

# REALISM IN VISUAL MATERIALS

## —CLEARING THE GROUND—

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### **Introduction**

Visuals talk more than words in the teaching/learning process. What can not be explained effectively in written or spoken words is often easily understood by using visuals as far as they are made and used appropriately. It is also assumed visuals play an important role in learning in general, specifically when they are used as a subsidiary resource in learning.

Meanwhile, visual learning has been studied in relation to the learner's cognitive style, such as field dependence/independence. Field dependent/independent dimension, most studied by educational researchers so far, would affect learning from visuals (Hozaki, 1989). This is particularly true when spatial information is elaborately embedded in a given lesson. Until now many studies were conducted and found more than several interesting results in this field.

In this short paper an attempt is made to clear what has been studied on features of visual materials, specifically, realism.

### **Visual Learning**

First of all, it is understood visuals are single or multiple kinds of symbol systems, which are defined as "a set of elements that refer in specifiable ways to domains of reference and are interrelated according to some syntactic rules" (Salomon, 1979). From another perspective of visuals as symbol systems, Eisner (1970) also classified symbols into four classes from artistic point of view. They are:

- 1) *conventional symbols*: "arbitrary forms taken to stand for events or ideas in a particular culture" (p. 107), e.g., names of objects or Valentine's heart.
- 2) *representational symbols*: "forms which are designed to represent, almost literally, the empirical aspects of reality" (p. 107), e.g., photos.
- 3) *connotative symbols*: forms which are "the result from morphological distortions of representational symbols" (p. 108), e.g., a series of after-realism Picasso's works of deformation.
- 4) *qualitative symbols*: forms which are "an organization of qualities designed to represent some idea, image, or feeling the artist wishes to convey; it has neither objective referent in the empirical world nor arbitrary assigned meaning as does the conventional symbol" (p. 108), e.g., the emotion a particular color gives or a line that gives contemplation.

Although it is not sure if these four classes are the only classes, or the best classification, the level of realism undoubtedly lies within representational symbols.

Salomon (1979) also describes one of the aspects of symbol systems by notationality; notational and nonnotational symbols. Borrowing the definition of notationality from Gardner, Howard, and Perkins (1974):

"A notational system consists of a set of separate, discontinuous characters (for example, a musical score) correlated with a field of reference which is similarly segregated (sounded pitches) so that any character in the system isolates the object or objects it stands for, or, conversely, an object isolates the character that is correlated with it. Notationality contrasts with a continuous, unsegregated (for, example, pictorial) system for which no alphabet or set of disjoint characters exists" (1974, p. 31).

Salomon further hypothesizes that notational symbol systems would require crystallized ability, what Cattell calls (1971), based on verbal skills, and nonnotational systems would require mainly fluid ability (Gf), based on spatial and perceptual skills.

From the view point of realism there have historically been two main groups of researchers related to visualized instruction. Relatively described, early researchers supported "Realism theories," which suggest more realistic visuals enhance learning. Early theoretical developments in audiovisual education and psychology such as Morris' (1946) iconic theory, Dale's (1964) cone of experience, and Carpenter's (1953) sign similarity orientation, developed such theories. Gibson (1954), one of the supporters of realism theories, suggested that fidelity of visuals such as shape, proportion, size, motion, color, and texture should be enhanced in order to increase realism of surrogates, visual materials, and eventually, for the learner to need less associative learning between the real object and the surrogates. A related finding is that humans even at a younger stage tend to prefer to view visual displays that have some complexity to them (Travers & Alvarado, 1970) although this would not simply assure that more realistic visuals are always effective in learning than less realistic visuals. In fact, more realistic cued materials require more time for information to be processed. Color coding, for example, is presumed to be effective at some minimal level to help the learner to pick out important information, but it would decrease learning if the use of color was extended beyond a certain point (Kanner, 1968) probably because of the limitation of human capacity for information-processing (Miller, 1956). In terms of age, younger children generally can not process information of an entire visual but see only each part of the visual because of developmental stages.

Thus, more realistic visuals are not always more effective for learning than less realistic ones. It seems that several conditions should be investigated to clarify the conditions under which realistic visuals are not more, or most effective, for learning. Such studies would refine "Irrelevant cue theories" or "Cue summation theories."

