Int'l J. Instructional Media Vol. 13(1), 1986

THE EFFECT OF VERBAL VISUALS IN FACILITATING STUDENT ACHIEVEMENT OF DIFFERENT EDUCATIONAL OBJECTIVES

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ABSTRACT

The form of information transmission is currently becoming the focus of considerable attention. The purpose of this study was to assess the relative effectiveness of different methods of presenting and emphasizing verbal instruction. Mode of presentation was the independent variable; achievement and time were considered to be the dependent variables. The results of this study revealed that (a) the use of print examples to complement print and oral instruction does not automatically improve student achievement of all types of educational objectives; (b) not all types of presentation methods used to present oral and print instruction complemented by print examples are equally effective in facilitating student achievement of specific educational objectives; (c) color is an important variable in presenting print examples to complement externally paced oral instruction; and (d) using identical stimuli in both the instruction and testing situation is a reliable and valid strategy for measuring certain types of educational objectives.

INTRODUCTION

There is no doubt that visuals (e.g., drawings, illustrations, photographs, pictures) can improve student achievement of specific educational objectives [1]. However, there are instructional settings in which visuals may not be appropriate. Under these circumstances the use of print examples instead of visuals to complement audio or print presentation is not unusual in some subject areas. For example, teaching the use of an index or catalog in the library requires the

student to be familiar with the format of the entries, which are in verbal (print) format, used in the index or catalog. Computer bibliographic databases, where entries exist in condensed form and use a great number of abbreviations, are another type of material of this kind.

Although the effectiveness of visualized instruction has been investigated for decades, very few researchers have studied the use of print examples in instruction. Very little, if any, research has investigated whether the findings from visual research could be generalized to instructional environments in which print examples are used to complement the verbal instruction. Salomon [2, p. 26] indicated that "a verbal description of an object and a picture of it do not different only in appearance, they also call upon different mental skills which are then used to process the conveyed information." It seems that researchers and educators need to be cautious about the application of research findings across symbolic modes. However, for this study it was assumed that independent variables such as color, instructional strategy (the effects of self-paced and externally paced instruction) and testing method would have the same effect as those found in evaluating visualized instruction [1].

Specifically, the objectives of this study were to (a) measure the relative effectiveness of three types of presentation methods used to present verbal instruction completmented by print examples, (b) determine whether these presentation methods are equally effective in facilitating student achievement of different educational objectives, and (c) determine whether the most effective presentation method in facilitating student achievement is also the most efficient as measured by the achievement divided by the time used on instruction and testing.

MATERIAL PREPARATION

The subject content employed in this study was information needed to understand and use the Social Science Citation Index (SSCI). The presentational method of the instructional material was the independent variable of this study. Four different presentation methods were developed for this investigation:

Printed script presentation (Group 1): Students in this group received instruction through printed script only. The 1,220-word textbook-like script was printed on 8½x11-inch paper in booklet format. Students read the script at their own pace. This group was considered to be the control group.

Printed script/examples presentation (Group 2): In addition to the printed script, students in this group received 18 printed examples integrated between paragraphs of the script. The print examples were entries extracted from SSCI. Arrows were used to focus students' attention on the particular entry elements being mention in the script. The name of the entry was presented at one end of the arrow.

The script used in this group consisted of 1,660 words and was printed on 8½x11-inch paper. The increased length of the script, compared to the script used by Group 1, was the result of adding words and sentences to illustrate the examples when they appeared.

Audiotape/examples presentation (Group 3): Students in this group received the same script and examples as those used in Group 2. The script was presented via tape recorder and the 18 examples were presented on 8½x11-inch paper. The audiotape presentation was professionally read and produced at the studio of the Graphics Services, The Pennsylvania State University. The audiotape/examples presentation was externally paced, and took 16 minutes to present.

Slide/tape presentation (Group 4): The script and examples used in Group 4 were the same as those used in Groups 2 and 3. The 18 examples were photographed and produced as 2x2-inch slides. The letters and symbols on the slides were colored in yellow and to focus the students' attention the names of the elements (e.g., author, title, journal, etc.) were colored in red. The six title slides were colored in green. The color cueing effect was held constant for all slides.

