hindrance) to depth perception.

Self-concept. As a third example of probable relations between the physical environment and exceptional education, we can consider the very important goal of the development of self-concept. We are not born with a concept of self- as new beings children cannot distinguish between self and surroundings. Through repeated experience and sensation we learn that those waving arms, the hungry tummy, were part of self, the blanket was not. Secure arms, warm smiles, and soft coos told us the self we were learning about was a joy to others, and thus self became a joy to us. As others delighted in our growing accomplishments, so we delighted in our own. As others showed confidence in our trying and

achievement, and were not distressed by our occasional failings, so we continued to try and achieve. Each skill, each success, brought its own reward, a delight in our coming to terms with our surrounds, a delight in our own growth, a delight in our self. For the normal child there are periods of disequilibrium, when aspirations and accomplishments teeter-totter, when the wanting to ride a bike so far exceeds the capability to ride a bike that frustration erupts into tears or aggression. For the child with learning disorders, such disequilibrium is resident. If there is any universal concurrence in the developmental literature, it is on the critical importance of a positive self-concept. For the child with developmental lags, whatever their type or cause, the growth of a positive self-concept is even more critical; the exceptional child has a persisting motivation to try, but a considerably more difficult time to obtain a stable and positive self-concept. Opportunities should therefore be provided for the exceptional child to find out about self, to recognize and identify body parts, to develop a body image through movement, to imitate the acts and movements of others, and to sense achievement from his or her own movements, actions, and accomplishments. For the supporting environment to out shout the exceptional child's inner frustrations, it must be designed for success. It must have graded challenges and clear accomplishment points. It must be receptive to the child's actions, and it must provide alternative ways of accomplishing the same activity.

Thirteen Design Principles for Environments for Exceptional Education

Consideration of the program information collected for the project led to the generation of thirteen design principles for facilitating exceptional patterns of development through design of the environment.

Design principles are verbal and graphic statements of characteristics the built environment should have in order to solve certain problems and respond to human behavior. They have six defining characteristics: they are similar to traditional intuitive designers' "concepts" in that (1) they generate specific

design solutions and can be used in explaining those solutions, though they are very unlike intuitive concepts in most of their other defining characteristics. They are also similar to Alexandrian "patterns" (Alexander, Ishikawa, and Silverstein, 1977) in that (2) they respond to critical environment-behavior problems in humanistic terms, (3) are based on the latest of research information, yet (4) are stated in environmental terms, not behavioral terms, i.e., they specify in what ways the environment is to be designed to satisfy certain behaviors, and (5) they are testable. Alexandrian patterns have been criticized for being too dogmatic, deterministic, and absolute. Design principles as we have been developing them are intentionally open-ended, they are intended to suggest form, and to stimulate the designer's imagination and intuition, while avoiding overly doctrinaire and absolute solutions that might inhibit design innovation.

The following principles were generated in three main ways: (1) through informally sorting information which seemed to hang together and to suggest interrelated problems and a similar class of solutions (i.e., an informal, cognitive equivalent to say, Alexandrian complex hierarchical decomposition; cf. Part II of Marr 1976), (2) through synthesizing information on developmental goals and making explicit the major implications for design in a one-for-one atomistic translation of judgments into design implications, but a more holistic transformation cycling between the level of the problem and (3) through individuals generating preliminary design alternatives in response to a general question in the problem and then the team reflecting on what was important about those initial designs that really responded to segments of the critical developmental objectives. In these ways we arrived at a set of thirteen principles which seem most important to the good design of environments for exceptional education. Figure 5 shows the relation of these principles to the developmental goals, in particular indicating which principles are expected

to facilitate most strongly which goals (solid dots). The principles are ordered from broad organizing principles to be considered early in the design, to very specific principles which can be applied into the overall framework of the evolving design. Due to space limitations in this paper, the full rationale including description of the problem to which each principle responds and the empirical evidence supporting it cannot be presented here. The full texts of the principles are contained in the complete generic program document, Outdoor Environments for Exceptional Education (Moore, Cohen, and Team 699, 1977).

Insert Figure 5 about here

Organizing Principles

OP1: Design Principle 1 Continuity and Branching

Problem: Activities which dead end or open onto an undefined play area diminish the child's level of motor activity, intensity, decision-making opportunities, and attention span. For example, once reaching the bottom of a traditional slide, there is usually no obvious or direct connection to other play activities other than going back up the slide and sliding down again.

Principle: The environment should allow for activities to flow and move actively and continuously with multiple branches and alternatives at crossroads and decision points. When a child has come to the end of one activity or a cycle of activities, there should immediately and obviously be a choice of continuing options. Continuity and branching can influence motor activity, free play, exploration and discovery, attention span, decision making, and spatial awareness.

Insert Figure OP1 about here

DP2. Imageability and Orientation

Problem: Many exceptional children do not have the ability to see a meaningful whole (Cruikshank, 1967), and have difficulty with spatial and temporal organization and with sequences of verbal and spatial directions (Kephart, 1960). Each time a special child enters a room, he or she may see it anew--the novelty and complexity so stimulating to a normal child may only confuse a special child (Bednar and Haviland, 1969). Experiences of the basic horizontal and vertical planes help orientation in space (Bayes and Francklin, 1969).

Principle: The environment--buildings and parts of buildings--should be clearly imageable and have clear orientation based on vertical and horizontal cues and landmarks. All cues, parts, changes, and landmarks should convey a single clear image. (This design principle must be balanced with the demands expressed in Paced Alternatives, Variety of Spatial Experiences, and Loose Parts.)

Insert Figure DP2 about here

DP3. Orderliness and Consistency

Problem: Many learning disabled children have a perceptual difficulty. When exposed to irrelevant stimuli they may react with [illegible] into a hyperactive state (Cruikshank, 1967). Sudden movements or noises may also set off hyperactivity.

Principle: Orderliness and consistency in the environment reduces perceptual ambiguity, irrelevant stimuli, and hyperactivity, and thus increases the conduciveness of the environment for the entire learning process. Predictability may reduce the sensory-based hyperactivity and inner anxiety the learning disabled child experiences. Therefore the environment should have qualities of being orderly, straightforward, unambiguous, and consistent. (This design

principle does not require extreme monotony or boredom; some novelty, complexity, and dissonance are necessary as stimulating properties. The principle would suggest a slight leaning toward stimulation within the context of an overall orderly environment.)

Insert Figure DP3 about here

DP4. Paced Alternatives

Problem: Environments with which the average child can cope are often frustrating or impossible for the person with reduced competancy. The environment must not frustrate the exceptional child, and yet must provide enough challenges to generate and maintain activity (Ayers, 1972; Cratty, 1974). Exceptional children have a great need to gain self confidence and a positive self-image. Most development results from an optimal discrepancy between child and environment--challenges are made to existing motor, cognitive, and social schemata motivating the child from one state of equilibrium to another (cf. Hart and Moore, 1971). Such successes and achievements can also break the frustration cycle so common to exceptional children.

Principle: Paced alternatives may insure that incremental paced increases in required skills exist throughout the exceptional child's environment. The environment may dynamically pace the child without exceeding the optimal level of discrepancy between the child's current level of competancy and the demands put on him or her by the environment. There must be stimulation for continuing to the next level and alternative amounts of challenge and total n

Insert Figure DP4 about here

Specific Principles

DP5. Ambiguous to Defined Spaces

Problem: The possibilities for having designed settings stimulate creative and fantasy behavior have not been exploited in many children's buildings. Preliminary evidence suggests that ambiguous environments are especially supportive of fantasy play (Moore, Rose, and others, 1976). In such settings, an undefined structure can become anything a child wishes, from a castle to a car. But modeling behavior of real-world activities is also very important for the learning disabled child. Concrete activities like pulling shades, drawing curtains, washing dishes, opening windows, etc. intensify and reinforce appropriate modeling behaviors.

