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ABSTRACT

The purpose of this study was to see if learning could be improved by controlling the environment at the individual student's level. A pretest, post-test, random choice design was chosen to obtain data from over 900 subjects of technical-vocational schools, area community colleges, and high schools of Iowa, with emphasis on grades 11 and 12 and upon technical and scientific subject-matter. An apparatus consisting of a visual shield, an audio-blocking control, and an audio-control system, was developed to control the experimental subject's environment. Mental ability records of high school students were used to group subjects in three categories, while the analysis of variance single class and the t-test were used for grouping the other subjects. The findings indicated that three of the four hypotheses were accepted: (1) Visual control was not effective in increased learning, (2) Audio-visual control using commercial ear pads to block sound was not effective in increasing learning, and (3) No interaction was found between mental ability levels and the types of treatments. The original Ph.D. thesis of which this is a summary was submitted to Iowa State University of Science and Technology. (GR)

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LEARNING EXPERIMENT:

DETERMINE EFFECTIVENESS OF CONTROLLING ENVIRONMENTAL DISTRACTIONS AT THE STUDENT LEVEL

by

Paul Edward Sumter

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The study was conducted with the cooperation of the Iowa State Department of Public Instruction and the Industrial Education Department at Iowa State University.

The study was conducted under the direction of Professor Lowell L. Carver and Dr. Ray Bryan.

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PURPOSE OF THE STUDY

In recent years, the emphasis on vocational education has resulted in financial support by the government for establishment of the area vocational schools and consequent attention to educational facilities and curricula. Considerable support has been extended in the area of educational research. Special attention has been directed to research teaching techniques, methods of presentation, repetitions, timing, etc. However, little attention seems to have been given to observing students in their environment to see the effects of controlling their various senses from distractions to see if such shielding of the senses will affect learning.

A minimum level of achievement in a given subject-area or course seems necessary to motivate students. Especially in technical and science studies, the minimum level of achievement seems necessary to encourage individuals to succeed in given courses.

The purpose of the study was to see if learning could be improved by controlling the environment at the individual student's level. The idea was to control against random, unwanted, visual and audio stimuli.

An experiment was designed to take observations of student-subject's performance in certain Iowa schools. If control of a subject's environment at the individual's level was effective in increasing learning, attention could then be directed to help various groups and individuals learn faster.

The intent was to find out the effect of such control upon students in their school environment, i.e., the classrooms and study halls. Some 900 observations were made in technical-vocational schools, in area community colleges, and in high schools of Iowa.

Design

The study was designed to utilize an experiment in the schools. Data from the experiment would be analyzed and the results applied to test the hypotheses concerning the effectivity of such environmental control.

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The objectives of this study were:

1. To determine if students' learning could be improved by shielding them from visual distractions.

2. To determine if students' learning could be improved by shielding them from visual and audio distractions.

3. To see if students' learning could be improved by shielding them from visual distractions and providing them with an "audio-blanket" sound.

4. To see if students' learning under such conditions would vary according to their mental ability.

Delimitations of the Study

The study was delimited to utilization of subjects in technical schools, area community colleges, and high schools with emphasis on 11th and 12th grades and upon technical and science subject-matter in the high schools. Forty-eight trials were conducted in thirteen schools including the Technical Institute of Iowa State University, a technical high school, nine high schools, and an area community college. Nine hundred three observations were made representing individual's pre-score and post-score over a learning treatment.

Table 1 lists the schools, trials, and observations at the schools in the order of occurrence.

Table 1. Schools and observations by trial number

School	Trial	Observations
The Technical Institute, ISU	1	20
Marshalltown	2-8	145
Fort Dodge	9, 10	69
Cedar Falls	11, 12	87
Price Laboratory School	13, 14	65
Des Moines North	15, 16, 17	33
Des Moines Technical	18, 19	66
Story City	20, 21	57
Roland	22	33
Gilbert	23, 24	50
South Hamilton	25-28	104
Marshalltown	32-35	63
Area XI Ankeny	36, 37	44
Des Moines Technical	29-31, 38-41	100

METHOD OF PROCEDURE

The writer supervised each trial in the classroom of each school. Research assistants were trained to assist in the trials and to set up trials. Prior to a given trial, the subjects were grouped according to the controls to be used. A major expense of the project was the several trips necessary to a school to arrange with school officials for the details of the experiment and to obtain necessary information from the school records. The instructor and the class were oriented prior to each trial. Each trial utilized an entire class of students one to three hours.

To obtain data to apply to the hypotheses, the pre-test, post-test, random-choice design was chosen. Each trial involved an experimental group and a control group. Each trial involved an entire class of students at a given time. Lengths of the trials, i.e., the study period, was one and two hours.

