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Design's Community of Knowledge: Identifying and Organizing Design's Fundamental Concepts to Support Teaching and Learning

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The words we use and the concepts they represent affect how we see, think and talk about the world. Each community of knowledge (e.g., Architecture, Physics, Sociology, etc.) has a language that is specific to that community or discipline. Membership in a community of knowledge involves learning the community's language and developing an understanding of the concepts that it identifies. Our level of understanding of a community's language can either obscure or clarify—it can help or hinder communication. The degree to which we understand the language and concepts of a community of knowledge is directly related to our ability to learn and develop within that community. The shared language makes communication within the community more efficient and supports greater discrimination, subtlety and nuance. As we talk to ourselves and each other we sharpen our ability to think and construct a community of knowledge.

The goal of beginning design education is to build a foundation for dialogue that will lead to the sharing of perceptions concerning the what, why and how of design and its products. The value of the dialogue lies in its ability to improve the quality of our thinking and experiences, to identify and understand the factors that contribute to our perceptions, and to enhance our ability to create experiences, objects and environments.

There are over one hundred concepts associated with basic visual design. They are called different names by different teachers and writers and appear in different combinations in different courses and books. It is no wonder that beginning design students have a difficult time acquiring the understanding needed to implement the concepts in their thinking as opposed to mimicking existing patterns or styles. We see what we have concepts to see and describe what we have language to communicate. Little meaningful dialogue is possible without an appropriate vocabulary of concepts.

By identifying, defining and relating what can easily become an overwhelming number of ideas, each of us (student, teacher, professional and client) can develop a cognitive structure that supports current and future learning. The intention is not to define "the" structure but to model one that provides a shared starting point for dialogue and development. The goals are to engage diverse individuals in dialogue, make the community of knowledge explicit, support both intuitive and rational design processes and enrich design seeing, thinking and communication.

The following will present a rational for clarifying and making explicit our community of knowledge, propose a hierarchical mapping of visual design's basic concepts and define key terms.

Concept Mapping

Our knowledge of things is constructed from our perceptions of objects and events and takes the form of cognitive structures—systems of interrelated concepts. These frameworks of knowledge provide the basis for learning and integrating new knowledge. The best way to help students learn meaningfully is to help them explicitly see the nature and role of concepts and the relationship between concepts as they exist in their minds and as they exist "out there" in the world...

"Concept maps present a way to visualize concepts and the hierarchical relationships between them." It supports visual thinking by allowing the visual perceptual system to take in and the mind to process multidimensional relationships simultaneously. Concept mapping externalizes concepts and thereby affords the perception of new relationships and hence new meanings—concept mapping can foster creativity. Concept maps provide a basis for dialogue concerning the validity of linkages, missing linkages, missing concepts and the meaning of concepts. Learning is an individual activity that cannot be shared but meaning must be shared, discussed, negotiated and agreed upon. Concept maps facilitate both individual learning and the creation of shared meaning.

The illustration (Figure 1) is based on one by Walter and Beverly Wesley. It is both a good example and a map of concept mapping. Concept mapping is a very effective tool that can be used to help students think meaningfully about and develop a deeper understanding of any area of knowledge. I have experienced the power of concept thinking in the classroom and in my own intellectual growth.

Attributes & Means

What something is, is what we perceive through our sensory systems and the meanings we assign to those perceptions. Our perceptions have both sensory and formal components however; the dominance of vision gives special importance to visual information and thereby the formal qualities of the things we perceive. What things mean is based on the associations they afford. We can share what our senses perceive and the associations that they have for us. We can describe a thing and identify its cultural, social and personal meanings.
From the perceiver’s point of view, something has a set of physical attributes to which meaning is assigned. From the designer’s point of view, there are means through which design goals and intentions take form to afford meaning. Attributes are the characteristics or qualities of things. Means are that by which something is done or obtained. They are the conceptual categories of physical choices available to a designer. Once chosen they establish the physical attributes of perceivable things. Means and attributes are the same concepts seen from different points of view. The designer makes decisions about means with the intention of affording meaning to the user. The user is confronted with the specific thing, perceives its attributes and assigns meaning.

The fundamental attributes/means are the minimum set of independent variables that are always present and required to create something that can be perceived. They are the raw material of every experience and design. All the possible attributes/means of form can be grouped into seven fundamental conceptual categories. These categories can be expressed in terms of the following questions.

What context is there? What context should there be?
What number are there? What number should there be?
What variety is there? What variety should there be?
What relationships are there? What relationships should there be?

The seven fundamental attributes/means are independent in that you can change the size and not the shape, number and not the size, etc. Furthermore, they are interrelated in that changes in one can affect the perception of others.

Given the seven fundamental attributes/means, the task is to relate the myriad of other concepts that identify the breadth and richness of design thinking. The Means/Ends illustration represents my attempt to map the relationships. The goal is to make sense of what can easily become an overwhelming number of seemingly unrelated ideas. I am indebted to the authors of the many books on design and my teachers and colleagues who have provided terms that appear in the concept map. What I have contributed is the organization and some linking concepts.