Principle: A range of settings should exist from very specific and defined settings to ambiguous ones--defined settings like play houses, garages, stores, bridges, etc. allow for specific modeling while ambiguous settings like a pile of rocks, a wood pile, and sand box, etc. allow the child's imagination and creativity to be used and developed.

Insert Figure DP5 about here

DP6. Variety of Spatial Experiences.

Problem: In order to relate to macro- and micro-environments, a child must become aware of space and learn spatial relations such as topological, projective, and euclidian concepts. Depth perception in early infancy is dependent on texture and shadow (Bower, 1965). Directionality is dependent on the kinaesthetic experience of moving the body through three-dimensional space (Kephart, 1960). The opportunity for falling, a sometimes fearsome, frustrating, and humiliating activity, is an important example of the kinds of experience vital to spatial awareness.

Principle: To assist in the awareness of space, children should be able to experience spaces through various sensorimotor and locomotor activities. A rich variety of spaces provides a range of experiences for being in or moving through spaces. The following spatial relations--and others--can be built into sequences of experiences: on, in, beside, behind, through, below, above, along, under, over, before, between, against, around, across, apart, near, far, away, toward.

Insert Figure DP6 about here

DP7. Range of Social Scale

Problem: Socially maladjusted children are more subject to the effects of crowding than average children. They need places to work alone, to do task oriented activities, or to retreat and dream (Gordon, 1972). Being alone and learning to accept oneself and others is also basic to the social and emotional development of a whole self concept. There is always a need for spaces for a child and a staff member to work one-to-one. On the other hand, exceptional children often suffer from a lack of group experiences; a socially maladjusted child may not even sit with a teacher. Increased interest in play comes from greater [illegible] interaction ([illegible]). [illegible] group experiences may also yield social communication or at least the desire to communicate.

Principle: The provision of a range of spaces in terms of size, types, and enclosures, but most especially in terms of the number and size of group activity they will contain would provide greater opportunities for different individual and interpersonal experiences. Solitude and physical togetherness can be experienced in small spaces while team sports can be organized in large open fields. Children and staff can work together intensely without interruption in very separate places while children can work best cooperatively when the space is large and open enough for them to see the activities of others.

Insert Figure DP7 about here

DP8. Retreat and Breakaway Points

Problem: Although all children need to interact with their peers, children with learning disabilities also need to be alone, to get away and dream, and to escape from external pressure. At times an exceptional child feels an acute need for privacy. When attempting a new activity a child can discover that it is too difficult or otherwise unpleasant. Immediate escape prevents panic, and provides encouragement for exploration by providing face-saving exits from unfavorable situations. Subgroups of the population can benefit also by retreating from the larger population thereby avoiding inappropriate comparison and conflict.

Principle: Environments for exceptional children need places of retreat and points of breakaway from major activities. A retreat from ongoing activities and a way out of too challenging or unenjoyable activities helps maintain positive self-concept. An ideal retreat is neither too close nor too far from other children and provides privacy and the opportunity for observing the behavior of peers from a safe distance and for imaginative and other quiet activities. A good breakaway point is immediately off any activity which proves to be too challenging--it is a face-saving exit

Insert Figure DP8 about here

DP9. Repetition and Multiple Coding

Problem: Objects common to the environment may prove to be uninteresting to the child, are not likely to elicit a great deal of attention, and therefore may not aid in learning. If the object differs from shapes and designs the child has seen before, it is likely to capture his or her attention. But because the exceptional child's attention span is short, it takes a while to learn what can

be done with the environment. The frequent repetition of cues can help recapture attention and enable the child to cope with the environment (Cratty, 1974). The pairing of cues can help the child to learn perceptual descriminations (Moran and Kalakian, 1974). Parts of the environment need to be multiply coded in order to communicate, inform, and illustrate to the child a particular message, concept, or information. Multiple coding can be multi-sensory, the cues being visual, tactile, and auditory.

Principle: The environment should contain a repetition of cues and multiple coding of the same concepts through different cues. Repetition deals with similar cues having the same meaning being repeated. Multiple coding deals with the same type of objects or concepts, e.g., level changes, having multiple cues which serve to identify them. An example would be all objects that are large and cylindrical in shape being red in color and with a large "C" on them and having a surface that is rough to the touch. Whichever cue the child learns first can aid in learning the other cues and concepts.

Insert Figure DP9 about here

DP10 Clear Accomplishment Points

Problem: A sense of achievement, of being successful, is important to the development of exceptional children. Opportunities which combine challenge with success with an eye towards children's capabilities, and opportunities for play experiences calling upon successful achievement of play skills reinforce self-image and self-confidence (Ayers, 1972; Moran and Kalakian, 1974).

Principle: A major goal of outdoor and indoor learning centers is to provide endpoints to challenging activities that are easily recognizable, thus making success obvious to the self and to others. These endpoints may be called clear accomplishment points.

Insert Figure DP10 about here

DP11. Loose Parts.

Problem: Children love to interact with variables, such as materials, shapes, smells, and other physical phenomena, and such as other people, animals, plants, words, concepts, and ideas, and this interaction in early childhood has been theorized to be a well-spring of creativity (Nicholson, 1971). Children also need to satisfy their curiosity, and to experience the pleasure derived from discovery and invention. Through play that is freely chosen, or unstructured play, children learn new skills, gain self-confidence, take pride and extend their knowledge into the real world. There is also a release of violent, aggressive and destructive energies through raw materials in free play areas (Handicapped Adventure Playground Association, n.d.).

Principle: An environment which contains loose parts has numerous loose, dynamic, interchangeable, and manipulative elements that can be used in an infinite variety of ways by children. There are three different types of loose parts: a kit of manufactured loose parts in which the child realizes the finished form which is not variable (e.g, a puzzle); a kit of prebuilt or manufactured loose parts in which the finished form is flexible (e.g., tinker toys); and loose parts that are not prefabricated and that can be used in a number of interchangeable ways with infinite finished forms possible (e.g., loose tires, boards, sand, gravel, rope, etc.). In any event, the child's achievement is sensed and rewarded by seeing and using the finished form, and more so from the process of making a finished form out of loose parts. As handicapped and special children require special care and attention, their parents and teachers find it difficult, at first, to expose them to such an apparently rough and ready atmosphere-so very different from the usual supervised structured play environment. It is precisely through such unstructed play, however, play that is freely chosen and

enjoyed for its own sake, that children learn new skills, gain self-confidence, take pride in their achidvements, sort out fact from fantasy, build up a picture of reality, and extend their knowledge of the real world (Handicapped Adventure Playground Association, n.d.).

Insert Figure DP11 about here

DP12. Emotional Release Areas

Problem: Children often become frustrated due to various reasons involving their inability to function both mentally and physically, e.g, inability to climb a ladder, to communicate successfully with others, or to cope with sensory overload. For some children, the simple joy of free play outdoors or a relaxing walk through a garden will help ease frustrations. Other children need to be coaxed into relaxing, e.g., with music or color. For others, role playing can be useful. Finally, others may need to be coaxed into becoming active to release frustration and pent-up energy; these children need things to build, knock down, throw, kick, and places to run, fall, jump, and cream off steam.

