Learning to Forget:
Architectural Recreation, Spatial Visualization, and Imaging the Unseen

EUGENIA VICTORIA ELLIS
Drexel University

LEARNING THROUGH PLAY AND RE-CREATION

> *The subject of this article is a very ordinary hobby horse... It is satisfied with its broomstick body and its crudely carved head which just indicates the upper end and serves as a holder for the reins... The hobby horse does not portray our idea of horse... The "first" hobby horse was probably no image [of a horse] at all. Just a stick which qualified as a horse because one could ride on it... It needed two conditions, then, to turn a stick into our hobby horse: first, that its form made it just possible to ride on it; secondly—and perhaps decisively—that riding mattered.*
>
> *—E. H. Gombrich, "Meditations on a Hobby Horse or the Roots of Artistic Form"*

Does the architecture student in the Age of Information need to learn to draw, make models, or even visit sites of significant works of architecture? That is the question facing architectural educators globally. After all, the world is at our fingertips visually at the touch of a computer keyboard and the click of a mouse. Since nearly all information is accessible to everyone, would it not be possible for students to learn all they needed to know about architecture and design through accessing and manipulating the visual output of the computer screen?

A similar question faces educators at all levels of learning, beginning with the early childhood years. The answers teachers at the early childhood level are finding is that the development of the child's motor skills directly affect the development of a child's cognitive skills, and vice versa, which is why so much emphasis is placed on indoor space that can provide for a variety of activities, playground equipment that can explore the workings of the world, and outdoor space to accommodate different forms of bodily movement (walking, running, bike riding). It has also been discovered that the foundations for learning at this level provide the platform for future learning, referred to by Jean Piaget as "schemas."

Architectural knowledge, too, is acquired on several different levels through the experiential: drawing, modeling and visiting notable works of architecture, for example. The following will be a discussion of an architectural pedagogy in the light of the experience of several different early childhood educators. This studio teaching is based on design as a transformative *process*, as opposed to design as a product, or end result. This process emphasizes skills building and the craft of making drawings and models in order to provide the foundation for the design of future projects, very similar in intent to Piaget's schemas. This design teaching methodology can be compared to child's play and is based upon a type of architectural recreation that teaches students to forget, to leave behind what they already know, in order to develop the skills that will allow them to visualize spatially and imagine constructions they have never seen before.

Children learn through play, through re-creating situations and events. While playing, children forget themselves, time is suspended, and mind, body and emotions work together simultaneously in the child's re-creations. The child at play creates his or her own intelligence by puzzling out the differences between what the child already knows with the reality of everyday living. The child constantly updates what is known by hanging new information on previous pieces of knowledge, building a framework of mental hooks that combines to form the child's cognitive structure. The bigger the mental scaffolding and the stronger the hooks, the more that can be remembered with each new experience. Schemas can be explained, but without personal experience the words will fall off the incomplete mental hooks.[1]

Patterns are key to learning. In order to pattern information, new information needs to be organized and attached to previously developed mental hooks. Instruction passively received and automatic learning such as memorization, are less effective tools for learning than creating patterns of meaning through experiential activities. For example, dance or carpentry are kinesthetic types of learning that can only be acquired through practice, or repetition, which involves the imitation of the movements themselves by moving the body through the complete range of motion required for the activity to be learned. This type of kinesthetic knowledge cannot be intellectualized by observation alone and then become an embodied knowledge of physical movement. The same logic applies to the relationship between drawing and seeing.

The moving body lays the neural path in the brain.[2] This has been demonstrated in laboratory studies with animals. For example, in one study two identical twin kittens were raised together in a box that had an apparatus rigged to stimulate their developing visual

systems. One kitten pulled the other kitten around in a cart. They both received the same visual stimulus, however, the active kitten developed more neural connections.[3]

It is true that we begin losing brain cells from the moment we are born, however it is not the number of brain cells lost that counts, but the quality of the cell itself. Brain cells grow in two ways: 1) as neurons are stimulated, synapses grow stronger and the dendrites receiving their messages branch out, growing larger and heavier; 2) the long axons over which these messages travel develop protective coatings of myelin, making chemical transmission more efficient. The immature neuron at birth has little myelin present, and not until twenty or thirty years is the process finished. The brain develops from the base of the skull at the cerebellum where the occipital lobe (seat of vision) is, moving forward to the pre-frontal cortex where higher level thinking occurs, which is also the last part of the brain to fully develop.[4]