Irrelevant cue theories (Dwyer, 1978; Miller, 1957; Travers, 1964; Wise, 1983), suggest that too much detail tends to reduce student

learning. It would be a mistake to assume that one cue added to another would increase learning by a linear increment (Miller, 1957). Miller (1956) summarizes from several studies on limitation of human information-processing capacity that humans could process maximally only a little more than three bits of information (between 10 and 15 distinct positions) in a task of discriminating points on a line, which is a unidimensional stimulus. One bit of information is, according to Miller, "the amount of information that we need to make a decision between two equally likely alternatives" (Miller, 1956). It is also pointed out that the number of kinds of stimuli does not algebraically increase (e.g., 3 bits on a one-dimensional line  $\times 2$  as in points in a square = 6 bits) if the dimension of stimuli increases. The number of kinds of information for recognition consisted at around  $7 \pm 2$  (between 2 to 3 bits). Interestingly, a similar limitation was detected by the experiments of not only visual but also echoic recognition (2.3 bits) and tastes (1.9 bits). Thus human channel capacity does limit the amount of information that can be processed. Therefore, it is assumed that more cued visuals with many dimensions of stimuli such as complicated shapes, and color could be disadvantageous for information processing within a fixed period of time. Miller's study did not consider individual cognitive differences in recognition of visual stimuli. Therefore, more elaboration would need to be given to situation in which individual differences are measured. What would occur in a real situation with more meaningful materials for learning given to learners with different cognitive styles, is not yet clear. Whether a person with a particular cognitive style can process information in a different way from another person as in field dependent/independent dimension would lead to a new study of visual information processing.

Dwyer (1982) concluded, from the systematic evaluation of huge amounts of research on visual learning done between 1965 to 1981, that simple line drawings are generally more effective than complex visuals containing more cues or realistic visuals on externally paced

instruction because effectiveness of a particular type of visual on a specific educational objective partially depends on the amount of time students are allowed to interact with the instruction. He also suggested the realism continuum for visual illustrations is not a reliable predictor of learning efficiency. It is also suggested that color is effective to increase learning as well as it attracts and motivates the learner toward learning, but is not necessarily cost-effective. If more realistic visuals are not always the best instructional materials for a particular kind of learning task, teachers or instructors do not have to rely heavily on reality in visuals for instruction because less realistic visuals are generally easy to produce like computer-generated line-drawn visuals.

Related to realism of visuals, Moore (1985) conducted a study with a group of college students for short term recall on size and type of visuals. He used visuals of photos, paintings, and line drawings as well as three different sizes of visuals (full,  $1/2$ , and  $1/4$ ) with field dependent and independent students. His findings were that first of all, there was no difference between field dependent and independent subjects, and significant differences were observed on the type (in favor of the more realistic) and the size (in favor of the small). However, the highest mean score came from one half-sized painting although he hypothesized the large (real-sized) visual with less distracting visual stimuli (line drawings) would have been the most effective. A similar study conducted by Bundesen and Larsen (1975) showed that reaction time for correct reactions to test pairs of figures of the same shape and orientation consistently increased approximately linearly as a function of the linear size ratio of the figures.

A related study on fidelity in simulation by Alessi (1988) suggested a learning curve in which as fidelity increases learning is enhanced until a certain point. Beyond that point learning actually does not increase but decreases according to what he suggests. In fact, what he hypothesized is high fidelity in simulation enhances learning of expert learners but not novice learners. High complexity in simulation

might distract learning of novice learners because of their less problem-solving skills and experience. About Alessi's theoretical consideration, however, few research studies have been conducted so far to support his ideas. More research needs to be done in this area.

Also, as for the format of visuals, recent technological advancement has allowed us to make computer-generated images relatively easily. Computer graphics, from two-dimensional to three-dimensional, have become the focus of several educational researchers (Cambre, Baker, and Belland, 1986; Zavotka, 1985). This technology is interesting in relation to visual learning and cognitive styles. Hozaki (1987) conducted a study on visualized instruction in relation to field dependence/independence and found field independent college students performed significantly better in the mental and actual paper-folding task after they received a lesson via two-dimensional computer-generated graphics. Although extensive research has yet to be done because of the newness of the technology, topics related to computer graphics have so far included how three-dimensional wire frame images affect learning a mathematical concept of relationship of edge to volume of a cube on field dependent/independent boys and girls (Cambre et al., 1986) and how a particular sequence of visual presentation (using 2-D, 3-D computer graphics with/without color) enhances the learner's spatial skills in understanding orthographic projections of home economics-related objects (Zavotka, 1985). It is safe to predict more computer graphics will be used for various kinds of instruction and learner's cognition may be affected more or less by this new technology.

### **Summary**

Visuals via simple line drawings which are less realistic are more effective than realistic visuals with a high level of iconic stimuli when presented with ample time (Dwyer, 1978). In addition, a study (Wise, 1983) suggests that field dependence/independence would not significantly affect visual information processing of learners, while it is



also suggested that field dependence/independence would be a very important factor in visual instructional materials (Witkin, 1977). For example, how field dependence/independence would affect such learning tasks as paper folding and unfolded figures which require visual-spatial skills is not intensively studied yet.

Literature reviewed in this short paper suggests the necessity of intensive study on a learner's field dependence/independence and visual learning on various learning tasks. Research indicates that field dependent/independent dimension would make a difference in a learning task which requires a learner's visual-spatial skills.

As more computer graphics are introduced to educational fields with more ease in production and utilization, computer-generated images will be more frequently seen in school settings whether school people like it or not. In this paper, previous studies on visual learning were reviewed with some future possible research suggested.

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