Principle: When children have trouble coping, an emotional release area then becomes a setting in which they can relax, role play, or express their emotions, frustrations, and aggressions without harm to self or others

Insert Figure DP12 about here

DP13. Plants and Critters

Problem: Children need to give and receive affection. Contact with animals can fulfill those emotional needs. Children can develop relationships with animals by petting them and taking part in their upkeep. Nonverbal children can develop a sense of communication from a tame animal that they can pet without fear of having it "talk back" (Osmon, 1971). Outdoor garden plots help to

satisfy the child's very great desire to grow things. By experiencing changes in their environment--their natural environment in particular--exceptional children can begin to learn how to respond to these situations and to develop confidence in their ability to handle change, rhythm, and surprise.

Principle: The interaction of children with plants and animals allows them to gain knowledge, understandings, and appreciation of living things, and to give and receive affection and thus to develop emotionally in a secure environment.

Insert Figure DP13 about here

SUMMARY AND CONCLUSIONS

This paper has summarized the substantive findings from an applied research, programming, and design project for children with learning disabilities. Information was collected from existing research literature, interviews, observations, participatory games, consultants, and a building type analysis. Results from the project have been reported in terms of fourteen developmental goals to which environments for exceptional education should respond, and in terms of thirteen design principles which suggest ways in which the environment may be designed to respond to and facilitate these goals.

The project resulted in three main outputs: (1) the development of new methods for the extraction and organization of design-relevant environment-behavior research information, and for the translation and communication of it to designers (reported elsewhere, Note 2), (2) the development of a generic program document using an experimental format and stressing developmental goals and design principles applicable to a wide range of indoor and outdoor environments for exceptional education (summarized in this paper); and (3) a detailed design proposal for an outdoor learning environment on a 1-1/3 acre site for the client group (see Figure 6).

Insert Figure 6 about here

This approach to applied research, programming, and design is a further step in the continuing effort to bridge the gap between the behavioral sciences and architectural design by integrating research and design. The main points of development over earlier efforts are:

1. Use and presentation of a wide range of information normally untapped by designers--behavioral information, developmental goals, and behaviorally-based design principles.

2. Program information which can be used at various levels and in various ways by different disciplines and professions, approaching the problem either from the developmental side or the architectural side.

3. A systematic and innovative format making the program useful and accessible by designers, educators, administrators, researchers, and others crossing traditionally disciplinary lines.

4. The development of design principles and the use of graphic communication to provide direction and information suggestive of a range of design solutions, and thus stimulating the designer's imagination and intuition, while avoiding overly doctrinaire and absolute solutions that might inhibit design innovation.

This project and summary paper are a first attempt at generating design principles for exceptional education environments. Many questions remain about the role of the physical environment in helping to overcome learning disabilities. Though it is possible tentatively to transfer findings from one population to another, e.g., from how children in general come to discriminate visual cues to how exceptional children might learn the same discriminations, considerably more research is required, especially first-hand research testing these hypotheses and uncovering more fundamental relations between exceptional education and the physical environment.

NOTES

1. We would like to thank the staff, administration, and children of the St. Francis Children's Activity and Achievement Center in Milwaukee for their wonderful cooperation, encouragement, and insights throughout this project. A complete report on the project is available through the School of Architecture and Urban Planning, University of Wisconsin-Milwaukee.

2. U. Cohen and G. T. Moore. The organization and communication of environment-behavior research information in architectural programming. Manuscript submitted for publication, 1977.

3. The results of this section of the paper owe much to the diligence of Lani van Ryzin, Myles Graff, Gunilla Terell, and other members of the project team and to Geri Giannotta, Renee Knutilla, Barbara Sammis, and other members of the Center staff and administration.

4. The results of this section of the paper owe much to the creativity of Myles Graff, Jeff Oertel, and other members of the project team. Most of the graphic images were prepared by Jeff Oertel. Particular principles were contributed also by Debrah Buck, Bruce Lunde, Scott Nolinske, Mardi Perschbacher, and Bill Starmer.

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CAPTIONS

Table 1. Unordered set of 30 most important developmental goals for exceptional education and the physical environment.

Figure 1. Sequence of the program development process: applied research, programming, and design.

Figure 2. Basic classification of developmental goals for environment-behavior programming of environments for exceptional education.

Figure 3. Hierarchical relationship of each of the 30 most important developmental goals to broad domains of human development.

Figure 4. Priorities for the major developmental goals by domains of development.

Figure 5. Matrix showing the relation between developmental goals, priorities, design principles which respond to the goals, and types of environmental settings where the principles may successfully be applied.

Figures DP1 through DP13. Graphic images of the thirteen design principles.

DP1. Continuity and Branching.

DP2. Imageability and Orientation.

DP3. Orderliness and Consistency.

DP4. Paced Alternatives.

DP5. Ambiguous to Defined Spaces.

DP6. Variety of Spatial Experiences.

DP7. Range of Social Scale.

DP8. Retreat and Breakaway Points.

DP9. Repetition and Multiple Coding.

DP10. Clear Accomplishment Points.

DP11. Loose Parts.

DP12. Emotional Release Areas.

DP13. Plants and Critters.

Figure 6. One view of the final model built for a portion of the St. Francis site. (Design and model by Jeff Oertel and William Starmer.)

ILLUSTRATIONS

(Note--these are xerox copies; original camera-ready copy will be provided as needed.)