The cerebral cortex is the key to meaningful memory because it receives incoming information and associates it with previous experience. There are two types of memory: 1) implicit memory, which happens without conscious attention and is particularly useful for storing background information about space and time; and 2) explicit memory, which requires conscious attention and is associated with more specific learning experiences. As skills are learned and practiced through explicit, conscious learning, they may become more implicit or automatic, freeing up the working memory for new learning. Implicit, automatic memory appears to be facilitated by the sensory and motor systems of the brain, which probably explains why teaching that engages many senses works better than a primarily abstract approach through the sense of vision alone. Motor memory pathways are built by repeating patterns of bodily movement. The most effective method of remembering is to associate new information with previous knowledge; however, it requires a cognitive framework with many "hooks," which are acquired only through active thinking and learning about the world.[5]

The imaginative play of re-creation can best be explained through the analogy of E. H. Gombrich's "hobby horse." The hobby horse is not an image of a horse: it is a horse's head on a stick. In play, the child does not confuse the hobby horse with a real horse; it merely acts as a substitute for a horse in that it fulfills the child's desire to *ride*. In representing a horse, the hobby horse is not imitating a horse by reproducing its exact image, but is allowing for the function of riding.[6] Mimetic imitation is a play of imagination, in the sense of to *show* or to demonstrate, and is not an attempt to approach an original by copying its image. When children *play* at being someone else, they re-create, they imitate an action; they do not see themselves as a substitute for, but as a re-presentation of the subject of their imitation.[7] In re-creating situations and events, the child actively learns about the world and builds a cognitive framework for future learning endeavors.

RATIONAL MIND / METAPHORIC MIND

> *Imagination does not merely* schematize *the predicative assimilation between terms by its synthetic insight into similarities nor does it merely* picture *the sense thanks to the display of images aroused and controlled by the cognitive process. Rather, it contributes concretely to the* epoché *of ordinary reference and to the* projection *of new possibilities of redescribing the world.*
>
> —*Paul Ricoeur, "The Metaphorical Process as Cognition, Imagination, and Feeling"*

Drawing is recreation, a re-creation of what is seen through the eyes of its creator, and carries with it its maker's interpretation of what has been seen. In his book, the *Natural Way to Draw*, Kimon Nicolaïdes, teaches drawing through the notion of touching with the eye. In re-creating what is seen through drawing, Nicolaïdes emphasizes the experiential and emotive aspects of re-presenting what is seen with the eye by fusing visuality with embodiment. He identifies two types of drawing, the contour and the gesture (figure 3). In contour drawing, one draws by imagining the point of the pencil actually touching the model and, without looking at the paper, moving the pencil along the paper at the same rate as the eye travels along the model's contour. While drawing, one maintains the conviction that the pencil point is actually *touching* the contour. In this instance, Nicolaïdes' contour drawing is produced by an optical type of vision that merges with the haptic by visually reaching out and touching the drawing's subject.

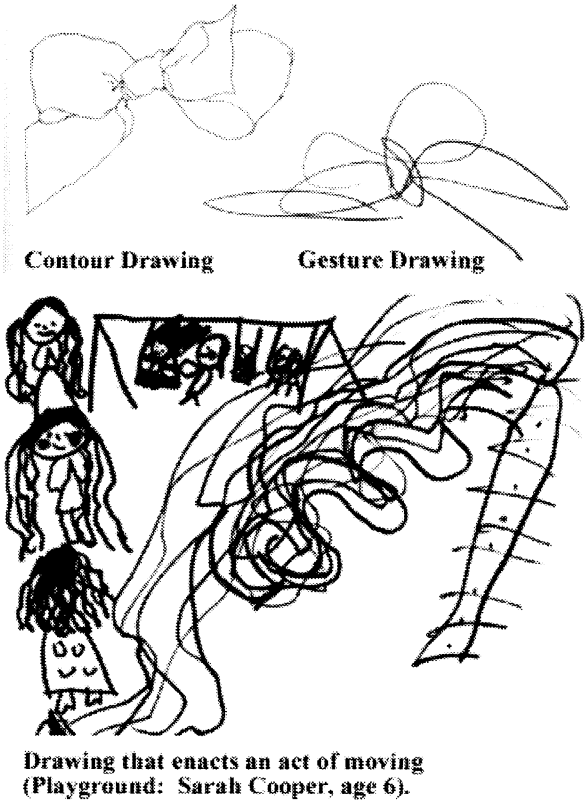


Figure 1. The Contour Drawing, the Gesture Drawing and Drawing that enacts an act of moving (Playground: Sarah Cooper, age 6).