The script was presented via audiotape. The audiotape was duplicated from the one used for Group 3, except that the cueing words that reminded the students to turn pages were removed. This removal reduced the presentation time from 16 minutes to 14 minutes. Slide change during the presentation was synchronized with the audiotape by inaudible pulses.

Table 1 summarizes the different presentation methods used in this study.

Table 1. Summary of Presentation Methods for the Four Treatment Groups

Treatment	Group	Pacing	Script	Examples
printed script presentation	1	self-paced	printed 1,220 words	none
printed script/examples presentation	2	self-paced	printed 1,660 words	printed 18 examples
audiotape/examples presentation	3	externally paced	audiotape 1,660 words	printed 18 examples
slide/tape presentation	4	externally paced	audiotape 1,660 words	projected 18 examples

EVALUATION MATERIAL

In this study script and examples of entries all in verbal form were used in the instruction. To provide a testing situation that was similar to the instructional situation, two criterion tests were designed in verbal form similar to that used during the instruction.

The Identification Test was developed to measure the students' ability to recall specific index entries which were extracted from the SSCI. For this test students were required to identify the names of index entry elements which were identified by a numbered arrow.

The Comprehension Test was developed to measure students' ability in the application of the knowledge to life-like situation. Four questions which resembled the library search situations were designed. To answer these questions, students needed to use the sample pages which were xeroxed from the original volumes of Social Sciences Citation Index.

The Comprehension Test required students to construct appropriate search strategies, locate the right entries, and extract the necessary bibiographical information to solve the library search problems. Four questions were asked in this test. To answer each question, the student was required to (a) write down the name of the index that was used to answer the question, and (b) fill in the bibliographical information as requested in the question. Therefore, with each of the four questions consisting of two items, a total of eight items was contained in the Comprehension Test.

Scores received on the two criterion tests were combined in a composite 28-item total criterion test which was designed to measure students' total understanding of the concepts presented in the instruction.

EXPERIMENTAL PROCEDURE

One hundred eleven students enrolled at The Pennsylvania State University participated in this study. Each student was randomly assigned to one of the four treatment groups. Group 1 was considered to be the control group and the other three groups were the experimental groups. Groups 1 and 2 received self-paced instruction. Students in Group 3 listened to the instructional script presented via audiotape and, at the same time, read the corresponding page of the booklet which contained the printed examples. The presentation time for this treatment was 16 minutes.

In Group 4 students viewed and listened to a synchronized slide/tape presentation. The presentation time was 14 minutes. Testing procedures for Groups 3 and 4 were identical to those used for Groups 1 and 2. The experimental design for the study was a posttest-only control group design. Dependent measures were the Identification and Comprehension Tests. A third set of dependent achievement data was obtained by the combination of scores on the two previously cited dependent measures. One set of dependent efficiency data was calculated by a formula which was a modification of that used by Lamberski [3]:

$$\text{Efficiency} = \text{Total Criterion Test Score} / \text{Total Time}$$

Efficiency was defined in this study as achievement in terms of time used. ANOVA was employed to detect differences in achievement among treatments.

Tukey's Wholly Significant Difference (WSD) was used to determine where differences were located. The alpha level of significance was set at .05.

RESULTS

Descriptive statistics for the criterion test scores are presented in Table 2.

Table 2. Summary of Criterion Test Scores

	Identification Test	Comprehension Test	Total Criterion Test
Number of items	20	8	28
Number of students	111	111	111
Mean	11.865	4.730	16.595
Variance	13.591	5.508	23.243
Standard deviation	3.687	2.347	4.821
Range	4 - 19	0 - 8	7 - 27
K-R 20	0.734	0.823	0.785
Standard error of measurement	1.892	0.983	2.226
Standard error of test mean	0.350	0.223	0.485
Skewness	−0.031	−0.200	0.097

The Analysis of Variance procedure conducted on the Identification Test data indicated that significant differences existed among the means of the various treatment groups ($F = 14.19$, $d_f = 3,107$, $p < .05$). The Tukey's WSD procedure revealed that significant differences existed between: (a) the printed script/examples presentation and the printed script presentation (Group 2 > Group 1), $t = 6.30$, $d_f = 48$, $p < .05$); (b) the audiotape/examples presentation and the printed script presentation (Group 3 > Group 1, $t = 5.68$, $d_f = 50$, $p < .05$); and (c) the slide/tape presentation and the printed script presentation (Group 4 > Group 1, $t = 4.93$, $d_f = 51$, $p < .05$).

