

An Investigation of the Relative Effectiveness of Varied Visual Presentation Methods

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ABSTRACT

The purpose of this study was to measure the relative effectiveness two types of illustrations in facilitating college student achievement of different learning objectives. It also attempted to evaluate whether illustrations were able to improve learning when students were reading textbook-like material which consisted of keywords in English. One hundred and ninety-eight students at National Taiwan University participated in the study. Students took four criterion tests immediately after receiving the respective instructional units. The results of this study indicate that a) the use of illustrations to complement print instruction did not automatically improve student achievement on all types of learning objectives, and b) variation in the amount of realistic detail in illustrations did not make a significant difference in facilitating student achievement on individual criterion test.

INTRODUCTION

Illustrations have been commonly used in many instructional settings, from kindergarten to college, to complement print instruction. It seems that the inclusion of illustrations in textbook is based on the assumption that illustrations are effective in facilitating student achievement on learning. In general, illustrated text requires relatively more time and is more expensive to produce than text-only material. Therefore, it is important to investigate the effects of illustrations on aiding learning.

Research on effects of illustrations has resulted in mixed and contradictory findings. By reviewing 55 illustrations-related experimental studies, Levie & Lentz (1982) concluded that illustrations could improve learning of print text, but the effects of illustrations depended on how they were used. In an analysis of 74 studies on visualized and conventional instruction carried out in college classes, Cohen, Ebeling, and Kulik (1981) reported that visualized instruction had no significant effects on student achievement. In a report of the results of a systematic evaluation on visual learning, Dwyer (1982a) concluded that "... for specific educational objectives visualization of content material is no more

effective than the same instruction without visualization" (p.1).

On the other hand, illustrations consist of many types when used in textbooks. Dwyer (1978) listed eight types of illustrations based on the amount of realistic detail possessed by the individual visualized treatment, and he pointed out that increase in realism in a visual did not always cause a significant increase in learning. It is obvious that if the effects of illustrations are to be studied, the realism of illustrations should be taken into consideration.

Since 1965, Dwyer and his associates conducted more than 100 systematic research studies. In those studies, a 2000-word instructional unit describing the human heart, its parts, and its internal process was developed. After receiving different types of presentation, the students received different criterion tests. In a report of overall studies, Dwyer (1982b) concluded that all types of visuals were not equally effective in facilitating student achievement of different educational objectives. The author is therefore interested to know whether the same results will be found when Dwyer's instructional unit was translated into Chinese. However, quite a few textbooks used by college students in

Taiwan are in English, and it is not uncommon that in many cases students need to memorize keywords in the text in English. Students must understand the meanings of keywords first in order to have a complete understanding of the text. The author wished to investigate whether illustrations can aid learning of text when keywords in the text are in English.

Specifically, the purpose of this study was to assess the relative effectiveness of two types of illustrations used to complement print instruction. It also attempted to evaluate whether illustrations were able to facilitate student achievement when student was reading a textbook-like material which consisted of keywords in English.

RELATED LITERATURE

The effectiveness of illustrations has received wide attention in recent decades. The advantages of illustrations in improving learning were found in many students. Peeck (1974) indicated that illustrations facilitate the learning of some specifiabile information in a text. Florence & Geiselman (1986) suggested that illustrations with iconic symbols were easier to locate and easier to recall from memory. Anglin

(1986) found that, in both immediate test and delayed test, students who read illustrated prose materials achieved significantly higher scores than those students who read the same prose materials without the illustrations. Levin (1981) listed eight assumed functions of illustrations: decoration, renumeration, motivation, reiteration, representation, organization, interpretation, and transformation. Levie & Lentz (1982) indicated the possible functions of illustrations as: attentional, affective, cognitive, and compensatory.

In many cases, illustrations were used as complements to print or verbal presentation. Schallert (1980) regarded illustrations as metaphors in that they increased vividness of the text and represented information more economically. For information that was impossible to be verbalized, illustrations could lead the learner to constitute the relationship between events, concepts, etc.

The effects of illustrations to complement print instruction may be interpreted by the 'cue summation theory' which predicts that learning will be more complete as the number of cues or stimuli in the learning material increases (Hartman, 1961). Gropper (1963) pointed out that visual materials were effective in aiding learning in that they functioned as cues, reinforcers, and examples.

The instructional effectiveness of illustrations does not always occur in all circumstances. Levie & Lentz (1982) indicated that "illustrations had a significant positive effect on learning illustrated text information and no effect on learning nonillustrated text information" (p.198). They also reported that if used simply as decorative stimuli, illustrations did not automatically facilitate students to learn messages contained in the text.

Sewell & Moore (1980) concluded that learners preferred instructional texts which were complemented by illustrations. But, it seemed that learners' preference had no significant relationship with learners' achievement. In a study by Dwyer (1971), students who selected their preferred treatment (text with color illustrations) did not achieve higher scores on the criterion tests than those students who received treatment without illustrations. The presence of illustrations may hinder the learning of content that is not illustrated. Vernon (1953) pointed out that illustrations might distract attention for the rest of the text.

