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STUDY OF CHARACTERISTICS CONTRIBUTING TO THE EFFECTIVENESS OF VISUAL DEMONSTRATIONS.

BY- BOGUSLAVSKY, GEORGE W.
RENSSELAER POLYTECHNIC INST., TROY, N.Y.

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SLIDES OF SELECTED TEXTBOOK ILLUSTRATIONS, DRAWN TO HIGHLIGHT THE PERTINENT AREAS OF THE ILLUSTRATION BY MEANS OF SHADING AND ILLUMINATION, WERE USED TO EVALUATE THEIR EFFECTIVENESS OVER SELECTED SLIDES OF CONVENTIONAL ILLUSTRATIONS AND DIAGRAMS IN WHICH ALL DETAILS WERE PROMINENTLY DISPLAYED. WHEN THE CONTROL SLIDES WERE PRESENTED, A TEACHER USED A POINTER TO INDICATE THE PERTINENT DETAIL IN COORDINATION WITH THE DIALOG. THE PROJECTED SLIDES WERE ACCOMPANIED BY A TAPED DIALOG. JUNIOR HIGH SCHOOL, HIGH SCHOOL, AND COLLEGE STUDENTS IN SCIENCE COURSES COMPRISED THE STUDY POPULATION AND WERE DIVIDED INTO EXPERIMENTAL AND CONTROL GROUPS. BOTH GROUPS RECEIVED THE SAME DIALOG, ONLY THE SLIDES DIFFERED. THE SLIDES AND ACCOMPANYING DIALOG WERE MADE FOR THE FIELDS OF BIOLOGY, CHEMISTRY, PHYSICS, GEOMETRY, STATISTICS, AND MECHANICS AND WERE PRESENTED IN ONE OR TWO LECTURES OF ABOUT 40 MINUTES DURATION. RESULTS OF TESTS INDICATED THAT THE EXPERIMENTAL SLIDES TENDED TO BE SOMEWHAT SUPERIOR TO CONVENTIONAL SLIDES IN LECTURES ON BIOLOGY AND MECHANICS, REQUIRING ILLUSTRATION OF CONCRETE OBJECTS. IN SUCH COURSES AS CHEMISTRY AND PHYSICS, REQUIRING EXTENSIVE PROBLEM-SOLVING, THE SUPERIORITY OF THE CONVENTIONAL APPROACH WAS INDICATED. IN GEOMETRY AND STATISTICS, THE DIFFERENCES WERE NEGLIGIBLE. ANALYSIS OF EFFECTIVE EXPERIMENTAL SLIDES LED THE AUTHOR TO INFER THAT AN EFFECTIVE VISUAL DEMONSTRATION CONTAINS NO EXTRANEOUS DETAILS AND IS CAPABLE OF COMMANDING ATTENTION BY SELECTIVE SHIFTS IN FIGURE-GROUND CONTRAST. (PM)

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George W. Boguslavsky

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Rensselaer Polytechnic Institute
Troy, New York

CONTENTS

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INTRODUCTION

In most educational circles it is customary to refer to instructional films, slides, charts, and illustrations as "visual aids". The implicit assumption in such reference is that any visual demonstration is ipso facto an aid and not a hindrance. Another assumption (which apparently operates in the construction of visual demonstrations) is that the closer an illustration resembles the real situation, the greater is its instructional value.

Recent research in the Soviet Union has cast some doubt on the accuracy of both assumptions.[1] According to Soviet investigators, a visual demonstration may be a real hindrance if its irrelevant features happen to capture the viewer's attention. They suggest, furthermore, that in a realistic demonstration the irrelevant features may have prepotency in competing for the viewer's attention.

The main implication of the Soviet research is that a visual demonstration, to be an aid, must minimize those aspects which are not immediately relevant to the accompanying text. The principle is that of contrast between the feature under discussion and its background.

If the Soviet inferences are correct, the making of the instructional visual demonstrations must move in the direction of greater simplicity, with attendant reduction in cost. It may also be profitable, educationally as well as financially, to substitute in some phases of teaching schematic outlines of pertinent features for real situations with their concomitant distractions.

The aim of the present study is the development of guide lines for planning visual demonstrations. As indicated earlier the specific assumptions to be tested are that the effectiveness of teaching will be improved by (a) elimination of irrelevant features, and (b) prominent exposure of features pertinent to the narrative in progress.

