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The dilemma of visualized research: Lack of practioner involvement and implementation

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A single learning theory which will function as an effective predictor of visual learning may never be possible.

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by Francis M. Dwyer

The decade of the 1970s ended with expenditures for audio visual equipment and materials exceeding the $3 billion per year level. With the introduction and implementation of microcomputers, video disc, satellite and laser communications, cable television, etc., and the software to be developed for use in these electronic delivery systems, expenditures for audio visual equipment and software materials will reach astronomical proportions in the decade of the 1980s. Within the varied instructional strategies the use of the visual medium has been optimized, presumably to assist learners in acquiring, storing, transmitting and applying information.

Despite the widespread acceptance and use of visual materials for instructional purposes, surprisingly little is known relative to the instructional effectiveness of different types of visualized materials, both from the standpoint of how learners react to variations in the amount and kinds of stimulation contained within the various types of visual delivery systems and how visuals differing in amounts of realistic detail influence learner achievement of different educational objectives. Consequently, difficulty has been experienced in designing visualization that will function effectively in increasing learner information acquisition of designated eductional objectives. This fact is evidenced by the large number of experimental studies reviewed by Stickell (1963), Chu & Schramm (1967) and MacLennan & Reid (1967), which indicated that the use of visually mediated instruction in many cases resulted in no significant increases in student learning when compared with conventional types of instruction.

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Research on visualized instruction

Theorizing and philosophizing about the advantages of visualized instruction and how learners interact, process, store and retrieve visually acquired information are useful in establishing general structures which can be used to provide a focus for exploration; however, it is only through experimental research that actual cause and effect relationships can be established among variables. Why then is there a scarcity of guidelines for the design and use of visualized materials, since there is certainly no scarcity of experimental research associated with visualized instruction?

An inspection of the experimental research relating to visualized instruction reveals that much of the research, in addition to suffering from many of the threats to internal validity identified by Campbell and Stanley (1963), has additional problems. These problems tend further to complicate data interpretation and frustrate any attempts to derive broad generalizations useful to practitioners in the classroom. Following is a sampling of the types of complications found in many of the experimental studies: (a) lack of hypotheses or predictions based on theory, (b) the use of content material far removed from that which is commonly taught in the schools, (c) failure to identify specifically the type of educational objectives to be achieved by the learners, (d) failure to describe properly the type of visualization used in the study or how it was used—whether it was related or redundant to the verbal/oral information it was designed to complement and (e) failure to specify for how long learners were permitted to view or interact with the visualized instruction and how long of a time span existed between when learners received the instruction and when they were tested.

Program of Systematic Evaluation

In response to the apparent lack of information about how to design and/or use visual materials, the Program of Systematic Evaluation of variables associated with visual learning was initiated at The Pennsylvania State University in 1965. Since its inception over one hundred experimental studies involving over 40,000 students have been conducted by the author and his colleagues. Research in this program has focused specifically on the instructional effects of visualization in the teaching-learning process—where visualized instruction has been presented in a variety of formats: television, synchronized slide-audiotaped instruction, visualized programmed instruction, regular textbook type of instruction (visualized, etc.). The results from these studies indicate that the use of visual materials to complement oral/print instruction can be a powerful strategy to increase student information acquisition; however, if visuals are used inappropriately and for the wrong types of educational objectives, instruction with visuals is no more effective than the same instruction without visuals.

In general the research has indicated that effectiveness and efficiency in visualized instruction are primarily dependent upon (a) the amount of realistic detail contained in the visualization used, (b) the method by which the visualized instruction is presented to learners (externally paced vs. self-paced), (c) learner characteristics, i.e., intelligence, prior knowledge in the content area, reading and/or oral comprehension level, etc., (d) the type of educational objectives to be achieved by the learners, (e) the technique(s) used to focus learner attention on the essential instructional characteristics in the visualized materials, e.g., cues such as questions, arrows, motion, verbal/visual feedback, overt/covert responses, etc., and (f) the type of test format employed to assess learner information acquisition, e.g., for certain types of educational objectives visual tests have been found to provide more valid assessments of the amount of information learners acquire from visualized instruction than verbal tests. In this respect effective visualized instruction (and learning) must be approached not as an isolated phenomena, but as an interrelated constituent process operating at varying levels of complexity—the elements of which acquire significance only in the context in which they are used.

Research Findings

Following is a sampling of specific conclusions obtained in the Program of Systematic Evaluation (Dwyer, 1978):

1. The use of visuals specifically designed to **complement** oral and printed instruction does not automatically improve student achievement. For example, when visualization is used to illustrate basic terminology (e.g., screwdriver, carburetor, baseball bat, etc.) for which students already possess meaningful examples, then the use of visualization is superfluous. Similarly, when visualization is used to complement already complicated material, very little additional learning is achieved. In general, a major portion of a student's learning results from either oral or printed instruction—both are sequential and orderly in nature. When visualization accompanies complicated content, students have a tendency to scan **all** of the visualization immediately. Since students are not adept in switching back and forth from the oral/printed to visual channel as the crucial cues are described in the respective channels, a certain amount of frustration occurs causing the student to block out the less familiar communication channel (the visual) and concentrate more intently on the more familiar (the oral or printed).