On the Comprehension Test, the analysis of variance procedure indicated that significant differences were found to exist among the means of the various treatment groups ($F = 5.55$, $d_f = 3/103$, $p < .05$). Tukey's WSD procedure revealed that significant differences existed between: (a) the printed script/examples presentation and the audiotape/examples presentation (Group 2 > Group 3), $t = 3.34$, $d_f = 52$, $p < .05$); (b) the slide/tape presentation and the audiotape/examples presentation (Group 4 > Group 3, $t = 3.54$, $d_f = 53$,

$p < .05$); and (c) the printed script presentation and the audiotape/examples presentation (Group 1 > Group 3, $t = 2.71$, $d_f = 54$, $p < .05$).

On the Total Criterion Test, analysis of variance indicated that significant differences existed among the means of the four groups ($F = 7.68$, $d_f = 3/107$, $p < .05$). Tukey's WSD procedure indicated that significant differences existed between: (a) the printed script/examples presentation and the printed script presentation (Group 2 > Group 1), $t = 4.49$, $d_f = 46$, $p < .05$) and (b) the slide/tape presentation and the printed script presentation (Group 4 > Group 1, $t = 4.90$, $d_f = 54$, $p < .05$).

On the Efficiency Ratio Criterion the analysis of variance procedure indicated that significant differences existed between: (a) the slide/tape presentation and the printed script presentation (Group 4 > Group 1), $t = 2.79$, $d_f = 52$, $p < .05$) and (b) the audiotape/examples presentation and the printed script presentation (Group 3 > Group 1, $t = 3.01$, $d_f = 53$, $p < .05$). These analyses indicated that externally paced Groups 3 and 4 were significantly more efficient in facilitating achievement than was Group 1, which was self-paced.

DISCUSSION

Print examples, either in printed or projected form, when used to complement oral or print instruction, were found to be effective in facilitating student achievement on the Identification Test. This finding supports the stimulus generalization theory [4,5], which contends that when the testing situation is similar to the learning situation, maximum learning is achieved. The test items employed on the Identification Test were sample index entries which resembled the actual examples used in the instruction. Students who received instruction with the complement of examples were found to attain significantly greater achievement than did those students who had received instruction without the complement of examples regardless of whether they were printed or projected, or presented externally or self-paced. It appears that printed examples used in this study had the same function as visuals used in other visual studies [6,7].

The Comprehension Test required students to demonstrate their ability in the application of the knowledge to life-like situations. Although the learning objective required students to work with realistic examples, situations for which many researchers contended that the use of audiovisual materials would enhance learning [8,9], the data indicated that the use of examples to complement the audiotape presentation did not improve learning as expected. On the contrary, it seemed that this type of presentation method impaired the students' learning. One possible explanation of the failure of the audiotape/examples presentation is that studnets can not successfully process complex informational inputs simultaneously from both auditory and visual channels [10].

In the audiotape/examples presentation, students listened to the instruction presented by the audiotape and at the same time read the printed examples in

the booklet. Apparently students paid more attention to printed examples, and neglected to attend to the information input from the auditory channel where most of the conceptual information was presented. Another possible explanation is that information conveyed by examples was more complex, thus requiring students to interact more with that information. Under these kinds of circumstances students needed to sustain their attention to adequately process the complex information [11]. The contention that a combined channel presentation would improve receivers' discrimination ability [1,12] or facilitate their transmission and reception of information [13] was not supported.