The theoretical bases for these assumptions are the concepts "orienting reflex" and "vigilance", the former credited to Professor I. P. Pavlov,[6] the latter to Sir Henry Head.[5] Although the concepts have independent origins, their current definitions are practically identical. The phenomenon they describe is that of alert attention to environmental changes. The salient features of such attention are receptor adjustment, excitation, and preparation for subsequent action.[3]

In the classroom vigilance is manifested by the direction of the student's interest. For a teacher it is only too easy to assume that his voice commands a student's attention. Such however is not always the case since other sounds and other sights are often free to compete for it.

Extending this reasoning to the use of visual demonstrations, it is now postulated that competition for the student's attention is proportional to the number of separate components included in any one chart or diagram. Though the narrative discusses these components in a logical order, there is no certainty at any point in time that the student is attending to the detail being described.

The thesis of this paper is that vigilance can be directed and maintained by sequential changes in figure-ground relation. Figure-ground relation is a contrast between a shape and its background. Such contrast may be achieved by the use of boundary lines, coloration, or differential illumination.

It is now proposed that a student's attention will be directed to the relevant detail if such detail is in sharper contrast to the background than other details. As the lecture progresses from one detail to another, the contrast effect may be arranged to change in the same order. The very fact of change should be sufficient to maintain the excitatory aspect of vigilance,[2] and the heightened figure-ground contrast should give it direction.

TEST OF HYPOTHESIS

A. Method. The foregoing proposition was tested by controlled comparisons of two instructional methods consisting of tape-recorded lectures and photographic slides. In both methods the lectures were identical, but the slides differed:

1. Control slides: These were black-and-white reproductions of conventional textbook illustrations. The various components of each illustration were properly labeled. As the

taped narrative described a particular component, the teacher directed a pointer to the corresponding detail in the picture.

2. __Experimental slides:__ These, too, were reproductions of textbook illustrations, but done in black, white, and a shade of gray. There was no teacher with a pointer: instead, the detail under discussion appeared with maximal contrast of white against black, while other details remained in lesser contrast of gray against black. As the narrative progressed from one component to another, the maximal contrast shifted accordingly. This basic approach was occasionally varied by the introduction of coloration in order to maximize contrast.

B. __Materials.__ The materials were prepared with the help of the faculty in Troy High School and Rensselaer Polytechnic Institute, who had volunteered to take part in the project. The areas of study and the topics selected to test the hypothesis are summarized below:

1. High School Biology — two lectures:
    a. cell division
    b. the reproductive process
2. High School Chemistry — two lectures:
    a. oxidation-reduction
    b. balancing of equations
3. High School Physics — two lectures:
    a. wave motion
    b. reflection and refraction
4. High School Geometry — one lecture:
    a. simple and compound loci

5. College Statistics — one lecture:

a. correlation methods

6. College Mechanics — one lecture:

a. calibration of a universal testing machine

C. Procedure. Each lecture was about 40 minutes long, recorded on tape by a professional radio announcer. A script was keyed numerically to the narrative for manual changing of the slides. These were presented by Bell and Howell projectors: #750 specialist projector for the control group; lap-dissolve tandematic projector for the experimental group. The latter allowed for a gradual shift in figure-ground contrast without affecting topographic relation.

The hypothesis was tested by specially prepared objective examinations administered upon completion of the lecture or lectures. When comparison between treatments was based on only one lecture the examination was administered on the following day. In courses with two lectures the examination was given on the third day, except as noted hereafter.

D. Subjects. These were students regularly enrolled in the respective courses. The breakdown is summarized below.

1. Biology: 4 classes, total N = 107.
2. Chemistry: 3 classes, total N = 67.
3. Physics: 2 classes, total N = 56.
4. Geometry: 2 classes, total N = 38.
5. Statistics: 1 class, total N = 26.
6. Mechanics: 1 class, total N = 369.

Each class was divided at random into approximately equal control and experimental groups, and the treatments were administered simultaneously in separate rooms. The one exception was the class in mechanics where the treatments were applied in the same room at different hours. Though the several classes in a particular area of study met at different hours, the examination for all classes in the area was administered at the same time. The one exception was the class in mechanics where the examination was given immediately following the presentation.

E. Results. The results are presented in Tables I through VI, each table summarizing the data for a single area of study. In the first four tables the numbers in the column labeled "period" are ordinal numbers indicating the time of class meeting, based on a seven-period school day.