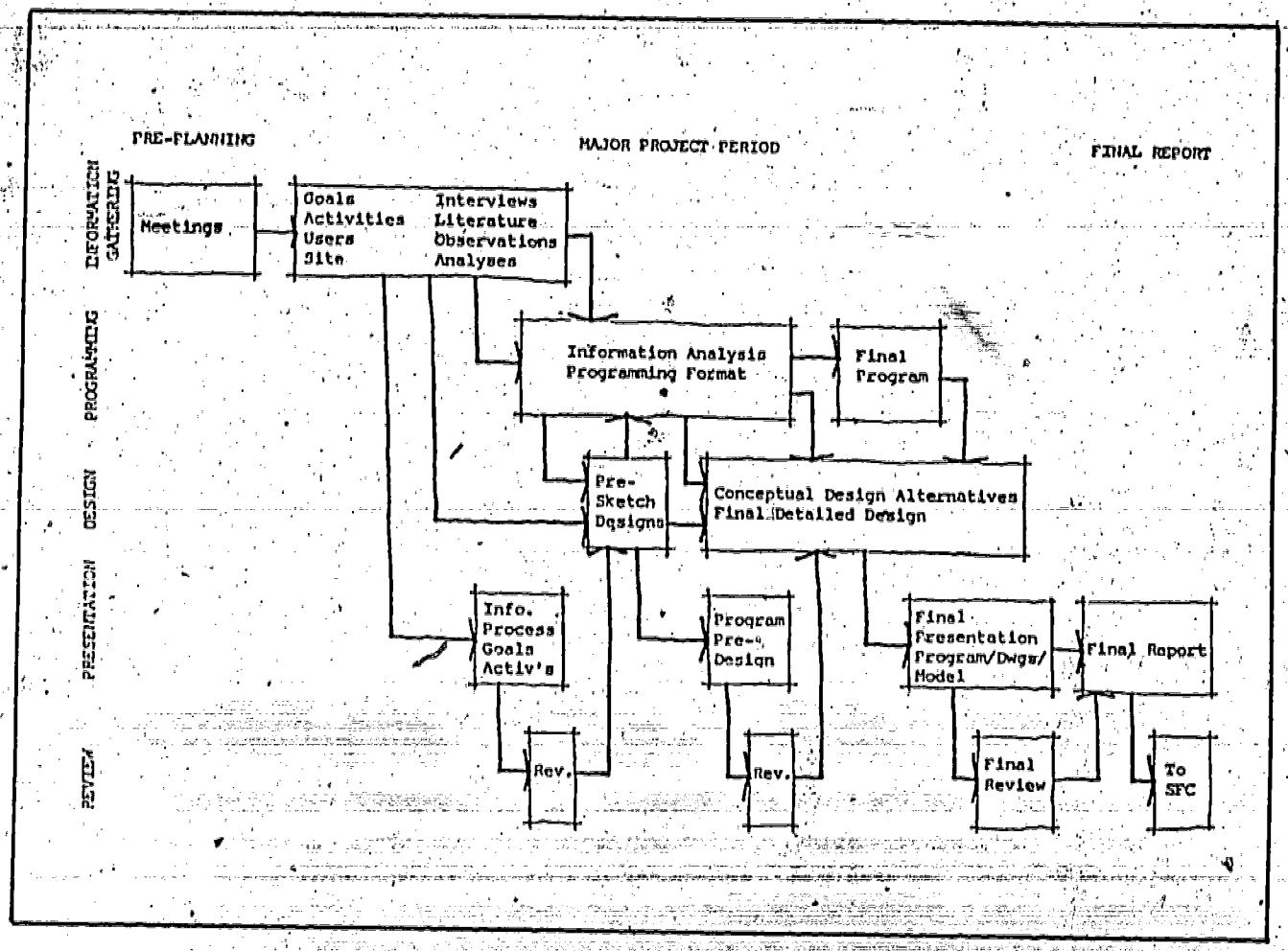


Figure 1. Sequence of the program development process: applied research, programming, and design.

UNORDERED SET OF 30 MOST IMPORTANT DEVELOPMENTAL GOALS

large muscles
fine muscles
manual dexterity
eye-hand/eye-foot coordination
balance
locomotion
general coordination
perceptual-motor coordination
perception
form recognition
spatial awareness, direction, and orientation
exploration and discovery
awareness of natural environment
imagination, creativity, and problem solving
environmental manipulation and control
mathematical concepts
spatial concepts
classification and seriation
attention span
representation
imitation and role playing
communication
cooperation and social play
body image
self-concept
self-initiative
ego development
emotional expression and control
handling environmental changes
language, speech, and hearing

Table 1. Unordered set of 30 most important developmental goals for exceptional education and the physical environment.

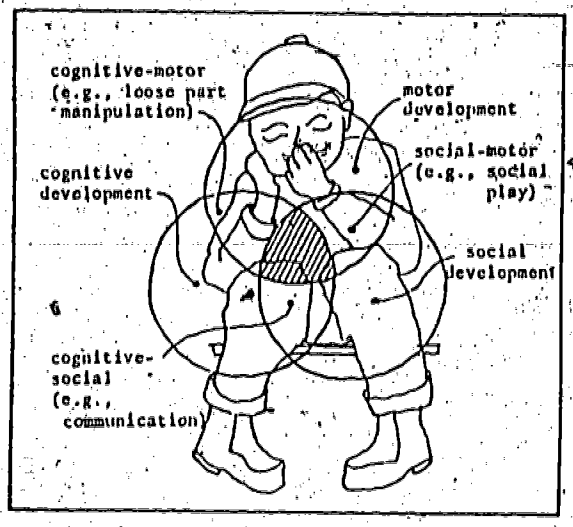


Figure 2. Basic classification of developmental goals for environment-behavior programming for environments for exceptional education.

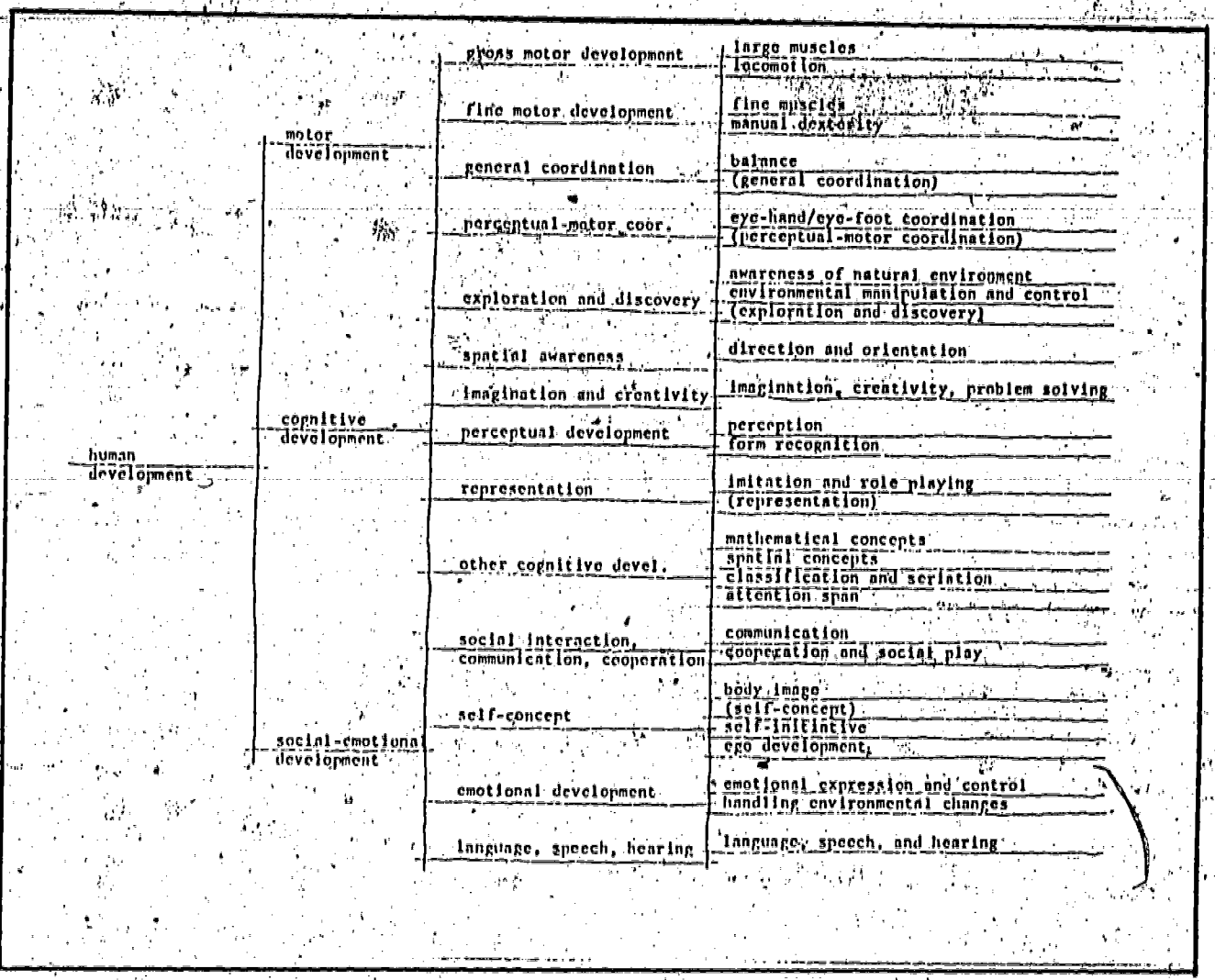


Figure 3. Hierarchical relationship of each of the 30 most important developmental goals to broad domains of human development.

