

# Implications

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## Cognitive Development of Children

Cognition refers to the area of psychology that has to do with all aspects of thinking. How we attain knowledge in the first place, how that knowledge is stored, how we modify that knowledge are all questions that concern cognitive psychologists. But cognitive psychologists are also concerned with why one individual differs from another in many of these cognitive processes. A very intriguing and exciting endeavor is the investigation of how these cognitive capacities change with age, the domain of developmental cognitive psychologists.

### Cognition and Age

Psychologists recently, and philosophers before them have argued about how our knowledge and cognitive abilities are acquired. It wasn't until about the middle of the last century that researchers began to systematically study the cognitive processes of newborns and young infants. It was found that they were capable of some learning (habituation and primitive forms of imitation). Such learning implies a memory capacity. There is even evidence that a newborn can recognize the sound of their mother's voice and some aspects of their mother's language. By six months of age

they also showed some evidence of conceptual knowledge like an elementary realization that two objects can't occupy the same place at the same time and an ability to distinguish between sets of small numbers of objects.

### Cognitive Processes

As remarkable as these achievements are, there is a huge amount of cognitive development that occurs after infancy, after the pre-school years and during the elementary school ages and even into adolescence. Almost all aspects of cognition show marked development during these later years: perception and attention, memory, conceptualizing, problem solving and reasoning, symbolic processes. All of these have important implications for education and other practical activities.

There are several theoretical perspectives about cognitive development. A popular one is known as information processing and it is based on an analogy between the information processing of a growing child and a computer. Schematically it goes like this: the perceiving child receives information through his or her senses. The information is fed into a working memory storage where it can only remain for a short time. In working memory, the informa-



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tion is operated on and then transmitted to a long-term memory storage or an action is initiated. The working memory can get information from long-term memory for its operations as well as from the senses. Perception and attention reflect the information input. Memory processes involve either the short term working memory or the long-term memory. Conceptualizing, problem solving and reasoning, symbolic processes comprise many of the mental operations that can go on in working memory.

Let us consider one example, that of perception and attention. It is a common observation that older children perceive more than younger but it is also known by teachers and parents that older children can pay attention better than younger. One aspect of paying attention is focusing attention on the important features of the task at hand. Occasionally older children's ability to focus their attention very well can actually reduce the amount of the wider situation that they perceive.

It is also the case that with increasing age children's ability to take on information becomes more automatic. This is usually good because it frees up mental capacity for other processes such as problem solving or reasoning. Sometimes, however, it can interfere with a task. An interesting demonstration of this occurs when learning multiplication tables after simple digit sums have been overlearned. So a child who has learned to automatically sum two digits will often make intrusion errors providing the sum of two digits when asked to multiply them, e.g., answering "11" when given the problem "7 x 4."

Another example of such automatization, known as the Stroop Effect, occurs after a child has learned to read. The task is to name, as quickly as possible, the color in which a word is printed. There is no problem if a word like "bat" is printed in red. But if the word "blue" is printed in red, it is difficult for a reading

child to say *red* immediately, as they have an automatic tendency to respond in terms of the written word. (This is a powerful effect even for adults.)

Researchers try as much as possible to isolate the various mental processes so as to study them in pure form. However, it is important to keep in mind that most real life processes, e.g., reading for comprehension, baking a cake, finding one's way somewhere, etc. involve combinations of many mental processes. It is a further challenge to understand how these processes are integrated to produce a useful outcome.

—Herbert L. Pick, Jr., Ph.D., Professor,  
University of Minnesota

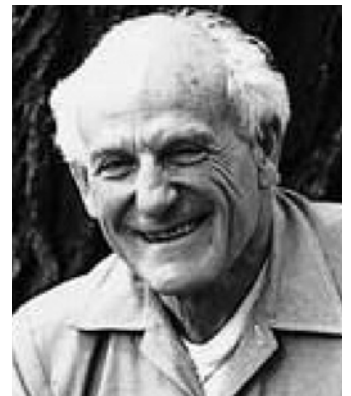
Dr. Pick recommends these relevant books:

—Siegler, Robert S. (1998). *Children's Thinking*. Upper Saddle River, NJ: Prentice Hall.

—Bjorklund, David F. (2000). *Children's Thinking: Developmental Function and Individual Differences*. Belmont, CA: Wadsworth/Thompson Learning.

### About the Author:

Herbert L. Pick, Jr., is a Professor working at the Institute of Child Development at the University of Minnesota. His research is primarily concerned with how people mix their sensory and cognitive abilities to navigate in different spatial environments. Dr. Pick's



writing and research has appeared in numerous psychology journals, edited book chapters, and he has also written about Human Navigation for the *MIT Encyclopedia of Cognitive Sciences*.

## Understanding Learning Environments for Children

An extraordinary learning environment provides more than just spaces for children to learn. It provides an engaging, stimulating and safe place for children to fully explore, experience, and understand the world around them. A great school inspires children to learn by providing places that encourage them to build upon the skills they are developing at each age level. In order to create environments that facilitate this learning process, one must have a clear understanding of how children develop, recognize how children understand their surroundings, and accommodate the teaching methods which are being implemented within a given school.