Table I - Biology

	Experimental			Control		
Period	N	Mean	Median	N	Mean	Median
1	16	51.7	56	15	50.2	52
2	14	39.1	37	14	34.8	35.5
4	15	36.4	40	12	35.4	35
7	11	35.7	37	10	34.4	38
ALL	56	41.9	40.5	51	39.4	39

The scores above represent the number of correct items, obtained on a multiple choice examination of 60 items.

Table II - Chemistry

		Experimental			Control		
Quiz	Period	N	Mean	Median	N	Mean	Median
Oxi-Redu	2	12	15.3	15	13	15.9	16
Bal. Equ			49.9	50.5		53.2	55
Oxi-Redu	3	11	15.0	17	12	15.7	16
Bal. Equ			49.4	54		52.3	56
Oxi-Redu	7	10	12.8	13	9	13.1	13
Bal. Equ			37.9	42.5		46.1	47.5
Oxi-Redu	ALL	33	14.5	15	34	15.1	15.5
Bal. Equ			46.1	50		51.0	50.5

The results above are based on a two-part examination: (1) a completion quiz on factual material in oxidation-reduction, allowing for a maximal score of 25; and (2) five problems requiring balancing of equations and allowing for a maximal score of 70.

Table III - Physics

		Experimental			Control		
Quiz	Period	N	Mean	Median	N	Mean	Median
Wave Mot	3	16	23.2	24	17	23.4	23
Ref-Refr		14	11.8	11.5	17	14.0	14
Wave Mot	6	13	26.2	25	11	29.8	30
Ref-Refr		13	15.0	15	12	17.4	16.5
Wave Mot	ALL	29	24.5	24	28	25.9	24.5
Ref-Refr		27	13.3	13	29	15.4	15

The physics examination consisted of two parts administered on two consecutive days. The first part contained multiple-choice items, primarily factual, on wave motion, and it allowed for a maximal score of 43. The second part, dealing with reflection and refraction, contained items of factual nature as well as problems; this part allowed for a maximal score of 27.

Table IV – Geometry

	Experimental			Control		
Period	N	Mean	Median	N	Mean	Median
3	13	13.2	14	13	12.5	13
7	6	14.5	14.5	6	13.7	14.5
ALL	19	13.6	14	19	12.9	13

The geometry scores represent the number of correctly answered items on a completion test of 16 items.

Table V – Statistics

	Experimental			Control		
	N	Mean	Median	N	Mean	Median
Pre-test	13	5.1	6	13	5.5	5
Post-test		10.2	10		10.1	11
Difference		5.1	5		4.6	5

The scores above represent the number of correct answers on a multiple-choice test of 15 items. In this course the test was given before and after the experiment because of different educational backgrounds of the students. These, though different in other respects, were fairly uniform in the field of statistics.

Table VI – Mechanics

Experimental				Control			
N	Mean	Median	σ	N	Mean	Median	σ
179	19.78	20	3.32	190	19.16	20	3.56

The mechanics scores represent the number of correctly answered items on a multiple choice examination of 25 items.

F. Analysis of Results. A cursory examination of the data reveals that the investigation fails to provide a basis for unequivocal acceptance or rejection of the hypothesis. A close analysis, however, suggests the possibility of interaction between treatment and area of study. The analyses for individual areas follow.

1. Biology. The results favor the hypothesis, but the differences are small. In each of the four classes the mean scores of experimental groups are a point or two above the scores of control groups. By the one-tailed sign test the probability of such consistency being due to chance is 1/16. It must be admitted, however, that the one-tailed test is hardly warranted in view of the fact that such test fails to provide for the contingency of obtaining data contradictory to the hypothesis. In consideration of such contingency it is proper to state that the probability of such consistency in either direction is 12.5%.

Because the results are not distributed normally they were subjected to another non-parametric analysis, the rank order test for two independent samples.[4] The test consists of determining the probability of chance deviation of the actual sum of ranks from the expected sum, were both samples drawn from the same population. The two-tailed test shows the probability to be 24.6%.

2. Chemistry. The results in this area are uniformly at variance with the hypothesis. The contradictory evidence is especially pronounced in the problem-solving test on the balancing of equations. The two-tailed rank test gives $p = 18.4\%$. In the factual information quiz on oxidation-reduction $p = 45\%$, also in the direction contrary to the hypothesis.

3. Physics. The data in this area, like those in chemistry, fail to confirm the hypothesis. The two-tailed test of scores on reflection-refraction quiz yields $p = 4\%$ against the hypothesis. The comparable probability for the scores on wave-motion quiz is 40%.