	MOTOR DEVELOPMENT	COGNITIVE DEVELOPMENT	SOCIAL-EMOTIONAL DEVELOPMENT
MOST CRUCIAL	gross motor fine motor general coordination	exploration and discovery spatial awareness	social interaction, communication, and cooperation
VERY IMPORTANT		imagination and creativity perceptual development	self-concept emotional development
IMPORTANT	perceptual-motor coordination	representation	
LEAST IMPORTANT		other cognitive developments	language, speech, and hearing

Figure 4. Priorities for the major developmental goals by domains of development.

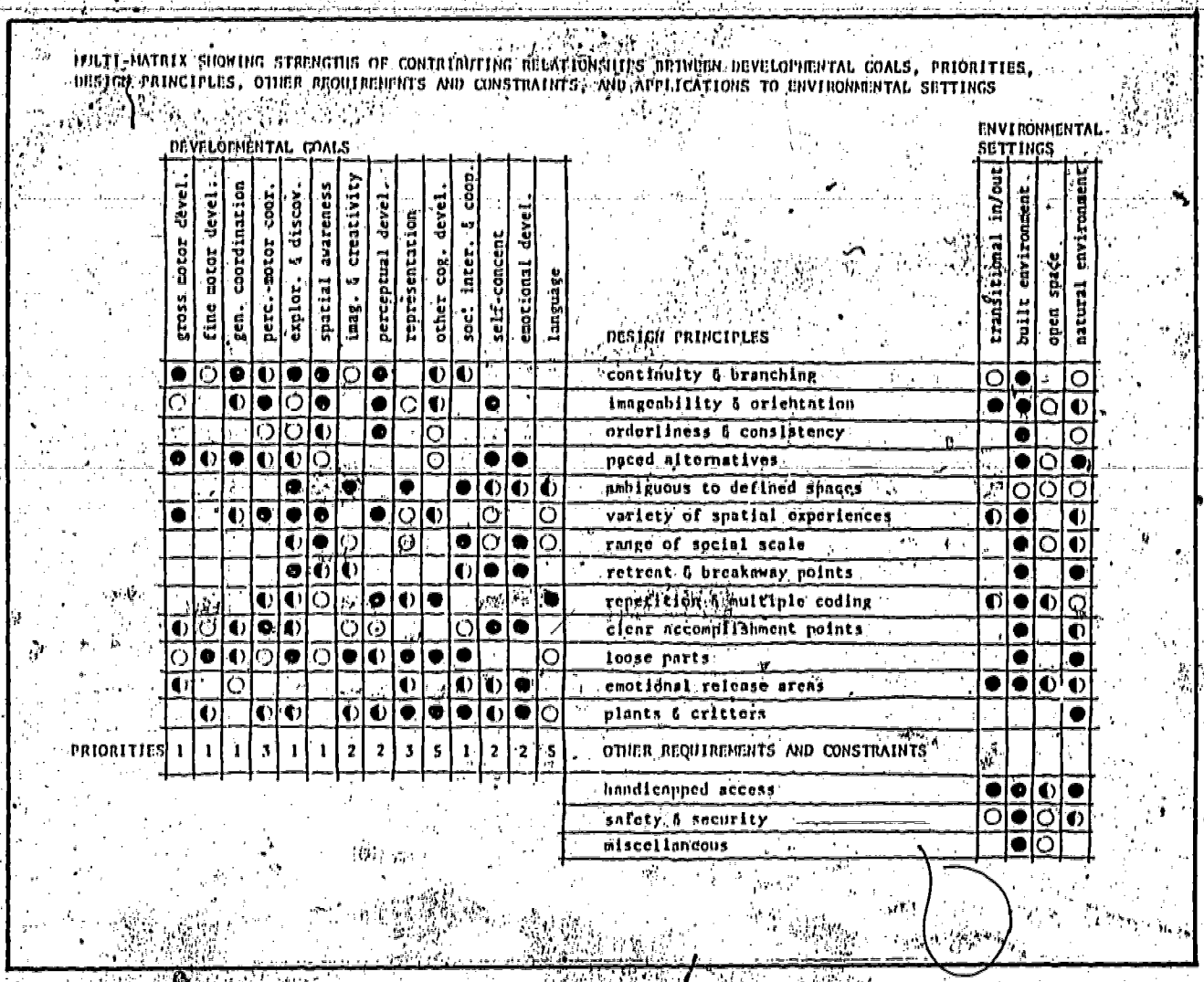


Figure 5. Matrix showing the relation between developmental goals, priorities, design principles which respond to the goals, and types of environmental settings where the principles may be applied.

ORGANIZING PRINCIPLES

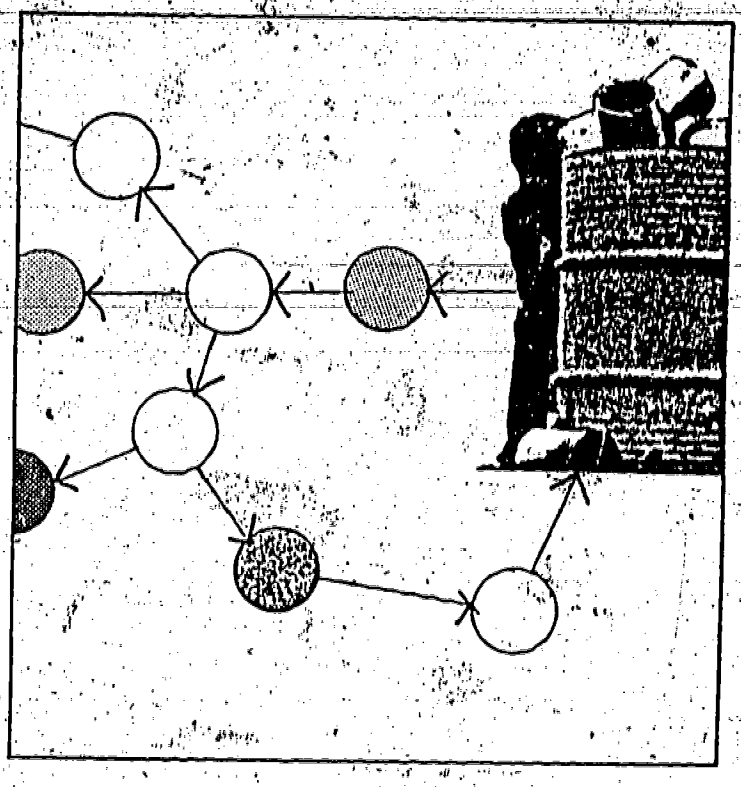
CONTINUITY & BRANCHING

MOTOR/DEVELOPMENTAL/COGNITIVE
Developmental Goals

BUILT
Environmental Settings

Principle

The environment should allow for play and behavior to flow and move actively and continuously with multiple branches and alternatives at decision or crossroads areas. More specifically, when a child has come to the end of one activity or cycle of activities, there should immediately be a choice of options as a next step to take.



Figures DP1 through DP13. Graphic images of the thirteen design principles.

SELF CONCEPT/PERCEPTION
Developmental Goals.