Students in both Groups 3 and 4 received the audiotaped presentation with examples printed in a booklet for Group 3 while examples were projected on a screen for Group 4. Very little, if any, research supported the argument that verbal information in projected form was more effective than the same information in printed form. As Salomon [2, p. 25] indicated, "children who face difficulties with reading do not read any better or worse if the material is printed rather than projected." The result that Group 4 was more effective than Group 3 on the Comprehension Test may be explained by the fact that examples in Group 4 were color coded. It seems that students may have preferred the color presentation, as has been the case in previous research studies [14,15], and consequently focused their attention more conscientiously, thus reducing the time needed to process visual information. Consequently students in Group 4 required less time to process the visual information than did students in Group 3, where visual information (i.e., examples) was not color coded. Therefore, the students in Group 4 had relatively more time to process oral information than students in Group 3. The explanation for this finding may need further justification because it is contrdictory with previous color coding investigations [16,17] which concluded that color would impair the learners' information processing speed.

Another interesting finding in this study was that students receiving instruction without the complement of examples (Group 1) achieved equal or better mean score on the Comprehension Test than those receiving instrtuction with the complement of examples (Groups 2, 3, and 4). Dwyer [1] reported similar findings in his studies where the oral presentation without the use of visuals was found to be as effective as oral presentation complemented by visuals. He explained that students were quite familiar with oral/print instruction and had developed their capabilities to acquire information from the oral/print modes. Another possible explanation is that some of the capabilities measured by the Comprehension Test employed in this study did not necessarily require the students to acquire information from the examples for maximum achievement.

The unusual effectiveness of the presentation without the complement of print examples needs further explanation. The Comprehension Test in this study required students to work with sample pages that contained entries similar to the examples used in the instruction. It seems that students in Group 1 were at a disadvantage in taking this test, but since the test was self-paced,

those students did have the opportunity to examine the material and rehearse those required capabilities which they did not obtain during the instruction.

One possible explanation of the superiority of the self-paced printed script/examples presentation (Group 2) on both criterion tests is that students in this group worked through the instructional material at their own individual paces. In self-paced instruction, students have enough time to review and rehearse the parts that they had difficulty in comprehending [1]. However, it should not necessarily be concluded that self-paced instruction is better than externally paced presentation, because in this study the externally paced slide/tape presentation (Group 4) was found to be as effective as the self-paced printed script/examples presentation (Group 2) on both criterion tests. This result was not consistent with the findings in previous studies where students receiving the self-paced programmed method achieved as well or better than students receiving instruction via the externally paced slide-tape instruction method [1].

On the Total Criterion Test no significant differences were found to exist between the audiotape/examples presentation (Group 3) and the printed script presentation (Group 1) which supports the contention that this same finding reported in many visualization research studies was the result of using a global test to measure student achievement [1]. The Total Criterion Test score was the sum of the Identification Test score and the Comprehension Test score. Different learning objectives were evaluated in these two criterion tests. In this study, the mean achievement score for Group 3 was found to be significantly greater than that for Group 1 on the Identification Test. Conversely, the mean achievement score for Group 1 was found to be significantly greater than that for Group 3 on the Comprehension Test. However, when these two achievement scores were combined into a Total Criterion Test score, the difference between the groups diminished. These results substantiate the contention that audiovisual research should specify the type of educational objectives that students were expected to achieve [1,18].

On the comparison of the efficiency ratio, no significant differences were found among Groups 2, 3, and 4. The results can be explained by the formula which was used to calculate the efficiency ratio in this study. Because this formula took into account the achievement scores and the time used on instruction and testing, an ineffective presentation method may appear to be more efficient if the students in that group spent less instructional and testing time than those in other groups. This argument can be supported by the fact that Group 2 was found to be consistently effective on all criterion tests; but when taking into account the time used, its superiority diminished.

Based on the above discussion, some conclusions can be drawn from the results of this study, as follows:

1. The use of print examples to complement verbal instruction does not automatically improve student achievement of all types of educational objectives.
2. Not all types of presentation methods are equally effective in facilitating student achievement of specific educational objectives.
3. Color is an important variable in presenting examples to complement externally paced oral instruction. It seems that color used in print examples will aid the student to focus on central information, and reduce information processing time.
4. It appears that using identical stimuli in both instructional and testing situations is a reliable and valid indicator of measuring certain types of educational objectives.

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