It should be noted that the reflection-refraction quiz, like the equation-balancing quiz in chemistry, is primarily a test of ability to apply factual knowledge rather than of factual knowledge itself.

4. Geometry. The results in this area favor the hypothesis, but the differences are not statistically significant. The two-tailed rank test yields $p = 49\%$.

5. Statistics. In this area the rank test was used on differences between pre- and post-test scores. The results favor the hypothesis but lack significance, with $p = 76\%$.

6. Mechanics. In this area the results approximated normal distributions, with the difference between the means supporting the hypothesis. Analyzed by the t-test, the difference, though small, approaches significance, with $t = 1.72$. The corresponding two-tailed $p = 8.5\%$.

G. Discussion. On the basis of the foregoing analysis it is tentatively proposed that the differences observed in selected areas of study are indicative of real differences between treatments. Specifically, it is proposed that the experimental approach is superior to the conventional approach in descriptive fields, such as biology and mechanics, where much of the content is concerned with localization and nomenclature of concrete details.

On the other hand, areas such as physics and chemistry, which deal largely with application of principles to solution of problems, do not lend themselves readily to the experimental treatment. Such treatment, in fact, may be a handicap inasmuch as it interferes with the student's self-paced and self-directed orientation to different aspects of the whole problem.

The validity of these conclusions was examined by replication of the comparisons with new populations.

TEST REPLICATION

A. Subjects. The subjects and classroom space were provided by five schools in New York State Capital District in Summer 1965. The list of schools follows.

1. Albany Academy: private, non-parochial high school.

2. East Greenbush High School: public school.

3. Lansingburgh High School: public school.

4. Milne School: experimental school of State College of Education, combining high school with lower grades.

5. Vincentian Academy: parochial high school.

Students in the Milne School were 7th, 8th, and 9th graders taking an advanced experimental course in biology; students in the other four schools were repeating courses they had failed in the previous academic year or in which they had received a low mark. A total of 227 students took part in the project.

B. Materials. Three areas of study were selected for the replication: (1) Biology, as maximally favoring the hypothesis; (2) Physics, as most contradictory to the hypothesis; and (3) Geometry, as failing to show differentiation between treatments. By eliminating reiteration and summaries, the two lectures in biology and the two lectures in physics were condenses into single 45-minute lectures.

C. Procedure. The presentation dates were established by the teachers, coinciding with the periods scheduled for teaching the material. As in the original experiment, the classes were randomly divided into experimental and control groups. Because most students had some acquaintance with the subject-matter, a test was administered before as well as after the presentation. This was a fifteen-item multiple-choice test, with ample time to answer the items. The entire procedure required about 75 minutes.

The sample sizes in the various comparisons are shown in Table VII.

Table VII - Sample Sizes

School	Biology		Geometry		Physics		Total	
	Exp	Con	Exp	Con	Exp	Con	Exp	Con
Milne School	10	11					10	11
Albany Academy	4	5	7	9	3	2	14	16
Vincentian Acad.	8	9	17	16	13	13	38	38
E. Greenbush H.S.	11	12	18	14			29	26
Lansingburgh H.S.	9	8	18	10			27	18
Totals	42	45	60	49	16	15	118	109

D. Results. Table VIII presents the results in terms of mean difference-scores between pre- and post-test performances.

Table VIII - Mean Difference-scores

School	Biology			Geometry			Physics		
	D_{exp}	D_{con}	D_{e-c}	D_{exp}	D_{con}	D_{e-c}	D_{exp}	D_{con}	D_{e-c}
Milne	5.40	4.63	0.77						
Albany	4.00	2.00	2.00	2.71	2.89	-0.18	3.67	2.50	1.17
Vincen	1.75	1.66	0.09	2.94	1.81	1.13	1.62	1.69	-0.07
E. Gr.	3.55	3.00	0.55	2.16	1.79	0.37			
Lans.	2.11	2.00	0.11	2.61	2.70	-0.09			
ALL	3.09	2.68	0.41	2.52	2.25	0.27	2.00	1.80	0.20

While the differences between the mean difference-scores of the experimental and control groups failed to achieve statistical significance at the 5% level, the mean difference-scores of the experimental groups were generally larger than those of the control groups. To determine whether or not the frequency of this occurrence (8 of 11 samples) exceeded chance, probability values were computed by the binomial expansion. The probability of obtaining 8 or more samples in which the experimental group's mean difference-score exceeded the control group was 11.3% for a one-tailed test. The value for the biology, however, lends substantial credibility to the hypothesis. The probability of five successes in five trials is .03. This, however, is again a one-tailed test, and the value should be doubled to allow for the contingency of a difference in the opposite direction.