IMAGEABILITY & ORIENTATION

TRANSITIONAL/BUILT/NATURAL
Environmental Settings

Principle

For many exceptional children the perception of space, line, time, boundary, figure-ground, and orientation are difficult to develop and inaccurate. Proper cues promote intended perception and internalization of physical space and the environment. What the boundaries of the body are, how the body occupies space, where one is in relation to the trees, houses, streets and, on a larger scale to the city, state, etc. is orientation. Orientation depends on the image of the environment the individual has in their head. The internal, head, image is affected by the ease of "reading" and understanding the cues provided.

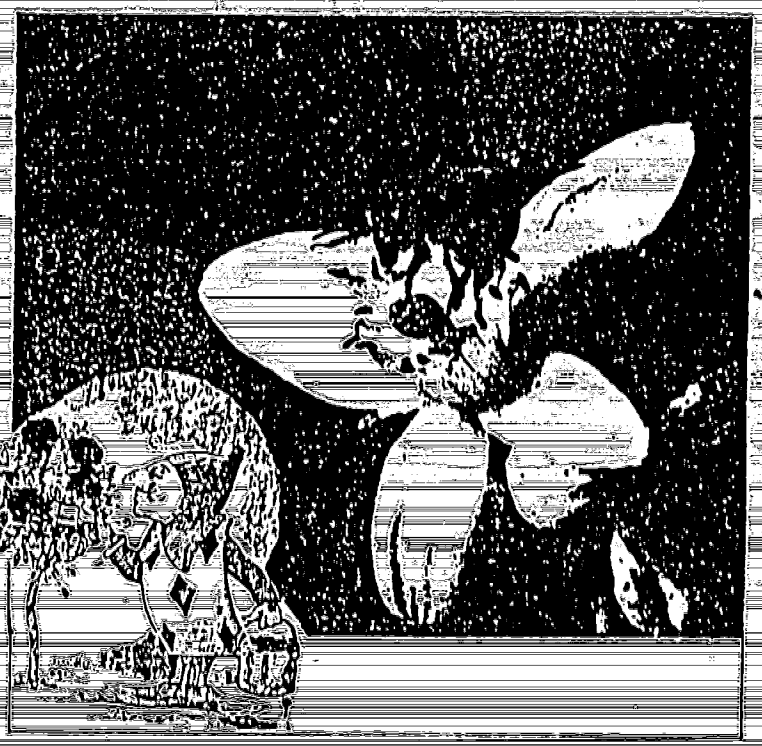
COGNITIVE
Developmental Goals

BUILT
Environemental Settings

ORDERLINESS & CONSISTENCY

Principle

The concept of orderliness and consistency can best be defined as the built environment including the qualities of being straightforward and unambiguous. The built environment should be perceived as predictable and non-confusing to exceptional children with learning or perceptual difficulties. This principle is not to be read as saying there should not be change, variety, and interest in the environment



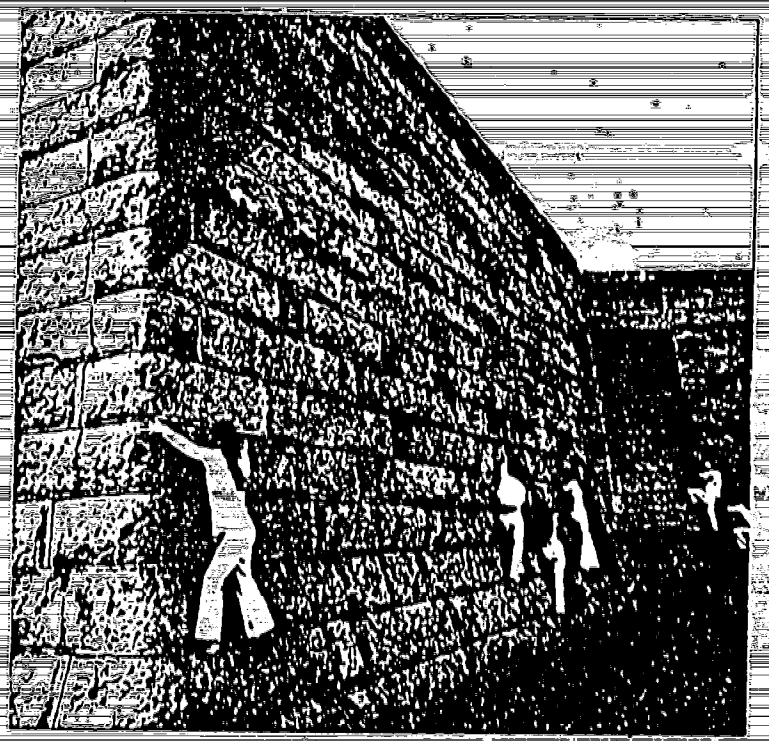
PACED ALTERNATIVES

PSYCHOLOGY/COGNITIVE
Developmental Goals

BUILT/NATURAL/OUTDOOR
Environmental Settings

Principle

Paced alternatives insure that incremental, paced increases in required skill exist logically throughout the environment. The environment must dynamically pace (and push) the child without exceeding an optimal level of discrepancy between the child's current level of skill and the environmental demands put on him or her. Each challenge is not beyond the skill level or anthropometric fit of the child. There must also be stimulus for continuing progression to the next skill level. Although success and achievement are necessary, neither should be automatic or instant. There must always be challenge, a certain amount of tension is required, except in rare occasions to prevent the reinforcement of frustration.



SPECIFIC PRINCIPLES

AMBIGUOUS TO DEFINED SPACES

EMOTIONAL/COGNITIVE
Developmental Goals

BUILT/NATURAL/OPEN
Environmental Settings

Principle

Play environments require a range of definition from ambiguous to highly defined settings. The range of definition relates both to the physical characteristics of the setting as well as to the implied or expected behavior. For example, highly non-specific settings such as a pile of rocks, is a very open-ended situation to which children can give their own meaning. A model doll house is a highly defined setting which encourages a predictable set of behaviors.

SPATIAL AWARENESS/SPATIAL CONCEPTS
Developmental Goals

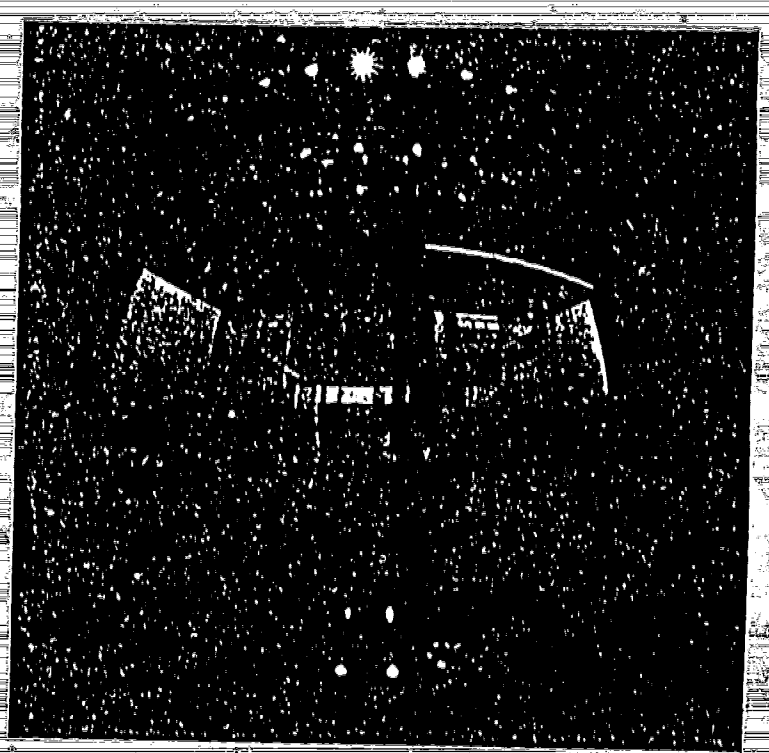
TRANSITIONAL/OUTLET/NATURAL
Environmental Settings