The subjects were first pre-tested, then they studied the learning unit, and then they were post-tested over the subject-matter of the learning unit. The gain, i.e., the difference between an individual's pre-test and his post-test was the "score" used in analysis. The mean gains of the experimental groups and the respective control groups were analyzed for effectivity of the treatments.

Analysis

Computer facilities at Iowa State University were used. In analyzing the data, analysis of variance and the t-test were used to analyze for significant differences between groups, between the levels of mental ability, and interactions.

Apparatus

An apparatus was developed and patented to control the experimental subject's environment. Three configurations were used: the visual shield, the visual shield and audio-blocking, and the visual shield audio control using sound.

Timetable

Initially the experimentation period was to be from April, 1968, to April, 1969. Data was to be collected during that time; analysis and recommendations were to be made by August, 1969. Some delay was encountered in the development and modification of the apparatus and in the orientation to the purposes of the experiment and selling of the idea to some schools for cooperation.

After dissemination of information about the project to the schools and orientation to its purpose, virtually all were ready to cooperate. However, by this time, the school year 1968 was near closing. Most respondents requested the experiment be conducted in their school after the beginning of the next school year, 1968-69. This caused some delay in the collection of data. Most of the data from the high schools were collected during the 1968-69 school year; after June, emphasis was upon collection of data from the Area XI Community College. The timetable was extended to September, 1969.

Design

The design of the experiment incorporated pre-test, post-test, control groups, and random choice. According to Campbell *et al.*, this is one of the "three true experimental designs". The design takes the form:

$$RO_1 \times O_2$$

$$RO_3 \quad O_4$$

where: R = RO_1 and RO_3 represents the random choice of the treatment group and the control group, and the first set of observations, e.g., the pre-test.

X = the treatment administered to the treatment group

O_2 and O_4 = the second set of observations, e.g., the post-test

FINDINGS

Because cell frequencies are not equal, the usual AOV technique was not used. The computer uses a technique of analysis referred to as the non-orthogonal mode. In this mode, multiple linear regression is used to compute the relative contributions of the variates. Sums of squares due to regression and sums of squares due to deviation from regression are computed for each variable. The relative contributions are printed out in the form of F-test values. A summary analysis of variance table is printed out for each analysis job.

Structure

The form of the analysis was a two-way classification. A_1 represented the treatment group and A_2 the control group. The mental categories are represented by B_1, B_2, and B_3. Since the grand means of the mental ability scores of the total samples was 107, fewer subjects in the low category can be expected. Some samples had only a few individuals in that category, as did sample 1.

Table 2 is typical of the form used, except only two levels of B were used:

Table 2. Frequencies in each cell of sample 1

Number of gains (enries) per cell*			
A_1B_1	A_1B_2	A_2B_1	A_2B_2
16	16	23	23

*N = 78.

Analysis

Analysis of sample 1 is typical of the form and procedure used for each of the fifteen samples of the study.

Sample 1

Sample one utilized subjects from the Marshalltown and Cedar Falls community schools.

Five trials were involved, three in the Marshalltown school and two in Cedar Falls. In each trial, the treatment control group experimental procedure was used. The subjects were pre-tested before the treatment was administered and before the group had been chosen. Prior to the trials, a random choice was made for the treatment group individuals on the basis of equal distribution in the three categories of mental ability. This choice was made for each half of the class. The class had been divided equally into "X" and "Y" groups previously. Then, after pre-testing, a random choice was made to see whether X or Y would be the treatment group, within which the individuals had previously been chosen to wear the apparatus.

In each trial, the reading time was one hour. The subject-material studied was mechanical principles and biology. After the reading, the subjects were post-tested. Gains, i.e., the difference between an individual's pre- and post-tests, are entered in Table 3. This is the data for analysis toward Hypothesis I.

Analysis of Variance, Sample 1

Model

The mathematical model was:

$$Y_{ijk} = A_i + B_j + AB_{ij} + E_{ijk}$$

Table 3. Data for sample 1.* Treatment was visual shielding

Grouping			
Treatment group		Control group	
26.00	30.30	43.00	36.60
39.00	21.70	13.00	13.00
39.00	13.00	17.00	30.00
13.00	47.00	43.40	4.30
17.60	23.50	4.30	0.00
19.50	64.70	4.30	4.30
0.00	17.60	17.30	8.60
64.40	58.80	34.00	30.30
11.70	26.00	0.00	30.30
11.70	28.20	52.90	0.00
29.40	36.80	47.00	-23.30
70.50	56.30	32.20	41.10
51.20	53.70	29.40	17.60
43.50	26.00	41.60	17.60
46.00		17.60	35.20
23.80		29.40	23.50
-17.30		52.90	38.40
26.00		11.60	43.50
		23.80	47.00
		15.10	53.70
		21.70	38.40
		43.40	19.50
		6.50	28.20

*N = 78.