E. Discussion. The confirmation of original results in biology by replication data provides grounds for accepting the hypothesis of the efficacy of the experimental treatment in this area of study. For physics, however, the replication data do not confirm the original results. The discrepancy here may be attributed to the fact that the 15-item quiz consisted primarily of factual knowledge items. The importance of this discrepancy is in its warning against premature rejection of the hypothesis.

The overall results in Geometry lend support to the slight advantage of the experimental treatment in the initial experiment. This points to the possibility of a real difference between treatments that may be brought out by further research.

A word of caution is appropriate at this point. Though the results have generally favored the experimental treatment in biology, it is not the area itself, but a specific topic in the area, which lends itself to the treatment. The essential accuracy of this statement was confirmed in a filmograph test, with a different topic in biology serving as the basis of comparison.

THE FILMOGRAPH TEST

A. Method. A filmograph is described by Allen and Cooney (AV Com. Rev., v. 12, #2) as "... a motion picture with no movement in its visual content: still photographs or drawings are used as primary visual content. These are photographed on standard motion-picture film, usually in the same way as animation, but without the resulting effects of continuous movement; and the visual content is usually supported by an associated sound track."

The use of filmograph was selected as being particularly adapted to the new topic of investigation — the circulatory system. The method provides considerable improvement in the several desirable features: gradual dissolution of a picture, adequate synchrony, and perfect registry. Furthermore, despite the fact that a filmograph represents a series of still photos, a strong suggestion of movement can be easily created by proper timing of duration and dissolution of individual pictures. The illusion is essential for an adequate discussion of the topic.

B. Subjects. These were Troy High School students enrolled in biology in the Summer 1965 session. All had failed the course in the preceding academic year and were repeating it.

C. Procedure. The presentation consisted of two lectures presented on consecutive days. Each lecture was about 40 minutes long. A 35-item multiple choice test was given immediately preceding and following the lecture. On the third day a 60-item multiple-choice test was administered to all students at the same hour. As in the previous tests of the hypothesis, the students were randomly divided into experimental and control groups.

D. Results. The mean scores are presented in Table IX.

Table IX - The Filmograph Test: Mean Scores

		Experimental				Control			
Day	Per.	N	Pre-	Post	Diff	N	Pre-	Post	Diff
1	1-L	13	10.6	20.5	9.9	14	11.5	20.2	8.7
	1-D	7	5.3	13.1	7.8	7	7.9	17.0	9.1
	2-D	10	7.0	14.8	7.8	10	4.6	13.1	8.5
	ALL	30	8.2	16.9	8.7	31	8.5	17.2	8.7
2	1-L	13	14.4	27.2	12.8	13	16.0	26.7	10.7
	1-D	7	5.1	13.8	8.7	7	11.1	19.5	8.4
	2-D	9	8.3	15.2	6.9	10	5.7	15.1	9.4
	ALL	29	10.2	20.2	10.0	30	11.4	21.1	9.7
3	1-L	13		32.6		10		33.0	
	1-D	7		23.4		6		21.5	
	2-D	9		21.2		8		20.2	
	ALL	29		26.9		24		25.9	

E. Discussion. The cumulative data for each day do not furnish sufficient basis for the acceptance or rejection of the hypothesis. Within each day, however, there is an indication of an additional interaction, the nature of which is not immediately obvious. It may be noted that the hypothesis is decidedly favored in period 1-L on days 1 and 2, yet generally contradicted in periods followed by letter D on the same days. The letters L and D are used to designate two different teachers of the course. Thus, the interaction may well be one between treatment and the classroom atmosphere created by a particular instructor. On the other hand, it may be noted that students in period L have higher initial scores than students in periods D. Accordingly, another interpretation of the interaction is that of one between treatment and the state of readiness on the part of the subject.

Interestingly enough, the trend is reversed in the final quiz on the third day. A possible interpretation of this phenomenon is that students with a relatively high degree of initial achievement (class L) were sufficiently motivated to seek out other sources of instruction in preparation for the examination, regardless of treatment. Students in classes D, however, may have experienced the phenomenon that generally goes under the label of "reminiscence", but is more correctly identifiable in this case as "rehearsal": the pictorial illustration of the filmograph was sufficiently colorful to precipitate many lively discussions among students following each presentation.