   However, when students are required to be able to demonstrate by identification or drawings: (a) a knowledge of the location and interrelationships among parts or positions inherent in the content, (b) a recollection of specific patterns or functions, (c) the ability to produce (via drawings) content relationships (e.g., drawing and positioning correctly the primary parts of an automobile engine, a carburetor, etc.), the use of visualized instruction has been found to be significantly more effective than instruction without visualization.

2. The type of visual illustrations most effective in transmitting information is dependent upon the type of information to be transmitted. For the types of educational objectives (identification and drawing) where visualization helps improve student achievement, simple line drawings have been found to be the most effective type of visualization. In general, the least effective type is the more realistic illustration. Apparently, the additional stimuli contained in the realistic drawings and photographs may, by distracting students' attention, interfere with the information being transmitted. It seems that realistic illustrations and photographs can be esthetically pleasing and very effective in acquainting a learner with reality but are limited for instructional purposes unless the learners are somewhat familiar with the material being presented or are experienced in learning from visual materials.

3. Identical visual illustrations are not equally effective when used for externally paced and self-paced instruction. The effectiveness of a particular type of visual in promoting student learning depends on the amount of time students are permitted to interact with the visualized instruction.

   In general, for students receiving externally paced instruction, the simple line drawings have been found to be most effective; for students receiving self-paced instruction, the more realistic detailed, shaded drawings are most effective.

   Students participating in externally paced instruction (slide/audiotape, television) view their respective instruction for equal amounts of time. The process of identification and discrimination is time consuming; the more intricate the visual stimuli, the longer it takes for the student to identify and absorb the information. The more realistic illustrations contain more information than the less realistic, but the students apparently do not have sufficient time to take full advantage of the additional information provided. It may be that realistic illustrations containing much information are not useful when students are not given adequate time to scan and interact with the information.

   The effectiveness of the more realistic presentations in self-paced instruction may be explained by the fact that students are permitted to spend as much time as they wish in absorbing as much information as necessary to complete their understanding. The less realistic illustrations possess less detail and are, therefore, limited in the amount of information they can transmit, regardless of how long the students are permitted to study them.

4. For students in differing grade levels, the same visuals are not always equally effective. A student's ability to profit from visualized instruction is related to his intelligence, reading comprehension level, and background knowledge in the area. This does not mean, however, that special or different types of visualized materials have to be used for each grade level. Fortunately, identical types of visualized materials often are effective for specific educational objectives across several grade levels.

5. For specific students and for specific educational objectives, the use of color in certain types of visuals appears to aid in improving student achievement. For other educational objectives, however, the effectiveness may not be enough to justify the added cost of color. Often the realistic detail in the visuals is accentuated by color; thus, the students are better able to make the appropriate distinctions to obtain the necessary information. Color may make the visuals more attractive to students, who might pay closer attention as a result.

6. Student perceptions of the value of different types of visual illustrations are not valid assessments of instructional effectiveness; that is, esthetically pleasing visuals may not be of great instructional value.

7. The realism continuum for visual illustrations is not always an effective predictor of learning. An increase in the amount of realistic detail contained in an illustration will not necessarily produce a corresponding increase in the amount of information assimilated.

8. Boys and girls in the same grade level (high school) learn equally well from identical types of visual illustra-

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tions when they are used to complement oral instruction.

9. Identical visual illustrations are not equally effective in facilitating the achievement of students possessing different levels of entering behavior (prior knowledge in a content area).
10. Merely increasing the size of instructional illustrations by projecting them on larger viewing areas does not automatically improve their effectiveness.

Summary & Conclusions

Results from studies conducted in the Program of Systematic Evaluation are making significant contributions to the development of a comprehensive understanding of the instructional potential inherent in different types of visualization. However, because there are so many variables associated with the learning process and because most of these variables are continuous rather than discrete in nature, it is doubtful whether the development of a single learning theory which will function as an effective predictor of visual learning will ever be possible. The results of experimental research are usually presented in the form of abstract theoretical statements, principles having varied ranges of generality or applicability and points of view. For the practitioner these "guidelines" may be conceptualized as a skeleton framework for guiding the operational management of instructional systems—including producing and selecting modes and media for presentation and/or distribution and finally assessing the effects.

The building of skeletal frameworks is the principal function of good research, but experimental research cannot alone clothe the skeleton with living tissue. This latter responsibility is the job of the practitioner—the writer, producer, instructional developer, etc. In the behavioral sciences research cannot be expected to yield precise and complete formulas or prescriptions for the effective use of visualization in the teaching-learning process, nor can research yield results which will apply directly and precisely to the enormous range of situations and requirements for all kinds of learning objectives, modes or formats and media.

Similarly, it is to be expected that research on the instructional effect of visualization will be an ongoing process. The skeletal framework of results grow and change. Sometimes results are additive; at other times they are conflictive. Problems are rarely solved completely, and for each one that is investigated, new ones are discovered for solution. We can hope that as intensive systematic research in the area of visualized instruction continues to make worthwhile contributions, the body of useable results will be systematically implemented by practitioners, in a variety of different circumstances so as to determine their areas of appropriateness and subsequent levels of generalizability.

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