Limits

Limits were:

$$I = 2, J = 2, K = 23$$

In the non-orthogonal mode, it is necessary to specify the number of observations in the largest cell, in this case K = 23.

Frequencies

Table 2 lists frequencies in each cell. Due to fewer individuals in the #3 (low ability) category, only two levels of B were used.

Means

Means for the main effects of sample 1 were:

$A_1 = 32.4806$, $A_2 = 24.7586$, $B_1 = 28.8421$,

$B_2 = 26.9179$, $AB = 32.9733$

Summary AOV

The summary analysis of variance for sample 1 is shown in Table 4. Since cell frequencies were not equal, computation was by non-orthogonal analysis using multiple linear regression.

Table 4. Summary analysis of variance for sample 1, visual treatment

Source[a]	DF	SS	MS	F
A adjusted for B	1	112.7695	112.7695	—[b]
B adjusted for A	1	383.4960	343.4960	1.10
AB adjusted for A, B	1	114.7539	114.7539	—[b]
Error	75	25777.7851	348.3483	

[a] N = 78.

[b] F-value is less than 1.00.

Conclusion

Testing the treatment mean square for significance, F_c was less than 1.00. Since the value of F_t was at .05, and 1, 75 degrees of freedom is 3.97, the calculated value was insignificant. No significant difference was found between the experimental group and the control group.

Testing for significant difference between the levels of mental ability, the calculated value of F was less than 3.97. The difference was not significant.

t-test, Sample 1

The t-test was used as a supplementary test to test the null hypothesis of no difference between the experimental and the control groups.

Model

Either the t-test for difference between two means with separate group variance and sample groups of unequal size could have been used or the t-test using pooled variance and sample groups of equal size. For degrees of freedom with which to determine the critical values, the median of the value at N_1-1 and N_2-1 applies for the former and the value at $N_1 + N_2 - 2$ for the latter.

To determine whether there was unequal variance between the two groups, the variance ratio formula was used:

$$F = \frac{S_g^2}{S_1^2}$$

Where S_g^2 was the sample group with the greater variance and S_1^2 was the lesser, the ratio became:

$$F = \frac{400.2673}{300.1984} = 1.33$$

Since $F_{31,45} = 1.72$, the ratio was not significant. The variances were considered to be equal, and the pooled variance model was used. Calculation was:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{s^2 \left(\frac{1}{K_1} + \frac{1}{K_2}\right)}}$$

$$= \frac{7.0726}{700.4657 \left(\frac{1}{32} + \frac{1}{46}\right)} = 1.66378$$

The value of $t_{32+46-2(N_1+N_2-2)}$ is 2.004. Since the calculated value was less than the table value with at .05, the value was not significant. The t-test agreed with the F-test; no significant difference was found between the performance of the experimental group and the control group.

Hypothesis I was not rejected. Learning was not improved. Visual shielding was not effective under these experimental conditions.

No observations were taken, in the visual configuration, with time exceeding one hour. It should be noted, therefore, that effects of increasing time on learning, using the visual control, were not investigated.

Hypothesis II

Whereas the apparatus used to control the subject's environment in those trials toward Hypothesis I was a visual shield only, commercial ear pads were used in the trials toward Hypothesis II. The subject's view was also restricted to a sector around the book, as in sample 1, and his reception of ambient sounds was also attenuated by commercial ear pads. The

degree of attenuation ranges up to 50 decibels at 3K hertz. This effect does not completely block all sounds, but the subject can hear few sounds more than a few feet away. The effect was to render meaningless most ambient sounds. See Appendix A for the attenuation graph.

Analysis of Variance, Sample 2

Sample 2

In sample 2, there were 30 observations. Students from the Des Moines Technical High School were used as subjects. The subject-material was electronics and computer programming. The length of the trial was two hours.

Samples 2 thrcugh 8 were used toward Hypothesis II. The analysis of variance summary in Table 6 is typical.

Summary AOV

The summary analysis of variance for sample 2 is shown in Table 6. The computer used multiple linear regression for each factor as in sample 1.

Table 6. Summary analysis of variance for sample 2, visual-audio treatment

Source[a]	DF	SS	MS	F
A adjusted for B	1	209.6640	209.6640	—[b]
B adjusted for A	1	934.8242	934.8242	1.77
AB adjusted for A, B	1	1167.6953	1167.6953	2.21
Error	26	14994.6445	576.7170	

[a] For N = 30.

[b] F-values less than 1.00 not shown.

Conclusion

Testing the treatment mean square for significance, F_2 was less than 1.00. Since F_t with = .05 and 1/25 degrees of freedom is 4.24, the calculated value of F was insignificant.