### Child Development

The Swiss, developmental psychologist, Jean Piaget, outlined four different stages of cognitive development: the sensorimotor stage, the pre-operational stage, the concrete operational stage, and the formal operational stage. Elementary school-age children fall within the pre-operational (ages two to seven) or the concrete operational stage (ages eight to eleven.)

Pre-operational stage children have not yet developed the ability to think logically. They “deal with the world symbolically, or representationally. That is, they develop the ability to imagine doing something,

rather than actually doing it” (Rice, 2001). In the pre-operational stage, children tend to proceed in thought from detail to detail and are unable to generalize. Children in this stage also discover and develop through pretend play. They are able to watch their parents and others around them, and pretend to go shopping or play house. A child in the pre-operational stage is unable to see things from another person’s perspective; hence, a child in this stage must experience everything directly because they cannot understand what consequences there may be or think about how another person may react.

In the concrete operational stage, children are able to think logically. They begin to understand things from another person’s perspective, and understand the ideas of conservation and reversibility. They also develop the ability to classify objects into a series or by hierarchy; however, it is important to understand that children in this stage are unable to think or reason abstractly. Concrete examples must be shown or experienced in order for children to understand most concepts.

### How Children Understand Their Environment

Children explore and understand their environments sensually. It is difficult to discern exactly which of the five senses children use to explore space. The most obvious way children ascertain information about space is through the visual sense; however, understanding an environment is an experiential activity—it involves much more than the visual sense alone. J.J. Gibson (Bloomer & Moore, 1977) defines the senses as a set of systems which do not necessarily have a body part associated with each system. The two most prevalent systems are the basic-orienting system and the haptic system. These two sensory systems do not have single organ, such as the nose or the ears, associated with them, but contribute the most to our understanding of the three-dimensional, spatial experience.

The basic-orienting system is our ability to define up from down. This system, dependent on gravity, allows us to keep our body balanced on the ground, and tells us our relationship to the ground. If all of our ‘traditional senses’ (sight, sound, taste, touch, and smell) were taken away, we would still have the ability to understand if our body were horizontal or vertical, or if our body were moving up or down.

The haptic system is a perceptual system. In the traditional five senses, touch is the only sense that requires tactile interaction. The haptic system is used to explore and understand space in a holistic manner. In contrast to the simplistic definitions of the traditional five senses, the haptic system “involves the integration of many senses, such as touch, positional awareness, balance, sound, movement, and the memory of previous experiences” (O'Neill, 2001). This suggests that people understand space tactility, and through movement, scale, and auditory senses.

## Educational Delivery Models

The methodology of teaching, or educational delivery, can vary from school to school and also changes over time as educational theory advances new modes of teaching and learning. The educational delivery model adopted by a given school has a profound influence on the design of the learning environment.

One example is the “Interdisciplinary Model” which supports the ‘house’ or ‘team’ concept, where a group of classrooms, each dedicated to a different academic discipline (i.e., math, language arts, science, etc.) surrounds a teaming area. Teachers of the various disciplines have opportunities to collaborate on educational themes that provide continuity for students as they move from class to class. In this model, the children stay together throughout the day in their ‘house’ and leave to go to specialty areas (art, gym, music, etc.) A central ‘team area’ is available to each

‘house’ to be programmed as the teachers decide. It is often used for large group meetings, as a flexible technology space that can be used by any of the surrounding classrooms, or for thematic displays and presentations.

## Creating a Learning Environment

It is critical to create an environment that encourages children to do child-like activities because this is how they learn and develop. The educational delivery model will shape the general layout of a school through the organization of classrooms and specialty areas in a fashion that best suites the teaching method. Some specifics:



- Provide children with places to explore, things to touch, and areas to climb.
- The design of the classroom should be informed by the age of the students using the room. This can be accomplished through age appropriate scale, a richness of texture, and a variety of places that holistically stimulate the senses.
- Create a space that promotes learning through play for kindergarteners. Perhaps this means designing a bench with drawers and doors made of a variety of materials, to encourage exploration and manipulation.
- Classroom floor finishes could include both carpet and tile areas to accommodate different types of experiments or physical interaction. These areas may incorporate a range of texture, color, and scale relative to children.
- Design areas that promote the investigation of balance or scale. This can be accomplished through elevational changes such as raised platforms, floor

depressions, and lowered ceiling planes, producing a rich and varied spatial experience while also identifying intimate areas within a learning environment.

It is important to make children feel both safe and proud to learn; therefore, it is the responsibility of the educational designer to understand how children develop and learn, to know how children relate to their surroundings, to remain informed on current teaching trends, and to create an aesthetically pleasing and welcoming environment. When designers are informed, school environments become more than a group of teaching spaces—they become extraordinary learning places.

—Amy L. Walz, Associate AIA,  
Rozeboom Miller Architects, Inc.