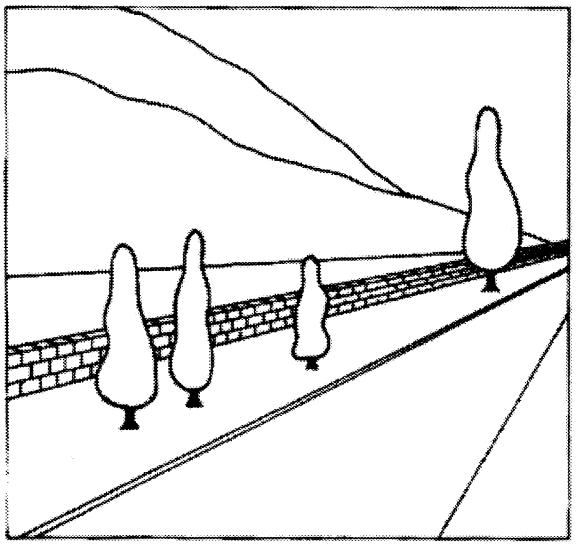
On the other hand, gesture drawing is a mimetic imitation that draws not what the thing looks like, nor even what it is, but what it is doing. In order to accomplish this, the artist must have an empathetic response with the subject in order to be able to *see* the gesture: the gesture must be *felt* within the artist's own body. In contour drawing the eye touches the outlines of the model, in gesture drawing the movement of the form itself becomes embodied within the artist.[9] One type of drawing outlines its subject, the other captures its essence. One type of drawing is the drawing of a blind person, an imagination based upon touching; the other is analogous to child's play, an imaginative re-creation based upon mimetic imitation.

Betty Edwards is an artist and an art teacher who always wondered why so many adults draw like ten-year-olds. In answer to her question, she ventured into a study of the growth and development of the human brain. She discovered that although both hemispheres of the brain develop equally, each side of the brain allows us to "think" in a different way (figure 4).[10] The left side is the rational mind; it is logical and linear and allows us to identify things through *naming* the parts. The right side is the metaphoric mind; it is intuitive and spatial and allows us to visualize things through *imaging* the whole. The left side keeps track of the passage of time and allows for sequencing, whereas the right side suspends time and allows for the simultaneity found in a child's recreations.[11] In our culture, the left side of the brain seems to dominate and by the age of ten the mind's symbolic and logic structures have become so fully developed as to begin to override conceptual and analogical thinking.

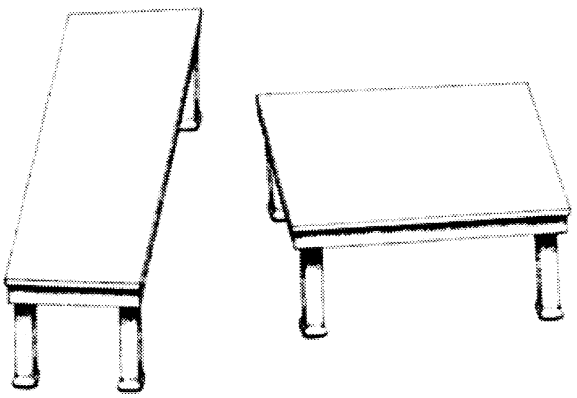
In analyzing drawings of her students from all age groups, Betty Edwards discovered that young artists before the age of ten composed their drawings to fill the whole sheet of paper. These drawings were experiential and generally were about capturing an event or activity (figure 1). However, she discovered that after about the age of ten, young artists were more concerned with drawing things as they "really are." Their drawings generally were composed with a single image set squarely in the middle of the paper. However, because of the maturation of their symbolic and logic structures that tell them what things *should* look like, some young artists were unable to really "see" things as they were, and, therefore, unable to draw what they really saw. Frustrated, these artists would give up and pursue other interests.

The consolidation of specific functions into one hemisphere of the brain or the other progresses gradually through the childhood years, paralleling the acquisition of language skills and the symbols of childhood art. By age ten the verbal left hemisphere is dominant and names and symbols begin to overpower spatial, holistic perception.[12] In *Drawing on the Right Side of the Brain*, Betty Edwards demonstrates techniques that allow students to leave the rational mind of the verbal left hemisphere behind in order to develop the potential of the metaphoric mind of the analogical right hemisphere.

The left hemisphere of the brain has a penchant for recognizing, naming and categorizing things.[13] The right hemisphere is specialized for the recognition of faces.[14] For example, an upside-down image of a face is unrecognizable. The dominant left side of the brain will search and search for recognition by looking at the image's individual attributes in an attempt to piece together the whole, like words comprising a sentence, and unable to do so, gives up. When the image is reoriented, the face becomes immediately recognizable. Her techniques teach students how to forget and how to leave behind those formal logic structures, which are cultivated in an educational system that neglects the nonverbal form of the intellect in favor of verbal, rational, on-time modes of thinking.[15] She teaches students not to name the parts as they draw and how to become so absorbed in their work that they lose track of time, like a child at play. The type of drawing she teaches is "by hand" and not the mechanical type. Linear perspective, for example, is left-brained because it relies on a left-brained type of processing: analysis, counting, logical cogitation, propositional thinking, mental calculations.[16] Because perspective fits into a symbolic structure, drawings like those in Figure 2 "fool the eye:" actually the two large trees and the two table tops are the same size. Again, the truth is revealed by turning the figures upside-down; or for the truly rational-minded non-believer, tracing one image and placing it on top of the other.