No significant difference was found between the treatment group and the control group. Hypothesis II was not rejected on the basis of analysis of this sample. Learning was not improved. Visual-audio shielding was not effective under these experimental conditions for the college students, considering results of the analysis of variance.

t-test, Sample 2

The t-test was used as a supplementary test to test the null hypothesis of no difference between the experimental and the control groups. No blocking by mental ability was used for the t-test.

Sample 2 had 30 observations of students in the Des Moines Technical High School. The subject-material was electronics and computer programming. The length of the trial was two hours.

Model

To determine whether the pooled variance model could be used, a test of homogeneity of variance was used. The variance ratio formula was used:

$$F = \frac{S_g^2}{S_1^2}$$

where S_g^2 was the greater variance of the two groups and S_1^2 was the lesser.

For sample 2, S_1^2 was 538.1682 and S_2^2 was 455.4392. Therefore, the variance of subgroup 1 was the subgroup of the greater variance.

The formula became:

$$F = \frac{538.1862}{455.4392} = 1.1816$$

Since $F_{12,13(K_1\text{-}1 \text{ and } K_2\text{-}1)}$ was 2.60 interpreted at the 10 percent level (= .05), the calculated value was not significant. The variances were considered to be equal since the data tested homogeneous. The pooled variance model was used:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{s^2 \left(\frac{1}{K_1} + \frac{1}{K_2}\right)}}$$

The computation was:

$$t = \frac{15.6615}{993.6254 \left(\frac{1}{13} + \frac{1}{17}\right)} = 1.91854$$

Conclusion

The value of $t_{15+17-2(K_1+K_2-2)}$ = 2.048 with at .05. Since the calculated value was less, the difference was not significant. The results of the t-test agreed with the F-test; no significant difference in performance was found between the experimental group and the control group.

Hypothesis II was not rejected on the basis of this experimental replication.

Samples 3-7

Samples 3 through 7 were analyzed using the AOV and the t-test in the same manner as sample 2.

Tables 19, 20, and 20b summarize the results.

Table 19. Summary analysis of variance for all samples toward hypothesis II

Source sample	N	DF	SS	MS	F
2	30				
A		1	209.6640	209.6640	[a]
B		1	934.8242	934.8242	1.77
AB		1	1167.6953	1167.6953	2.21
3	30				
A		1	6.7031	6.7031	[a]
B		1	131.2070	131.2070	[a]
4	47				
A		1	353.9179	353.9179	1.04
B		2	868.2460	434.1230	1.28
AB		2	354.4062	177.2031	[a]
5	70				
A		1	332.1562	332.1562	[a]
B		2	841.7734	420.8867	[a]
AB		2	178.5000	89.2500	[a]
6	78				
A		1	90.5117	90.5117	[a]
B		2	4741.8554	2370.9277	9.20**
AB		2	100.4140	50.2070	[a]
7	35				
A		1	120.4296	120.4296	[a]
B		1	110.4804	110.4804	[a]
AB		1	1166.5859	1166.5859	1.35
8	144				
A		1	17.4375	17.4375	[a]
B		1	890.3125	890.3125	[a]
AB		1	441.0625	441.0625	[a]
2-7					
A		1	1161.2500	1161.2500	2.52
B		2	3087.1875	1543.5437	3.35
AB		2	335.9375	167.9687	[a]

[a]Value was less than 1.00.

**Significant beyond the .01 level.

Table 20. Comparisons of the means and t-test for samples 2-8

Sample	N	Means A_1	Means A_2	F	T
2	30	18.5615	2.8999	_[a]	1.91
3	30	21.9888	12.2083	_[a]	1.34
4	47	17.3636	15.1039	1.04	_[a]
5	70	11.5142	-3.6542	_[a]	3.03*
6	78	20.8187	18.6630	_[a]	_[a]
7	35	15.2650	1.3067	_[a]	1.43
8	144	13.0389	9.4517	_[a]	0.52
2-7	290	16.9805	8.8233	2.52	3.29

[a]Value was less than 1.00.

*Significant beyond the .05 level.

Cumulative summary, all tests

Table 20b lists the cumulative summary of all tests toward Hypothesis II.

Summary conclusions, hypothesis II

Hypothesis II stated, "Video and audio control of ambient stimuli is not effective in increasing learning for students". The audio control consisted of blocking ambient sounds to a subject's audio system by using commercial ear pads.

Table 20b. Cumulative summary of all tests toward hypothesis II

Sample	AOV A	AOV B	AOV AB	t
2	—[a]	1.77	2.21	1.91
3	—[a]	—[b]	—[b]	1.34
4	1.04	1.28	—[a]	—[a]
5	—[a]	—[a]	—[a]	3.03
6	—[a]	9.20	—[a]	—[a]
7	—[a]	—[a]	—[a]	1.43
8	—[a]	—[a]	—[a]	—[a]
2-7	2.52	3.35	—[a]	3.29

[a]Values less than 1.00 not shown.