## References

—Rice, Phillip F. (2001). *Human Development: A Life-Span Approach*. Fourth Edition, p. 162. New Jersey: Prentice Hall.

—Bloomer, Kent & Moore, Charles. (1977). *Body, Memory, and Architecture*. New Haven: Yale University Press.

—O'Neill, Marie. (2001, September). Corporeal Experience: A Haptic Way of Knowing. *Journal of Architectural Education*, 55 (1), 3.

## About the Author:

Amy L. Walz, Assoc. AIA, received both her Bachelor's degree in Environmental Design and a Master's Degree in Architecture from Montana State University. During graduate school she



studied educational environments with a focus on elementary schools. She is currently working for Rozeboom Miller Architects, Inc., in Minneapolis, Minnesota. The firm specializes in educational design. Amy is presently working with a design team on a new elementary school in Victoria, Minnesota.

## How Are Design Professionals Informed?

### The Role of the Design Professional

Architects are much more than just sculptors of space. With a host of other design professionals, including interior designers, engineers, landscape architects, etc., they take on the job of balancing and synthesizing the many factors that lead to a complete building. This includes articulating the client's needs in a building program, providing a building design that meets the client's program and coordinating all the critical building systems (structural, mechanical, electrical, civil, landscape, etc.), while creating a building design that is a constructive addition to the built environment.

Design professionals must be excellent listeners to clearly understand the needs of their client and translate them into a building program. School districts provide a rich and complex client base comprised of students, educators, parents, community members, administrators, and school board members. Every one of these groups provides critical information regarding the design of a new school.

### A Clear Understanding

Before the design of a school begins, the design team must understand the client's vision for the project and articulate it in a building program. The program incorporates extensive demographic and curriculum information gathered from the client. It establishes the type, number and size of spaces, provides the overall square footage of the building, and identifies an approximate building cost. A questionnaire is

passed out to the current staff in the district that provides an excellent opportunity for the educators to describe their space needs. The design professionals then meet with a committee of administrators and educators to recognize any trends that arise from the questionnaires. Throughout this programming process, the design team derives a thorough understanding of the educational delivery model for the school district.

## Who is Involved?

There is a hierarchy of decision-making that is already established in the school district, beginning with the School Board, then the administrators, and finally the users—staff, students, parents, and community members. Since the users most frequently utilize this type of space, their input on the day-to-day use of the building is critical. Hence, a building committee is created, which consists of users and administrators.



## What is the Process?

The design team develops plans and elevations that are then presented to and discussed with the building committee. It is the job of the building committee to critically analyze the plans and decide if each program area has enough space, and the right type of space, to work functionally. They also comment on

the spatial adjacencies (i.e., which program areas need to be in close proximity to each other, near the front entrance, etc.). Since there is only a certain amount of square footage that can be built with a given budget, there are frequently lengthy discussions about the critical needs of each program area and which areas can, or cannot, be compromised. The design team looks to the building committee to help prioritize the building needs and balance these with the available budget.

## Keeping Informed

Throughout this process, members of the design team regularly attend community and school board meetings, both to listen to the concerns and issues being discussed and keep others up-to-date on the design process by presenting current site plans, floor plans, elevations, and models. There is a continual dialogue between the design team and the building committee, which represents the educators and the parents, who in turn represent the students, to ensure that everyone involved with the new school is heard.

Design professionals must synthesize diverse and often competing interests and information from many different groups of people. They clearly understand that the environment in which children learn can greatly enrich and influence the learning experience. The design team has the unique opportunity to creatively design extraordinary learning environments for children—and do so by remaining informed on current trends in education, by listening to every person involved, and through appropriate application of that knowledge.

## Related Research Summaries

InformeDesign has many Research Summaries about child development, learning, the learning environment, and related, pertinent topics. We believe that this knowledge will be valuable to you as you consider your next design solution and worth sharing with your clients and collaborators.

### Learning

“Relating Ways of Learning to Designing Spaces”  
—*Journal of Architectural Education*

“Wayfinding Tests Cognitive Development”  
—*Journal of Environmental Psychology*

“How Children Understand Space”  
—*Child Development*

“Children’s Reading Skills Affected by Noise Exposure”—*Environment and Behavior*

“Playground Markings Increase Children’s Active Play”—*Ergonomics*

“Permanent Student Artwork Improves Sense of Ownership”—*Environment and Behavior*

### Environments

“School Furniture Design Affects Children’s Behavior”—*Ergonomics*

“Crowding is Detrimental to Young Children”  
—*Environment and Behavior*

“Selecting Sustainable Interior Materials for Schools”  
—*Journal of Interior Design*

“Development and Design of Schools in Nairobi Slums”—Children, Youth and Environments

“School Size Affects Adjustment to Junior High”  
—*Environment and Behavior*

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Dave Hansen, Ag Experiment Station  
University of Minnesota  
(p. 3 & 4)

Debbie Boyles, College of Human Ecology, University of Minnesota (p. 6)



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