Place of Proportion



Turning the Tables

Figure 2. The Place of Proportion and Turning the Tables.

In his book, *The Metaphoric Mind*, Bob Samples identifies the two hemispheres of the brain as the rational mind and the metaphoric mind. He has found that the reason each hemisphere has become specialized is the result of the process of acculturation, with language having the dominating influence in affecting the workings of the rational mind.[17] He distinguishes between these two types of minds through the allegory of the Hopi Indian, whose language is cyclical, and the English-speaking person, whose language is linear. They both are watching someone running. When the person is no longer in sight, the English speaking person says "He ran away." The Hopi says, "He runs in my memory."[18]

According to Samples, language affects mind function. If language operates cyclically, then it is more metaphoric in intent and more likely to nurture the functioning of the metaphoric mind. If the language has a built-in bias toward abstraction, then the rational mind will be favored.[19] Samples has identified four metaphoric modes: symbolic, synergic-comparative, inventive and integrative. The symbolic metaphor exists whenever a symbol, either abstract or visual, is substituted for some object, process, or condition. Abstract symbols include letters of the alphabet, numerals, and mathematical symbols, whereas visual symbols would be trademarks, road signs, and logos. Both categories have a visual component, but the abstract is primarily processed in the left hemisphere and the visual is more compatible with the right hemisphere.[20]

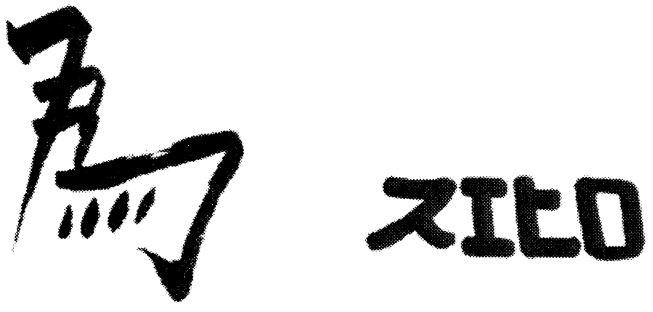


Figure 3. Kanji Ideogram and Katakana Symbols.

For example, the original Japanese language is written by using Kanji ideograms (figure 3). These visual symbolic Kanji metaphors are portraits of ideas that give no clues as to how they should be pronounced. Thus to learn them one must use the entire image as a holistic cue system which portrays the meaning. The psychological process is similar to the way people recognize a face. They see the whole face and do not concentrate on the parts. The Japanese developed Katakana in order to more easily communicate technical and scientific terms (figure 3). It is an abstract language form that creates abstract images of sounds. The Katakana symbols do not represent things, but the collection of sounds they portray is understood as the label of an object, process or condition. Left hemisphere stroke victims often survive with aphasia, or the inability to read or write. In Japanese-speaking people, the inability to read or write was only with the Katakana alphabet, the abstract symbolic alphabet, but survivors could still read and write in Kanji, the visual symbolic system.

Synergic-comparative metaphors always extend the network of possibilities in thinking and in this mode the mind discovers relationships in situations external to itself. This is the mind's most objective mode.

The integrative metaphoric mode occurs when the physical and psychic attributes of the person involved extend into direct experience with objects, processes, and conditions outside themselves. One's entire body—mind, emotions, sexuality—transcends the rational compartmentalization of objective states and approaches a meditative state whereby the thought process is entirely absorbed in the object, process or condition. This occurs when one is lost in thought, or a child is playing. The integrative metaphoric mode tends to get people into a much higher awareness level than any rational mode accomplishes.

The inventive metaphoric mode is an action that occurs whenever a person creates a new level of awareness of knowing as the result of self-initiated exploration of objects, processes, or conditions. When the inventive qualities of the metaphoric mind are operative, all the formal and informal knowings of both the left and right cerebral hemispheres are engaged. When the inventive mode is functioning, a total synergic kind of knowing evolves. Exploration has the quality of a dream.[21]

Humans use the entire body as a medium of experience to apprehend the world around themselves. The world is most often experienced objectively and rationally, two levels at a time—either emotionally and intellectually, sexually and emotionally, or sexually and intellectually. If one were to imagine the triad of intellectuality, emotionality and sexuality as the base of a tetrahedron, then the plane of human experience would generally occur on one of its faces. When lost in thought, when vision is turned inward and becomes blind to the world outside, one's entire body—intellect, soul and sexuality—transcends the rational and approaches a meditative state where intellectuality, emotionality, and sexuality are merged into an inseparable unity. Imagine the triangular base of the tetrahedron moving upward towards its vertex: the process of which is a four-dimensional movement toward the tetrahedron's point of unity.