Defining Key Concepts

It is beyond the scope of this paper to define all the terms included in the concept map. Furthermore, most of the concepts will be familiar to you because they are part of the community of knowledge that is basic design. The following defines those key terms that are illustrated in the map.

Size is the quality of a thing that determines how much space it occupies. Size defines the measurement, proportion or scale of things. Experientially size can be defined in terms of height (up and down), width (side to side) and depth (front to back) or by terms such as small, big, gigantic etc. Rationally size can be defined in mathematical terms using the three axes (x, y and z) of the Cartesian coordinate system and a unit of measure. Relative size can be judged in terms of a unit of measure, another thing or a person.

Shape is the quality of a thing defined by the relative position of all points composing its outline or external surface. Shape includes the concepts of dimension (point, line, plane or volume), presence (positive, negative), completion (explicit, implicit) and configuration (geometric, rectilinear, organic and accidental).

The shape of a thing is of particular importance in terms of affording meaning. The meanings afforded by shape can be conceptualized as falling along a Representational/Symbolic/Abstract continuum. A shape is representational (classical, figural, other-referential, historical, consumed for what it means) if it is recognized as looking like something in the natural or man-made world. A shape is symbolic (type or archetype) if it has a codified meaning which stands for something else and requires prior knowledge of the code. A shape is abstract (modern, iconic, self-referential, consumed with what it is) if it contains minimal representational or symbolic content.
Material is the quality of a thing afforded by its surface and substance. The physical existence of things is perceived directly through our sensory systems. As a result they are perceived as having a palpability, temperature, weight, inertia, inherent strength, etc. The surface qualities of material are perceived through our visual perception of surfaces including illumination, color, uniformity, reflectance, and transparency. The substance qualities of material are perceived through our haptic, audio and taste/smell systems and include rigidity, texture, temperature, weight, composition, sound, smell and taste.

Context refers to the location and orientation of an element relative to the observer and/or frame of reference. All things must be some place and be perceived within some context. Once established or recognized by the viewer, the context affords the recognition of an element's location and/or orientation.

Number refers to the quantity of elements. A designer must decide on the number of elements that are to be incorporated into a design. However, this is not as straightforward as it may seem because, although we can count from one to one hundred, we do not perceive from one to one hundred. We have a variable threshold in the vicinity of seven plus or minus two for recognizing a specific number of elements.

Variety refers to the degree of difference between elements. Variety is the number of ways and the degree to which elements are different in terms of their size, shape, material and relationship. Multiple elements exhibiting a pattern can function as an element within the whole.

Relationship is the quality that establishes an association or connection between elements. Anything that exists must be somewhere and if it is somewhere it has some relationship to other things and/or the person perceiving it. Relationships identify phenomena that afford the perception of association or connection between things. The perception of relationship is necessary for meaning to be afforded or constructed because elements without relationship are perceived as random and meaningless.

Four Relationships

There are four fundamental kinds of relationships. They are all operating at some level all the time. They include relationships of pattern, hierarchy, contrast and balance. Pattern must exist for contrast or hierarchy to be perceived. Contrast is created by deviating from a pattern. You cannot create a contrast if there is nothing to contrast with. Hierarchy is the systematic control of contrast. In the simplest terms, pattern affords relationships of commonality while hierarchy and contrast afford relationships of differentiation. Relationships of balance employ some combination of pattern, hierarchy and/or contrast to achieve equilibrium or instability.

Pattern refers to a predictable relationship between things. To perceive a pattern is to extract some underlying ordering system and/or shared qualities exhibited by some set of things. To propose a pattern is to identify some intended relationships that will guide design decisions. To recognize a pattern is to be able to know when something breaks the pattern or how to extend the pattern.

The simultaneous employment of multiple concepts reinforces the clarity of a pattern—it makes the communication clearer. If all the concepts work together they reinforce each other—they build redundancy and thereby clarity into the communication. On the other hand, if different concepts address different ideas within a composition the complexity of the communication goes up—more ideas can be communicated.

The fundamental concepts available to create patterns are proximity, joining, alignment, repetition, sequence, rules and organization. Proximity refers to the distance between things. Joined refers to the physical contact and connection between things. Alignment refers to the relationship between the edges, surfaces and axes of things and the context. Repetition refers to the sharing of one or more attributes by two or more things. Sequence refers to the ordering or response of things to a phenomena which produces movement or the perception of process or change over time and/or space. Rules refers to the specification of how things can be related to each other and/or another relational concept. Organization refers to the system or structure to which things respond through their selection, attributes and/or alignment.

Hierarchy refers to the quality that affords the perception of the relative importance of things. Hierarchy is the systematic control of contrast to afford a sequence of relative importance. It is the essential means by which a designer can affect the way viewers interact with a thing because we tend to look first at those elements within a thing that are dominant.

Contrast refers to the quality that affords the perception of difference between things. Relationships of contrast show variation that ranges from subtle changes in amplitude or gradations to complete opposition or the unexpected. Contrast breaks the pattern. It introduces surprise or variation in a system of relationships.