[b]Not tested.

AOV

In the analysis of variance, significance of difference was tested between the experimental groups and their respective control groups in each trial. The groups were designated A_1 and A_2. Significance of difference was tested between the levels of mental ability, usually three categories. The categories were designated as the levels of B. Interaction was tested between the groups and categories to see if the mental ability levels benefited differentially from a given treatment.

No significant difference was detected between the A groups. The experimental groups did not gain above the control groups in any sample.

In only one sample, number 6, was there significant difference found between the levels of mental ability, i.e., categories. In sample 6, there was a broad span between the mean IQs of levels B_1 and B_3. B_1 mean was 120, B_3 was only 93, a span of 27 points. The mean of gains in the two categories, i.e., the difference between the pre- and post-tests of individual subjects in a category, were greatly different. For the high category, i.e., A_1B_1 and A_2B_1, the means were 27.3714 and 22.8090 as compared to means in the low category, i.e., A_1B_3 and A_2B_3, of 11.6999 and 9.1357. Therefore, the low category individuals gained significantly less than the high and medium category individuals.

However, in sample 6, there was no interaction detected. This condition indicates that individuals in the different categories did not benefit differentially from a given treatment. Therefore, the significant difference mentioned was across both levels of A for the different levels of B.

Hypothesis IV

Hypothesis IV stated the null effect of interaction between mental ability categories and the treatments. No interaction was in these samples toward Hypothesis II. Hypothesis IV was accepted for this section.

t-tests

In only one sample, sample 5, was there significant difference found between the A groups. Therefore, in six out of seven samples, the experimental groups did no better than the respective control groups.

Sample 5 contained 70 observations of students in the Des Moines North High School and the Gilbert Community School in academic classes. Sample 5

had tested not significant with the analysis of variance, using stratification into three levels of mental ability.

In the test of the combined samples (samples 2-7), the means tested significantly different between the A levels, i.e., testing all observations without regard to individual differences within the groups, the treatment groups did significantly better than the control groups. However, the t-test is less sensitive in that it does not account for variance in the characteristics of individuals within a group.

The indication is, therefore, that there was variance due to individual characteristics of IQ, within the levels of A, which was effectively accounted for by the stratification into the three levels of category. The significant difference sensed by the t-test was apparently due to this within variance rather than due to the effects of the treatment.

Relating to Hypothesis II, the null hypothesis was accepted on the basis of results of analysis of variance and t-tests, under the experimental conditions. Video and audio control of ambient stimuli, using sound blocking at the subject's ear with commercial ear pads, is not effective in increasing student learning.

Hypothesis III

Hypothesis III stated the null effect of controlling the video and audio stimuli to a student using a visual shield with sound input to the subject's earphones. During a treatment, the subjects studied the printed material of a learning unit, such as a chapter in a textbook, in the same manner as those for Hypothesis II. The experimental-group subjects wore the environment-control apparatus which restricted vision to a certain sec-

tor at the textbook and input a low-level, meaningless, 100-cycle tone to their earphones. The volume was adjusted to a level which blanketed, or masked, the usual classroom or study hall sounds. The control group studied in the usual manner. Both groups were together in the same classroom or study hall as in the trials toward Hypothesis II.

Random choice was made for the groups after pre-testing. As stated before, the criterion was the gain of individuals, i.e., the difference between their pre- and post-tests. Trials were administered in the same way as those toward Hypothesis II which used commercial ear pads for sound blocking.

Analysis of Variance, Sample 9

Sample 9

The first sample toward Hypothesis III, sample 9, contained 71 sets of observations. These observations were taken in technical classes in the Des Moines Technical High School.

Two like-trials were combined in this sample. Since virtually all, i.e., 28 of 31, subjects in one of the trials were in the medium category, the data were analyzed with two levels of category. The subject-material was electrical and electronics. Length of the trials was two hours. Again, A represented the groups and B the categories.

Model

The model used for testing was:

$$Y_{ij} = A_i + B_j + AB_{ij} + E_{ijk}$$

Limits

Limits were: I = 2, J = 2, K = 23, the largest frequency in any cell.

Frequencies

Frequencies of the four cells are listed in Table 21.

Table 21. Frequencies for sample 9

Number of gains (entries) per cell*			
A_1B_1	A_1B_2	A_2B_1	A_2B_2
15	23	16	17

*N = 71.

Means

Means for the main effects of sample 9 were:

$A_1 = 25.3473$, $A_2 = 18.2272$, $B_1 = 30.6741$,

$B_2 = 15.3449$, AB = 28.8266

Data

Data for sample 9 are listed in Table 22.