According to Samples the fourth dimension is when intellectuality, emotionality, and sexuality merge into a unity that defies separation. This is when the metaphoric mind is acknowledged, accepted, and celebrated, and there is no longer a distinction between rational and metaphoric minds, there is only mind. This kind of sensation is spiritual. And spirituality is the fourth dimension of the emotional, intellectual, sexual triad.[22] This state of mind is intuitional: sensations lose their individuality and cannot be named, however, together they can be imagined in a new light by looking inward through a window into the fourth dimension of space, a type of spatial visualization that is born out of intuition and insight.

WORLD OF THE WONDROUS

> Intuition *deals with life directly, and introduces us into life's own domain: it is related to reason as flame is related to heat. All of the great discoveries in science, all of the great solutions in mathematics, have been the result of a* flash *of intuition, after long brooding in the mind.* Intuition illumines. *Intuition is therefore the light which must guide us into that undiscovered country conceded by mathematics, questioned by science, denied by common sense*—The Fourth Dimension of Space.
>
> —Claude Bragdon, *Four Dimensional Vistas*

Visual-spatial insights are frequently reported to have arisen through dreams, twilight states, or reveries: four-dimensional states of mind. This type of mental free-play tends to occur when simultaneously the mind is both stimulated, aroused and active and also freed from sensory distractions and/or mental calculations involving sequential and linguistic operations. For example, Einstein's theory of relativity came about by his imagining himself traveling along with a wave of light at 186,000 miles per second. He was confronted with a paradox that could only be resolved by a total restructuring of the then-known concepts of space and time. Einstein rarely thought in words: his inventive abilities did not lie in mathematical calculation, but in "visualizing effects, consequences and possibilities." Einstein indicated that visualizing for him consisted primarily of more or less clear images that could be voluntarily reproduced and combined. Another example is Watson and Crick's decifering of the double-helix structure of DNA. Watson came upon Crick flipping cardboard models of the base pairs about an imaginary central line. This inspired Watson to continue Crick's actions through his own process of mental rotation and spatial transformation of the models, which opened his imagination to new possibilities of redescribing the structure of DNA.[23]

The mental rotation and spatial transformation of objects is an analogical process because the intermediate points in the rotation can be visualized in the mind's eye but cannot be *named*, or calculated. Specific points can be described, however analogically successively further rotated orientations cannot be calculated because no one-to-one relationship can be described for the intermediate stages of rotation. For example, pigment can be added to pink incrementally until the color becomes orange. An orangish pink can be described and a pinkish orange can be described, however all colors in the successive stages in between pink and orange cannot be named. The nonanalogical, or rational, process would be the ability to categorize infinitely each stage of pink to orange.[24] The mental rotation and spatial transformation of objects is an operation suitable for the metaphoric mind that would only be stymied by the rational mind calculating, naming or interrupting the rotation and transformation infinitely at each imagined point.

While playing, children forget themselves, time is suspended, and mind, body and emotions work together simultaneously in the child's re-creations. This happens to grown-ups, too. Oftentimes, one is awoken as though in a deep sleep while driving down the road with the realization that thirty miles have passed without there being a memory of the distance traveled or the places traversed. One becomes blind, so to speak, to the outside world. One's vision has drawn inwards to the depths of the mind in imaginative re-creation, opening the window to the world of the wondrous that looks toward the fourth dimension of space. Architectural imagination is a type of spatial visualization that relies on mental images and their transformations, that relies on the continuity possible with the analogical thought process.

It is our responsibility as architectural educators to provide our students with a key that enables them to unlock the door that leads to the world of the wondrous. The door that when opened suspends time and allows entry into the fourth dimension of space, thereby freeing up their architectural imaginations and providing them with the ability to *image* the never-before-seen. One way to unlock the door into the metaphoric mind is through exercises based on the mental operations of the metaphorical construction. The metaphorical construction is a type of stereoscopic vision that through analogy allows us to entertain two different points of view at the same time. This imaginary construction is a type of spatial visualization that suspends ordinary reference and allows for the projection of new possibilities of redescribing the world, which is similar to the four-dimensional suspension of time children experience in their playful re-creations. This is not a mere *picturing* of the ordinary world which solely re-presents what has already been seen, but a mental rotation and transformation that opens the imagination to new architectural possibilities.[25]