VARIETY OF SPATIAL EXPERIENCES

Principle:

A rich variety of spaces provides the child with a range of experiences of being in spaces or moving through spaces. The desirable variety may be characterized by the following spatial prepositions:

on	through
beside	against
behind	around
over	across
in	by
along	from
under	toward
before	above
between	below



SOCIAL/EMOTIONAL
Developmental Goals

BUILT/HUMAN/NATURAL
Environmental Settings

RANGE OF SOCIAL SCALE

Principle

Exceptional children have a great diversity of needs. A range of spaces in terms of size, type, and enclosure, but most especially in terms of the social scale or size of group they will contain, would provide greater opportunity for different individual and interpersonal experience and for different kinds of activities. Possibilities include open playing fields, hedges, enclosed small sand areas, a very private tree house.

SELF CONCEPT/IMAGINATION
Developmental Goals

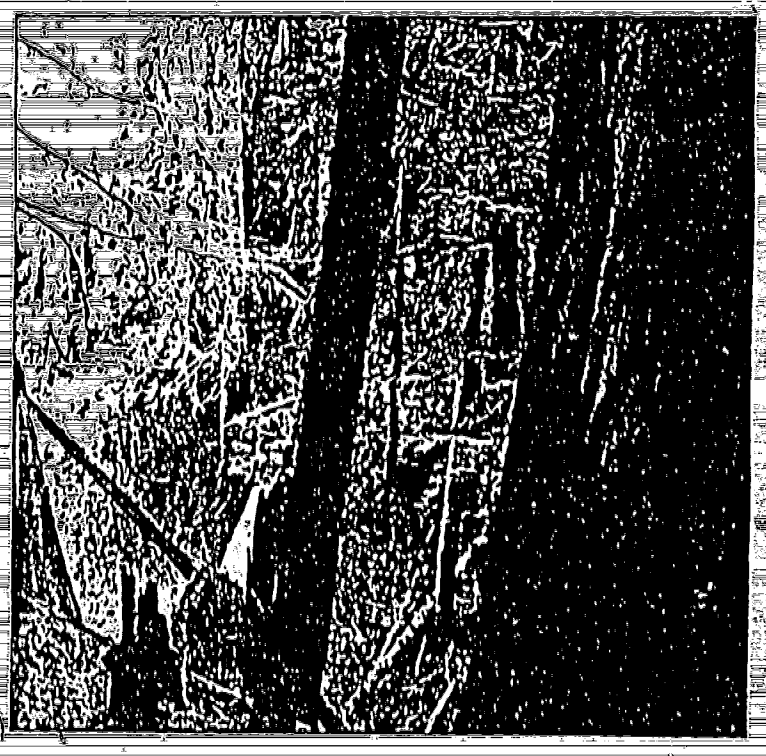
NATURAL/BUILT
Environmental Settings

RETREAT & BREAKAWAY POINTS

Principle

There are occasions when an individual or even a group need to get away from it all. The bustle of other people sometimes can crowd or frustrate a person, especially an exceptional person. An ideal retreat is neither too close nor too far from others and provides privacy and the opportunity for observing the behavior of peers and for imaginative or other quiet activity.

A more immediate need to escape can come from entering a too challenging or unenjoyable activity. If the child wants to leave the activity and there is no way out other than completing the activity, panic or fear may overcome the child. A way out of ongoing activities which would maintain the child's positive self-concept is needed.



PERCEPTUAL/MOTOR/COGNITIVE
Developmental Goals

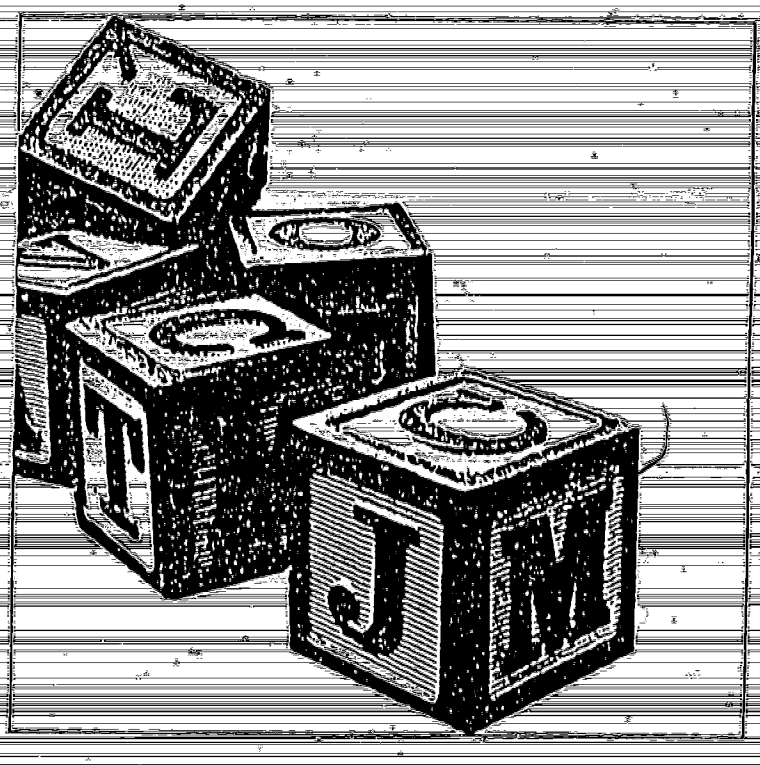
REPETITION & MULTIPLE CODING

UNIT
Environmental Settings

Principle

Repetition deals with similar cues having the same meaning being repeated. An example of repetition is the use of different colors to indicate a change in level; every time a color changes, it signals a corresponding change in level. The colors are repeated in various situations to signal each change.

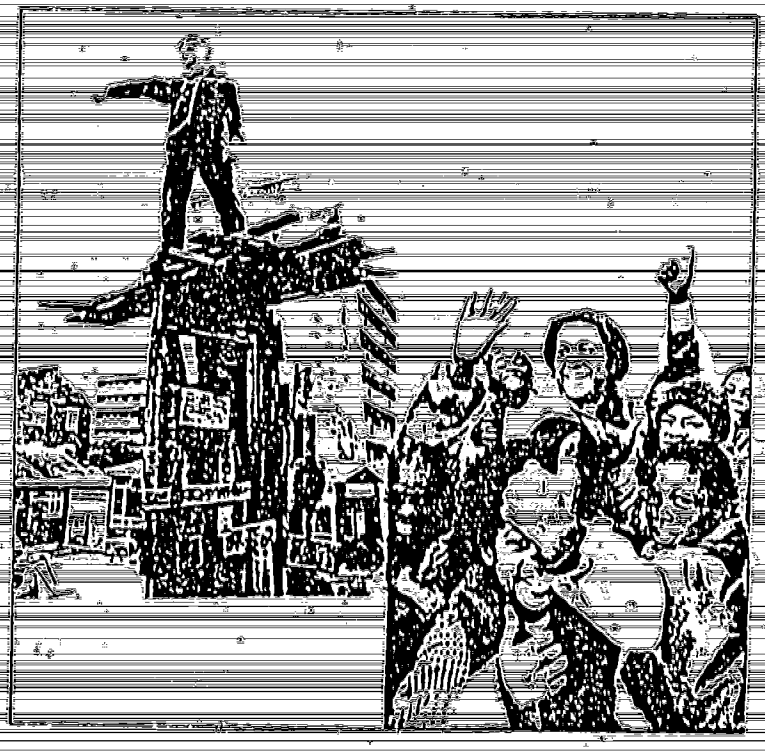
Multiple coding deals with the same type of objects having multiple cues which serve to identify them. An example of multiple coding would be all objects that are large and cylindrical in shape being red in color with a large "C" on them and having a surface that is rough to the touch. The object is defined in terms of its size, shape, color, symbol, and texture.