Summary AOV

The analysis for effectiveness of the shielding with sound input utilizing two-way classification is shown in Table 23.

Conclusion

The factor A was found to be significant. With at .01, the F_t at 1,69 degrees of freedom is 3.98. The F_c was 7.91, greater than the criti-

Table 22. Gains of the treatment group and the control group by trial for sample 9

Trial	Treatment Groups*			
	A_1		A_2	
	Treatment group VAS**		Control group	
B_1 #6	48.10	0.00	35.10	30.00
	46.60	30.70	13.40	24.40
	35.50	20.00	36.60	46.60
	41.00	36.60	11.00	14.40
	48.80	6.60	35.50	68.80
	52.50	47.00	42.10	32.10
	10.00	0.00	42.10	0.00
	9.00		39.40	47.00
B_2 #9	57.10	-9.20	-19.00	-1.90
	42.80	9.50	0.00	-36.20
	32.80	76.10	4.70	-9.90
	35.10	34.20	21.20	66.60
	11.50	26.80	15.70	38.00
	30.50	27.70	12.90	-1.90
	32.80	57.10	20.80	-38.00
	14.50	52.30	8.30	-1.90
	2.00	0.00	-13.80	
	20.80	-20.40	15.50	
	2.30	25.40		
	-30.90			

*N = 72.

**Visual-audio with sound.

cal value. There is significant difference between the treatment group and the control group. Hypothesis III was rejected. It is evident from the means, $A_1 = 25.3476$ and $A_2 = 17.635$, the direction of difference is toward the treatment group. According to the experimental evidence, audio-visual shielding with sound input is effective in increasing learning for these students.

Table 23. Summary analysis of variance for sample 9, electronics students. Treatment was visual-audio with sound

Source[a]	DF	SS	MS	F
A adjusted for B	1	4167.6523	4167.6523	7.91**
B adjusted for A	1	478.0195	478.0195	—[b]
AB adjusted for A, B	1	19.7343	19.7343	—[b]
Error	67	37688.3281	562.5122	

[a] N = 71.

** Significant beyond the .01 level.

[b] F-value less than 1.00.

Samples 10-16

Samples 10 through 16 were analyzed using the AOV and t-test in the same manner as sample 9.

Hypothesis III, All Samples
Analysis of Variance

It was decided to test the cumulative effectiveness of the samples used toward Hypothesis III. As in the test of all samples toward Hypothesis II, the questions of experimental interests were whether the experimental groups would learn more than their respective control groups and whether individuals in a given mental category would perform differently

from individuals in a different category but in the same treatment group. Two-way classification was again used.

Model

The model used was:

$$Y_{ijk} = A_i + B_j + AB_{ij} + E_{ijk}$$

Limits

Limits were: I = 2, B = 3, J = 72.

Means

Means were:

$A_1 = 17.0510$, $A_2 = 8.1692$, $B_1 = 17.7020$, $B_2 = 10.4580$, $B_3 = 8.0404$, $AB = 21.4499$

Summary AOV

Analysis of the cumulative samples toward Hypothesis III is shown in Table 34b.

Conclusion

Testing for difference between the levels of A, the critical value of $F_{1,261} = 3.87$ with at .05. The calculated value was 4.50, therefore, the difference was significant. Referring to the means, the value of A_1 was approximately double that of A_2. The difference was in favor of the experimental group. Hypothesis III was rejected on the basis of the cumulative analysis.

Table 34b. Summary analysis of variance of the cumulative samples toward hypothesis III

Source[a]	DF	SS	MS	F
A adjusted for B, AB	1	2193.3125	2193.3125	4.50
B adjusted for A, AB	2	957.9375	478.9687	—[b]
AB adjusted for A, B	2	774.7500	387.3750	—[b]
Error	261	127186.0625	487.3027	

[a]N = 267.

[b]Values less than 1.00 not shown.

t-test, All Samples Toward Hypothesis III

The samples toward Hypothesis III were tested for cumulative effectiveness using the t-test. The null hypothesis of no difference between the experimental groups and their respective control groups was tested.

Model

To see if the pooled variance model could be used, the subgroups were tested for homogeneity of variance using the variance ratio formula:

$$F = \frac{S_g^2}{S_1^2}$$

where the variance of the larger group was used as the numerator. Subgroup 2 had a variance of 533.0278, and subgroup 1 had 437.5590. The ratio was:

$$F = \frac{533.0278}{437.5590} = 1.2181$$

Testing for equal variance, $F_{127,138}$ is greater than 1.29, therefore, the obtained value of 1.21 was not significant. The variances were not unequal. The pooled variance model was used:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S^2 \ \frac{1}{K_1} + \frac{1}{K_2}}$$

The calculations were:

$$t = \frac{16.7905 - 8.4523}{970.5868 \ \frac{1}{134} + \frac{1}{128}} = 3.09$$

Conclusion

Testing the levels of A, $t_{139+128-2(K_1+K_2-2)}$ is less than 2.70 with at .01. Therefore, the calculated value was highly significant. The t-test detected a significant difference between the means of the experimental group gains and the means of the control group gains. Hypothesis III was rejected on the basis of this t-test.