Balance refers to the quality that affords the perception of symmetrical or asymmetrical equilibrium within some attended set of things. Balance is based on weight and motion—the two existentially based expressive meanings that things can afford. For a composition to be perceived as balanced it must possess a distribution of weight and motion that appears to be in equilibrium. Our bodies provide the basis for assigning weight to and sensing balance between things. Our understanding of balance is based on our bodily experience of resisting gravity. Because of this, we try to find balance in all things. It is so fundamental that we do it automatically.

Complexity

The most important formal decisions a designer makes are those that establish a thing's level of complexity. The level of complexity of things reflects the designer's personal aesthetic and the goals of the problem being addressed. In addition, the level of complexity directly affects people's interpretation of what is beautiful or pleasurable and the ability of things to
communicate. Therefore, understanding and being able to manipulate the level of complexity of things is essential for a designer.

The fundamental attributes/means of Number, Variety and Relationship are grouped under the concept of complexity in the illustration. Complexity is a measure of the number of elements and the relationships between the elements. As the clarity of the relationships decreases, the complexity increases. Minimum complexity exists when all elements exhibit common qualities and respond to a single unifying law. Maximum complexity exists if elements exhibit a variety of qualities, support a number of possible interpretations and exhibit no common unifying law.

Stated in the simplest terms, complexity is the number of parts, and the differences between them. If we start with a single element, we can describe its form in terms of size, shape, and material—it has some configuration, dimension, color and texture. The simplest shape is the one with the fewest edges and surfaces that is homogeneous in terms of color and texture. An element becomes more complex as the number of edges and surfaces and the differences between them increases.

The means available to control the complexity of multiple elements continue to be number (the more elements the more complex) and difference (the greater the difference between elements the greater the complexity) with the addition of relationship (the more ambiguous the relationship between elements the greater the complexity).

The simplest organization is one composed of identical circles related through a single organizing principle—a grid of dots. The dot pattern also has a clear distinction between the figure or positive element (the dot) and the ground (the surface upon which the dots sit). The activation of the ground as a figure increases complexity. This means a checkerboard is more complex because the figure and ground can be reversed—there are both positive figures.

Before continuing, the concept of number must be qualified. We have a variable threshold in the vicinity of seven, plus or minus two, for recognizing a specific number of elements. This means that our response to number "may be regarded as 0, 1, 2, 3, 4, 5, 6, 7, plenty, multitude." The concept of plenty being the point at which the addition or subtraction of one element ceases to have a precise effect.

For example, a group of sixteen elements may not be perceived as different from one of seventeen elements. Therefore, the concept of number in relationship to complexity must take into consideration the viewer's capacity to perceive the number.

The factor of relationship can also counteract the simple number plus variety equation of complexity. If we understand the relationship between the elements then we no longer pay attention to the individual elements. We pay attention to the whole created by the relationship that joins them together. Perceptual studies have shown that parts are perceived in relation to conceptual wholes and that perception favors organization into simple whole figures as a way to make sense of any given pattern or array of elements. This means that as the perception of relationship between elements increases complexity decreases.

For example, taking the group of sixteen elements and organizing them into a pattern of elements consisting of four circles each reduces the apparent number to four. Given this, the addition of one makes a big difference.

The preceding establishes the centrality of the concepts of number, variety and relationship to the understanding and exploration of complexity. This engages the attributes/means concepts in discussions about and decisions concerning the goals, meaning, communication and aesthetic impact of things.

Implications and Applications

The attributes/means concepts are essential for design communication. The terms that identify the concepts constitute the fundamental vocabulary of design discourse. Each term names a key idea that can be used in describing what we see and experience. They allow us to identify specific visual phenomena and attach words whose meanings are shared by those involved in the community of design.

Mapping the attributes/means makes visible the fundamental concepts of visual design and their relationships. It organizes the concepts into understandable and memorable groups. The map provides a framework within which shared meaning can be constructed. Over time the terms are integrated into the language of the studio and are used in analysis, critiques and design presentations.

Means are not goals—they are not solutions in and of themselves. Goals set targets for things and means provide ways of addressing goals. Things result from decisions concerning means in terms of goals. Means are useful if they support our
design thinking and aid in communicating design ideas to others.

Means support the rational and feed the intuitive. In rational terms they help us isolate parts and see the world from a particular point of view. The new point of view can provide insights not previously evident. Using different concepts to describe a composition is an effective way to provide a new point of view. For example, seeing and thinking of a pattern of elements as a radial organization that was previously thought of as a grid can lead to new ideas for its development and/or evolution.

During the time the attributes/means are being explored on a conscious level they are helping us build our understanding and knowledge. This understanding is then available to our unconscious thought processes—the intuitive. Flashes of insight, gut feelings and intuition are the products of the mind's ability to unconsciously make connections.

Finally, a clearly articulated mapping of a discipline's concepts provides a framework for the addition of new information. Each new idea is not seen as an isolated event but in relationship to a constructed cognitive schema. The juxtaposition of the new idea and the existing schema is fundamental to learning and growth. The interaction of an existing schema and a new idea develops a richer understanding of an area of knowledge at a minimum and holds the potential for insight and a new schema. Concept mapping is both the basis of knowledge and a source of creativity.

References

5. Wesley and Wesley, 4.