The inconsistent conclusion of illustration-related studies may be a result of the fact that many studies did not specify learning objectives in their studies. Dwyer (1982) indicated that the use of visual materials to complement print

instruction was not equally effective in all instructional settings. Using literal illustrations and analogical illustrations in an experimental study, Hurt (1987) concluded that the achievement of different instructional goals might require the use of different types of illustrations. Wager (1980) also contented that one of the most common problems in visual research was that the researchers did not identify the domain of outcomes in the experimental studies. He indicated that in order to improve the generalization of visual research, it was necessary to specify learning objectives.

METHODS AND PROCEDURES

Subjects of this experimental study consisted of one hundred and ninety-eight undergraduate students enrolled at National Taiwan University. Twenty-six of the subjects were solicited from the College of Science, while the rest were from the College of Liberal Arts.

The content material employed in this study was a Chinese translation with some modification of Dwyer's instructional unit. It was a 2000-word instructional unit describing the human heart, its parts, and the processes which occur during

the systolic and diastolic phases. The content material was selected specifically because it provided a hierarchy of several types of learning objectives, extending from the learning of basic facts, concepts, etc. to complex problem solving.

All students participating in this study received their instructional unit in textbook-like format. Students were randomly assigned to one of five groups. Students in Group I read the Chinese text without illustrations. Students in Group II received the text with simple line illustrations of the heart. Students in Group III received the text with detailed, shaded drawings. Students in Group IV read the text without illustrations ; however, English keywords were included in the text. For example, whenever the word `aorta` was mentioned in a sentence, it was spelled in English while the other words in the sentence were in Chinese. Students in Group V received the text complemented by simple line illustrations, and with the keywords in English as the ones received by Group IV. Students in each treatment group were allowed to read their respective instructional unit at his or her own pace.

Immediately after the instruction, students took four self-paced criterion tests. Students were allowed to take as much time as he or she required to complete one criterion test before proceeding to the next. Students in all five treatment groups received identical test items. Since instructional unit for Group IV and Group V consisted of English keywords, however, the test items for these two groups used English terms whenever appropriate. For example, when the term `tricuspid valve` appeared in test items for Group IV and Group V, it was spelled out in English while other words in the sentence were in Chinese.

Test items were designed to evaluate student achievement of specific learning objectives. Test 1, Drawing Test, was to evaluate student knowledge of specific locations of the parts of the heart. Students were required to draw a diagram of the heart and place the numbers of the listed parts in their respective locations. Test 2, Identification Test, consisted of 20 multiple-choice items to evaluate student ability to identify numbered parts on a line-drawing of a heart based on information received from the instruction. Test 3, Terminology Test, consisted of 20 multiple-choice items to

measure student knowledge of specific terms, definitions, facts related to the heart. Test 4, Comprehension Test, also consisted of 20 multiple-choice items to evaluate student understanding of the heart, its parts, and its internal activities during the systolic and diastolic phases. Scores received on these four tests were combined in an 80-item Total Criterion Test, which was designed to measure the student's total understanding of the concepts presented in the instructional material.

Each correctly answered item was scored as on point. The reliability coefficient for each test employing Kuder-Richardson Formula 20 was: Test 1, $r = 0.855$; Test 2, $r = 0.838$; Test 3, $r = 0.805$; Test 4, $r = 0.744$; Total, $r = 0.937$.

RESULTS

Except in the case of Comprehension Test, significant differences were found to exist among the means of five treatment groups on the individual criterion tests and Total Criterion Test. An analysis of variance which yielded differences on individual tests were: Drawing Test ($F = 10.508$, $df = 4/193$, $p < 0.001$); Identification Test ($F =$

9.076, $df = 4/193$, $p < 0.001$); Terminology Test ($F = 7.041$, $df = 4/193$, $p < 0.001$). Total Criterion Test ($F = 7.855$, $df = 4/193$, $p < 0.001$). Comparisons among the individual means of the five treatment groups, via Scheffe Procedure, were conducted to determine the effectiveness of the various treatments. The alpha level of significance was set at 0.05.

On the Drawing Test, students receiving the simple line treatment (Group II) and detailed, shaded drawing treatment (Group III) achieved significantly higher scores than students receiving the treatment without illustrations (Group I and Group IV). (see Table 1)

On the Identification Test, students receiving the simple line treatment (Group II) and detailed, shaded drawing treatment (Group III) achieved significantly higher scores than students receiving the treatment consisting of English keywords, but without illustrations (Group IV). Students of Group III alone achieved significantly higher scores than students receiving the treatment without illustrations (Group I). (see Table 2)

On the Terminology Test, students receiving the simple line treatment (Group II and Group V) achieved significantly higher scores than students receiving the treatment without illustrations (Group I and Group IV). Students receiving

detailed, shaded drawing treatment (Group III) also achieved significantly higher scores than students of Group I. (see Table 3).