The metaphorical construction project is an architectural re-creation of a kinesthetic activity: generally an activity of making that through its act carves out space and impacts this space in a three-dimensional and sensorial way. The metaphorical construction project can be derived solely from an imagined activity, or can be inspired by an image of an activity, among other methods. In the past I have experimented with Gottfried Semper's technical skills of man as a starting point: metalworks, carpentry, masonry works and weaving.[26] Through a series of transformative exercises, the students began with constructing maquettes that were architectural re-creations of the kinesthetic activities required by these technical skills and ended by designing a live-work environment for the maker. For example, one student's imagination of the sound and sparks produced by the act of the hammering of metal by a smithy is metaphorically transformed and expressed by tiny maquettes. The final project is a live-work environment for a blacksmith (figure 4).

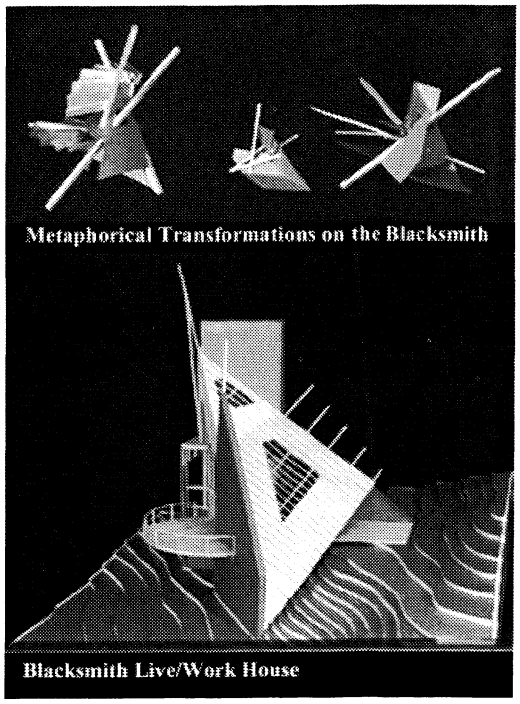


Figure 4. Blacksmith Live/Work House. Kendall S. Wilcox, student. University of Idaho. 1993.

Once a student has a three-dimensional object in hand, the student can mentally project into the space of the model and begin inhabiting that space. The student then has an object to provide inspiration for the mental rotation and spatial transformation required by the analogical thought process. This model allows the mind to free itself of the inherent symbolic and logic structures of the rational mind in order to open up to the metaphoric mind's architectural imagination to create never-been-seen-before projects.

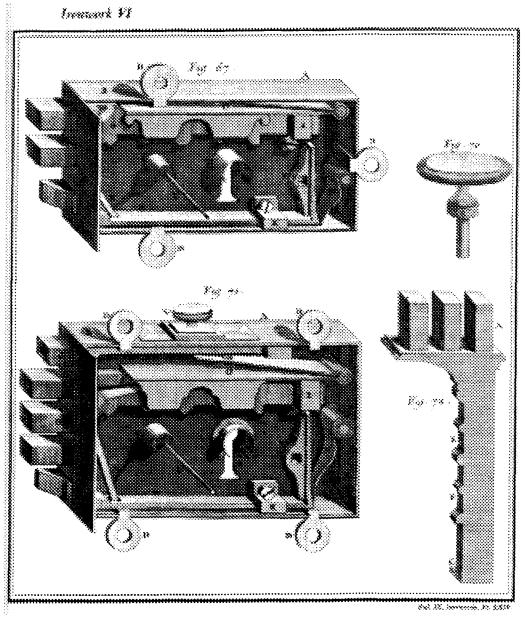


Figure 5. Plate 170 Ironwork VI. Denis Diderot. A Diderot Pictorial Encyclopedia of Trades and Industry

Another method is to use an image of an activity, such as is demonstrated in Denis Diderot's *Pictorial Encyclopedia of Trades and Industry*.[27] For example, as the point of departure one student took inspiration from *Plate 170 Ironwork VI* (figure 5) which depicts locksmithing. The essence of the lock and its tumblers is captured in the maquettes shown in figure 6. These architectural re-creations are then used as structural metaphors, which after a series of transformations of additional maquettes inspire the design of a three-dimensional space that becomes the locksmith's house (figure 7).