CLEAR ACCOMPLISHMENT POINTS

Principle

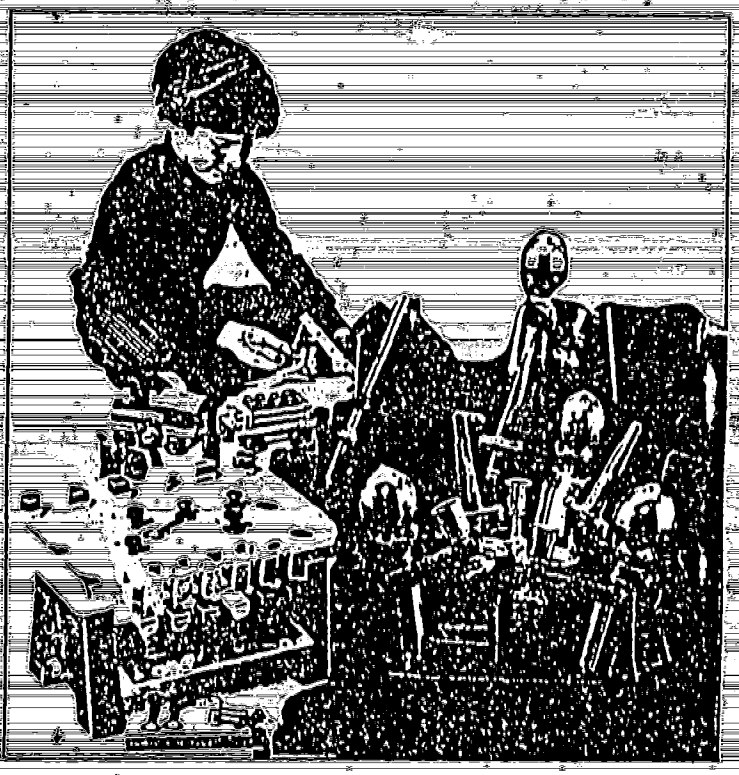
Success is an important component of growth in any child. Without success, frustration becomes the controlling factor and frustration breeds failure. Children with learning disabilities become frustrated more easily than others and have more difficulty recognizing success when it happens. Making success obvious in any endeavor a child with special problems might undertake is therefore an important design principle.



EXPLORATION/CREATIVITY/SELF-CONCEPT
Developmental Goals

OPEN/NATURAL/ABLE
Environmental Settings

LOOSE PARTS



Principle

An environment which contains loose parts has numerous loose, dynamic, interchangeable, and manipulative elements that can be used in an infinite variety of ways by the children. The design principle of loose parts can be categorized into three different types of loose parts.

A kit of manufactured loose parts in which the child realizes the finished form which is not variable (e.g., a puzzle)

A kit of purchased or manufactured loose parts in which the finished form is flexible (e.g., tinker toys)

Loose parts that are not prefabricated and that can be used in a number of interchangeable ways which influence finished forms possible (e.g., rough loose trees, boards, sand, gravel, dirt)

In any case, the child's achievement is noted and rewarded by seeing and using the finished form, as well as from the transition from loose parts to some finished form.

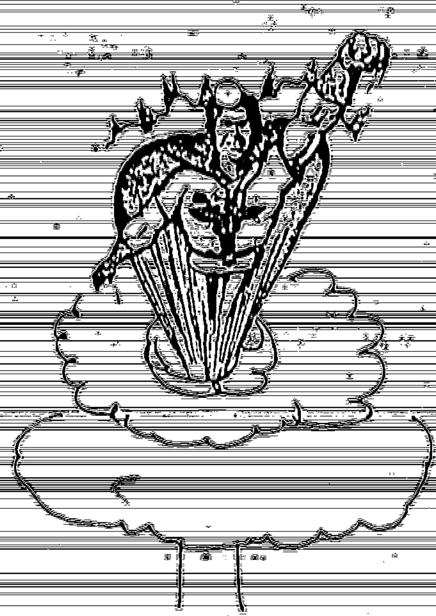
MOTOR/COGNITIVE/SOCIAL-EMOTIONAL
Developmental Goals

BUILT/NATURAL/OPEN
Environmental Settings

EMOTIONAL RELEASE AREAS

Principle

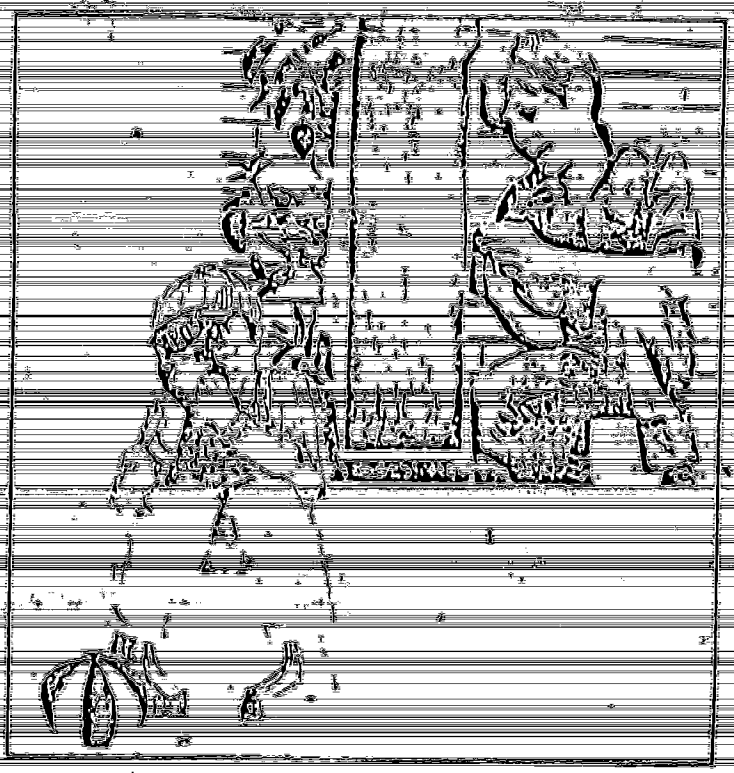
Settings or activities are necessary which allow children to express and release their emotional anxieties, be they anger, tension, or frustration with himself, others, or the environment.



PLANTS & CRITTERS

SOCIAL/EMOTIONAL
Developmental Goals

NATURAL
Environmental Settings



Principle

The interaction of children with plants and animals allows them to gain knowledge, understanding, and appreciation of living things.

Figure 6. One view of a model showing part of the final design solution for the St. Francis Outdoor Learning Environment. (Design and model by Jeff Oertel, William Starmer, and members of the project team; photograph by Gary Moore.)