Cumulative Analysis Toward Hypothesis III

Cumulative summary AOV

A summary of results of analysis of the data toward Hypothesis III is shown in Table 35 and Table 36. Table 35 shows the combined results of analysis of variance; Table 36 shows combined comparison of means using the t-test.

A cumulative summary of t-tests and comparison of the means of the samples toward Hypothesis III are shown in Table 36.

Samples 10 and 11 were not significant using AOV, but when the two were combined and the sample (12) "cleaned up" by removing the chemistry obser-

Table 35. Cumulative summary AOV for the samples toward hypothesis III

Source sample	DF	SS	MS	F
9 A	1	4167.6523	4167.6523	7.49**
B	1	478.0195	478.0195	a
AB	1	19.7343	19.7343	a
10 A	1	22.1250	22.1250	a
B	2	67.0898	33.5449	a
AB	2	84.9179	42.4589	a
11 A	1	94.3984	94.3984	a
B	2	474.9921	237.4960	a
AB	2	499.9257	249.9628	a
13 A	1	57.5351	57.5351	a
B	2	363.6914	181.8457	a
AB	2	446.9726	223.4863	a
14 A	1	801.0468	801.0468	1.73
B	2	2171.4296	1085.7148	2.35
AB	2	313.2421	156.6216	a
16 A	1	1048.5546	1048.5546	2.32
B	2	2701.6992	1350.4896	2.99
AB	2	1600.8945	800.4472	1.77
17 A (All)	1	2193.3125	2193.3125	4.50
B	2	957.9375	478.9687	a
AB	2	774.7500	387.3727	a

**Significant beyond the .01 level.

[a]F-values were less than 1.00.

vations, it tested significant at the .05 level. The sample contained observations of modern science students.

Sample 13 contained observations of science students also. Using AOV, there was no significant difference detected between the groups. But,

Table 36. Cumulative summary of t-tests and means of the samples toward hypothesis III

Sample	N	Means		T
		A_1	A_2	
9	71	25.3476	17.6352	1.22
9b	40	23.0782	4.8823	2.21*
10	44	10.9348	2.9143	1.52
11	47	6.0238	-3.1346	1.41
12	69	9.2437	-2.3968	2.35*
13	58	7.9643	-2.9400	2.03*
14	57	20.3228	11.6361	1.49
15	48	13.2674	10.3208	0.73
16	138	14.2057	4.6275	2.63**
17	All	16.7905	8.4523	3.09**

*Significant beyond the .05 level.

**Significant beyond the .01 level.

using the t-test to test for significant differences, the experimental group did significantly better than the control group.

Summary

Cumulative summary, hypothesis III

The cumulative summary of all tests toward Hypothesis III is shown in Table 37.

Summary conclusions

Hypothesis III stated, "Video control of ambient stimuli with an audio-blanket sound input is not effective in increasing learning for students". The sound input to the subject's audio system was a 100-cycle tone of low amplitude.

Table 37. Cumulative summary of all tests toward hypothesis III

Sample	AOV Source A	B	AB	T
9	7.40	a	a	1.22
9b	b	b	b	2.21
10	a	a	a	1.52
11	a	a	a	1.41
12	b	b	b	2.35
13	a	a	a	2.03
14	1.73	2.35	a	1.49
15	b	b	b	a
16	2.32	2.99	1.77	2.63
17 (All)	4.50	a	a	3.09

[a]Values less than 1.00 not shown.

[b]Not tested.

AOV

In the analysis of variance, significance of difference between the experimental groups and their respective control groups in each trial was tested as the levels of A. Significance of difference between the mental ability categories was tested as the levels of B. Significance of interaction between the levels of A and B was tested.

The difference between the levels of A of sample 9 was highly significant. And, in the AOV, the difference between the levels of A in the cumulative sample where all samples were tested together was significant. The experimental groups performed significantly better than the control groups for those two samples. There was no other significant difference found between the levels of A.

No significant difference was detected between the levels of B. No significant interaction between the levels of A and B, in the samples toward Hypothesis III, was detected.

t-tests

For four samples of the nine, significant differences were detected between the levels of A. They were samples 12, 13, 16, and 17. Sample 16 had combined three previous samples, and sample 17 was a cumulative analysis of all the samples toward Hypothesis III. In the other five samples, no significant difference was found between the levels of A, using the t-test.