To return to the original purpose of this test, it is now fairly apparent that not every topic within an area lends itself equally readily to the experimental treatment. Identification of suitable topics is a matter for empirical approach.

CONCLUSIONS

The results of the investigation support the conclusion that in certain areas of teaching selective high-lighting of detail in parallel with the text is an effective substitute for, and possibly an improvement over, the conventional visual charts and diagrams. It may be speculated that the obtained differences between treatments might have been more pronounced were it not for the following confounding factors:

1. Novelty. Despite attempts to conduct the demonstrations as part of the continuity in each course, students in both groups were aware that the departure from the conventional procedure was prompted by extraneous factors. The curiosity generated by the awareness may have had adverse effect on any potential differences.

2. Changing illumination. Although precautions had been taken to maintain constant level of illumination during treatments, the classroom shades and drapes failed to screen out entirely the changes in the amount of outdoor sunlight. Consequently, the irrelevant details in the experimental slides, which should have been subdued but clearly visible, became on several occasions invisible. This, of course, was not a handicap for the control group where the contrast was maximal for all details at all times.

3. Note taking. Many students in both groups failed to attend to visual stimulation by taking notes; such lack of

attention was not continuous, but occurred with sufficient frequency to affect potential differences.

While the results provide no valid grounds for the rejection of the experimental treatment, there are valid considerations which warrant its utilization:

1. Teacher shortage or teacher inadequacy. The experimental lectures, having a built-in change of focus on detail, can be presented by anybody capable of operating a tape recorder and a slide projector. If the projector is geared so as to operate on a signal from the tape, the task is simplified considerably. With conventional diagrams a knowledgeable person must be present to point out pertinent features. In regions where such persons are not to be found the present alternative is no education.

2. Prohibitive cost of animation films. Although a series of slides cannot fully duplicate a footage of film, an illusion of animation of relatively simple processes may be achieved with a relatively small number of slides shown in succession. The approach has been quite successful in illustrating the behavior of a compressed spring, chromosome division, and passage of an ovum through the fallopian tubes.

3. Adequate use of classroom time. Each of the lectures prepared for the experiment contained material which was normally covered in two or three conventional 50-minute periods. By the teachers' own admission much of the time in conventional teaching is spent in drawing and erasing diagrams,

waiting for an apparatus to be set up or a pointer needle to become stabilized, and enforcing discipline. None of these factors were present in the experimental treatments.

A final comparison of the relatively successful experimental slides with less successful ones leads to several inferences, all tentative and subject to further investigation.

1. A successful visual aid contains no information other than that contained in the script.

2. Each bit of information is presented sequentially in parallel with the script by heightened figure-ground contrast.

3. The contrast is more effective if it is achieved by illumination rather than by color. (In chemistry, physics, and the circulatory system, where color was used abundantly, its presence tended to distract the students' attention from the content, according to several students' comments).

4. The contrast occurs simultaneously in the detail under discussion and its label in the diagram.

5. The details not under the discussion remain visible at all times, but in lesser figure-ground contrast.

6. Wherever possible, the sequence of change in contrast follows the principle of topographic proximity.

7. The effectiveness of the treatment follows the principle of diminishing returns, probably reaching an asymptote in 20 to 30 minutes.

* * *

SUMMARY

Studies were conducted on the instructional merits of visual demonstrations in which details pertinent to the accompanying narrative are highly illuminated, while irrelevant details remain subdued in lesser contrast with the background. Comparisons were made with conventional diagrams in which all details are prominently displayed.

The tests were conducted on High School and College populations in several schools in New York Capital District. The areas of study which served as vehicles for the comparisons were: biology, chemistry, physics, geometry, statistics, and mechanics. Each area was represented by either one or two lectures of about 40 minutes' duration.

The results indicate that the experimental slides tend to be somewhat superior to conventional demonstrations in courses requiring illustration of concrete objects, such as biology and mechanics. In courses requiring extensive problem solving, such as chemistry and physics, such superiority was not found, there being some indication of the superiority of the conventional approach. In geometry and statistics the differences, if any, were negligible.

Analysis of effective experimental slides leads to the inference that an effective visual demonstration contains no extraneous details and is capable of commanding attention by selective shifts in figure-ground contrast.

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