On the Comprehension Test, no significant difference was found between students receiving varied treatments (see Table 4).

On the Total Criterion Test, students receiving simple line treatment (Group II) and detailed, shaded drawing treatment (Group III) achieved significantly higher scores than students receiving the treatment without illustrations (Group I and Group IV). (see Table 5).

The main results were concluded as follows:

1. The use of illustrations to complement textbook-like instruction did facilitate student achievement of most but not all of the learning objectives.

2. The effects of illustrations diminished when students received the treatment which consisted of English keywords. Except in the case of the Terminology Test, no significant difference existed among students receiving simple line treatment-plus-English Keywords and students receiving the treatment without illustrations.

3. Variation in the amount of realistic detail in illustrations did not affect student achievement.

Table 1

Scheffe Procedure Showing Mean Comparisons: Drawing Test

Treatment Group	N	Mean	S.D.	Results
I	38	7.94	4.62	II>I
II	40	11.67	6.14	II>IV
III	41	11.97	4.82	III>I
IV	40	6.32	3.89	III>IV
V	39	9.33	3.66	

Table 2

Scheffe Procedure Showing Mean Comparisons: Identification Test

Treatment Group	N	Mean	S.D.	Results
I	38	12.23	4.31	II>IV
II	40	15.22	4.46	III>I
III	41	15.73	3.16	III>IV
IV	40	10.82	4.83	
V	39	13.28	4.57	

Table 3

Scheffe Procedure Showing Mean Comparisons: Terminology Test

Treatment Group	N	Mean	S.D.	Results
I	38	10.55	3.88	II>I
II	40	14.25	4.70	II>IV
III	41	13.68	3.50	III>I
IV	40	10.82	5.14	V>I
V	39	13.76	3.43	V>IV

Table 4

Scheffe Procedure Showing Mean Comparisons: Comprehension Test

Treatment Group	N	Mean	S.D.	Results
I	38	10.10	4.03	Analysis of variance indicated no two groups was significantly different at the 0.05 level
II	40	12.30	4.32	
III	41	11.50	3.83	
I	40	11.12	4.21	
V	39	12.48	3.73	

Table 5

Scheffe Procedure Showing Mean Comparisons: Total Criterion Test

Treatment Group	N	Mean	S.D.	Results
I	38	40.84	14.28	II>I
II	40	53.45	18.02	II>IV
III	41	52.90	13.14	III>I
IV	40	39.10	16.54	III>IV
V	39	48.87	12.59	

DISCUSSION AND CONCLUSION

Illustrations were found to be effective in facilitating student achievement on the Drawing Test. This finding supports the stimulus generalization theory (Hartman, 1961), which indicates that when the test situation is similar to the learning situation, maximum learning is achieved. On the other hand, the Drawing Test evaluated student knowledge of spatial information provided in the illustrations. The exposure to illustrations during the instruction becomes a substantial factor for learning the information.

Illustrations were also found to be effective in facilitating student achievement on the Identification Test and Terminology Test. Students required verbal and spatial information to achieve on those two criterion tests. Illustrations and the keywords accompanying the illustrations provided appropriate stimuli.

The Comprehension Test was designed to evaluate students' understanding of complex procedures and processes that were less easily depicted by illustrations. The test emphasized mainly on students' verbal information obtained from the instructional unit. The advantages of illustrations disappeared on the Comprehension Test.

However, The effects of illustrations on learning were not found when students receiving their treatments consisted of English keyword. English is a second language for Chinese students. It seems that those English keywords related to the heart were difficult for them to comprehend. One possible explanation of the loss of advantages of illustrations is that information conveyed by the text was complex, thus requiring students to interact more with that information. Under those circumstances, students needed to sustain their attention in order to process the complex information and paid less attention to information provided by illustrations.

Simple line illustrations were found to be as effective as detailed, shaded drawings in facilitating student achievement on the different criterion tests. This result seems to indicate that simply increasing the realistic detail in illustrations does not automatically increase its instructional effectiveness. The assumption of realism theories that learning will be more effective as the number of stimuli in the learning situation increases is not supported by this study. One possible explanation is that the difference of the degree of realism between simple line illustration and detailed, shaded drawing is so small that no significant difference could be found when employed in instruction.

Results of this study supported the findings that illustrations are effective stimuli in facilitating student achievement of different objectives. However, the effects of illustrations need further study when the instructional unit consisted of keywords which students have difficulty to comprehend. Different presentation methods may be needed to aid learning in that case. In conclusion, results of this study indicate: first, the use of illustrations to complement print instruction does not automatically improve student achievement of all types of learning objectives; and second, variation in the amount of realistic detail in illustrations does not make significant differences in facilitating student achievement.

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