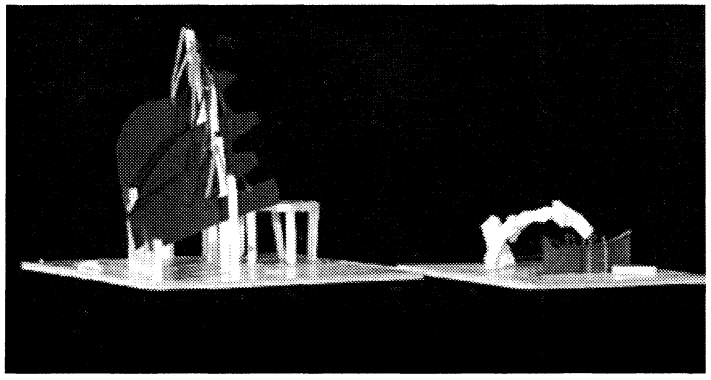


Figure 6. Metaphorical Transformations on the Workings of a Lock. Grant Getz, student. University of Idaho. 1995.

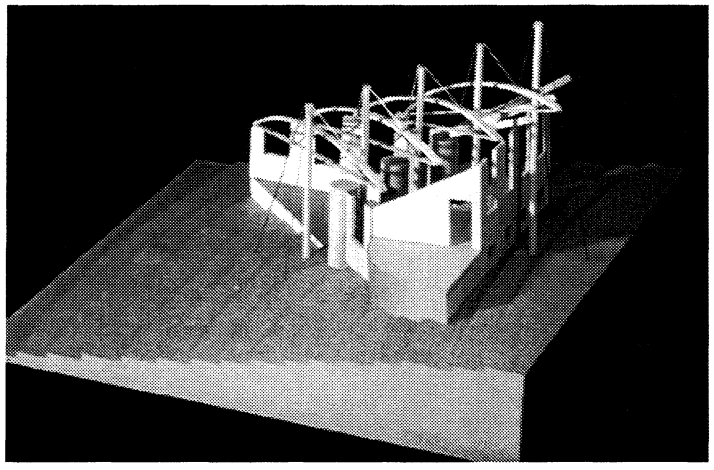


Figure 7. Locksmith Live/Work House, model. Grant Getz, student. University of Idaho. 1995.

The metaphorical construction project always begins with a transformative series of maquettes that are used both as structural metaphors and as objects to provide inspiration for the process of mental rotation and spatial transformation. The final model is constructed out of bass wood, chipboard and architectural metals and is completed prior to the construction of the drawing. The drawing is a collaged *analytique* based on the final model, which includes the site plan, floor plan, exploded axonometric and significant details that are not present in the model. Through the technique of collage, the drawing itself is a metaphorical construction that requires the reader to become an architect in its reading, because through

reading the different layers one mentally constructs the project in the mind's eye. This type of drawing can only be read by the trained eye and the reading itself becomes a process of spatial visualization (figure 8). In the process of constructing the drawing, the student's eye becomes trained to be able to visualize spatially when reading others' drawings.

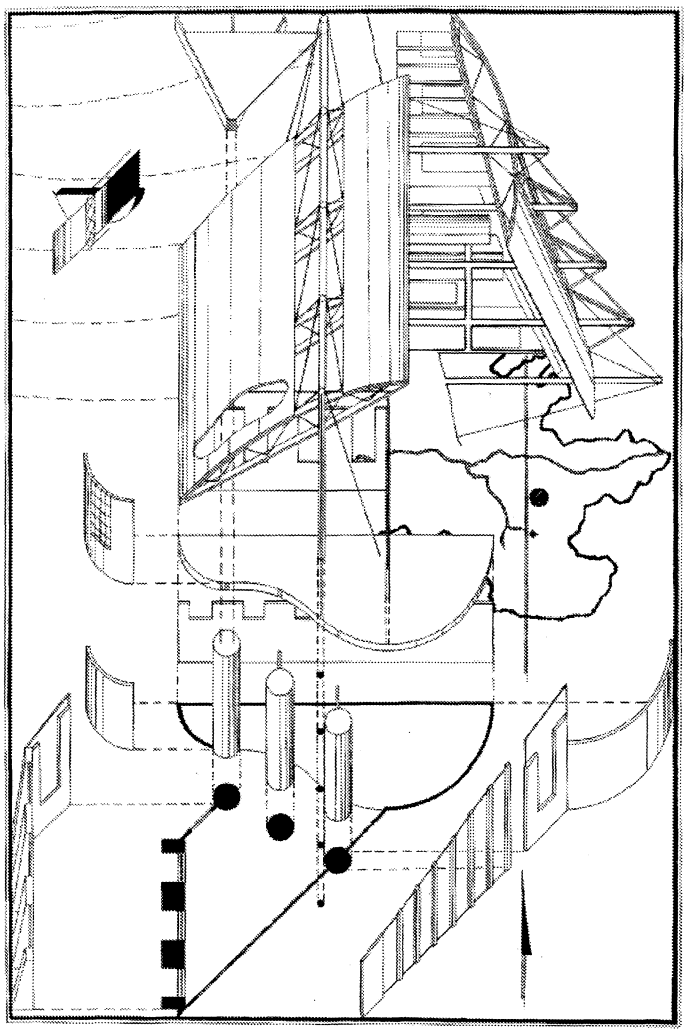


Figure 8. Locksmith Live/Work House. drawing. Grant Getz. student. University of Idaho. 1995.

An architectural project is the projection of a future building. Plan, section and elevation are projections of one to the other. When architects design, they manipulate form. In manipulating form we rotate objects in space. In entertaining the dialogue of the metaphorical construction we are provided with concrete images with which to project new forms. Our imaginations are filled in our architectural recreations. With the abstract notion of the rational mind and without metaphor, the vessel we manipulate is empty and we have to work much harder to fill it with meaning.

There is a relationship between drawing and spatial visualization, making models and the architectural imagination: through the practice of drawing and making models, the student develops the ability to visualize spatially and imagine architecturally. Through this activity of making, the student acquires the ability to internalize movement in a metaphorical thought process that rotates objects in order to suspend ordinary reference and project new possibilities of re-describing the world. It is possible for objects to be rotated and displayed on the computer screen, however in order to fully activate the student's architectural imagination, this process must derive from an embodied action and occur in the mind's eye *first.* Were this imaginative recreation to be generated from the space of the computer, our students would be left with incomplete imaginations. The computer logic most commonly used today relies on a formal symbolic code modeled after perspective and the notational systems of the rational mind, which reinforces a rational thought process. As architectural educators, we need to teach our students how to forget, how to draw upon their metaphoric minds in order to leave behind their inherent symbolic and logic structures that would have them *name* things, so that they may develop their abilities to visualize spatially and *image* the unseen.

NOTES

[1]Jane M. Healy, *Your Child's Growing Mind: A Guide to Learning and Brain Development from Birth to Adolescence.* New York, Doubleday, 1994, p. 44 (1987).

[2]Healy, *Your Child's Growing Mind.* pp. 49-51.

[3]Healy, *Your Child's Growing Mind.* p. 22.

[4]Healy, *Your Child's Growing Mind.* p. 75.

[5]Healy, *Your Child's Growing Mind.* pp. 203-207.

[6]E. H. Gombrich, "Meditations on a Hobby Horse or the Roots of Artistic Form," in Lancelot Law Whyte (ed.), *Aspects of Form,* Bloomington, Indiana University Press, 1951, pp. 209-228.

[7]Hans-Georg Gadamer, "The Play of Art," *The Relevance of the Beautiful and Other Essays,* New York, Cambridge University Press, 1986, pp. 123-130.

[8]Claude Gandelman, *Reading Pictures. Viewing Texts.* Bloomington, Indiana University Press, 1991, p. 5.

[9]Kimon Nicolaïdes, *The Natural Way to Draw.* Boston, Houghton Mifflin Company, 1969, pp. 10-16.

[10]Betty Edwards, *Drawing on the Right Side of the Brain.* Los Angeles, J. P. Tarcher, 1979, p. 28.

[11]Edwards, *Drawing on the Right Side of the Brain.* p. 40.

[12]Edwards, *Drawing on the Right Side of the Brain.* p. 59.

[13]Edwards, *Drawing on the Right Side of the Brain.* p. 119.

[14]Edwards, *Drawing on the Right Side of the Brain.* p. 138.

[15]Edwards, *Drawing on the Right Side of the Brain.* p. 29.

[16]Edwards, *Drawing on the Right Side of the Brain.* p. 119.

[17]Bob Samples, *The Metaphoric Mind.* Reading, MA, Addison-Wesley Publishing Company, 1976, p. 24.

[18]Samples, *The Metaphoric Mind.* p. 45.

[19]Samples, *The Metaphoric Mind.* pp. 47-48.

[20]Samples, *The Metaphoric Mind.* p. 85.

[21]Samples, *The Metaphoric Mind.* pp. 86-100.

[22]Samples, *The Metaphoric Mind*. pp. 166-171.

[23]Roger N. Shepard and Lynn A. Cooper, *Mental Images and Their Transformations*. Cambridge, MA, The MIT Press, 1982, pp. 6-7.

[24]Shepard and Cooper, *Mental Images and Their Transformations*. pp. 12-13.

[25]Paul Ricoeur, "The Metaphorical Process as Cognition, Imagination, and Feeling," *Critical Inquiry* 5, 1 (August 1978): 143-159.

[26]Gottfried Semper, "The Four Elements of Architecture," *The Four Elements of Architecture*. New York, Cambridge University Press, 1989, pp. 102-103.