Hypothesis IV

Concerning interaction between mental ability and the treatments, no significance was found in the data of this section. The subjects did not gain differentially between mental ability categories within a given treatment. Hypothesis IV, which stated the null effect of interaction, was accepted for this section of data pertaining to Hypothesis III.

DISCUSSION

General

If the principle of environmental control of distractive stimuli at the individual's level is effective in increasing learning, many persons might benefit from it. Regardless of mental ability level, the need to increase study efficiency for students seems to be universal. Surprisingly, only one sample reflected a significant difference between mental ability categories; the difference was found to be in favor of the higher category. One might expect the low ability individuals to gain over a wider range of scores in response to innovation. Their initial score may be only half that of the high individuals. Therefore, to double his gain, one individual may only need to improve his post-test score from 20 to 40. But, the high ability individual may need to improve a score of 80 to show a gain. In Table 14, the mean of the low ability group in the A_1B_3 cell, i.e., the treatment group, category 3, was only 11-plus compared to 23-plus and 27-plus for the medium and high ability categories in the treatment group. The gains in that sample favored the higher categories.

However, the above is not to say that benefit from the gain is categorically in favor of the higher achievers. While the percentage of gain for a low ability individual may be much less than for a high ability individual, the educational value to him of any gain whatsoever may be greater. But, throughout the study, significance of categories was found to be low.

The question arises how the principle of environmental control at the individual's level would affect mentally deficient or brain damaged individuals. Perhaps the resulting added concentration may help them achieve

more and attain a more firm initial footing in some areas of study, based on the theory that such individuals are more easily distracted from study and have shorter concentration periods. This study, however, did not investigate the effects of shielding upon mentally deficient or mentally retarded individuals. Presumably, to gather data against hypotheses concerning this group, many of the techniques would need to be altered from those used in this study. Specialist help from developmental and clinical psychology would also be needed.

An interesting conclusion based upon observation without statistical analysis resulted from the data collection effort. The control group seemed to read consistently faster than the treatment group in virtually all the trials. During the trials, it was the practice of the experimenters to monitor the reading speed of the two groups. Periodically, a page-check was made of individuals in both groups. Notes were taken during trials and then typed without editing in the form of "post-experiment remarks" immediately after the trial. The following are some typical post-experiment remarks:

> English testing began in their third period. Again, the subjects were pre-tested and allowed a couple of minutes to adjust the apparatus and get used to it. The reading began at 10:45. Observations were taken every 5 minutes to see the reading position of each individual by treatment group and control group. After 5 minutes of reading time (the reading began on page 163), in the treatment group, 7 were on page 164 and 3 on page 165. Within the control group, 2 were on page 164, 9 on page 165, 2 on page 166, and 1 on page 168. At 10 minutes of reading time, within the treatment group, 4 were on page 165, 4 on page 166, 1 on page 167, and 1 on page 168. Within the control group, 1 was on page 164, 2 on page 165, 1 on page 166, 4 on page 167, and 1 on page 168. At the next reading check, within the treatment group, 4 were on page 166, 4 on page 167, 1 on page 168, and 1 on page 170. Within the control group, 1 was on page 166, 4 on page 167, 6 on page 168, 2 on page 169, 1 on page 170, and 2 on page 172. From just a cursory examination, it looks like the control group is defi-

> nitely reading faster than the treatment group. At 10 minutes of reading time, there was some restlessness in the class. There were sighs, muffled whistles, and sniffs. There were 10 subjects in the treatment group and 24 subjects in the entire class. At 15 minutes reading time, 7 subjects in the control group appeared restless, and 1 in the treatment group appeared restless. I used a definite set of words in orienting this class of how they were to undertake the reading. "Read for comprehension". It seems to me that this class was reading a little more slowly and a little more carefully than usual. At 20 minutes, there were fewer signs of restlessness in the control group. There were 5 that appeared restless and 2 in the treatment group appeared restless. Apparently these subjects go through a restless period about anywhere from 10 to 15 minutes and recover from that and get back down to working intensely again. Here, for example, only 5 in the 20 minutes appeared restless and 7 of them appeared restless at 15 minutes. The reading was stopped at 21 minutes. Post-tests were completed at 11:10.

No explanation is attempted of the apparent faster reading of the control group over the treatment group, since no statistical analysis was made. It is to be noted, however, that the mean scores of the control group were consistently lower than those of the treatment group throughout the study. This suggests an effect of the isolation was to increase comprehension or to somehow enhance retention for the treatment groups.

Hypothesis I

An examination of the means in sample 1 suggests the balance was in favor of the treatment group, even though environmental control was not complete enough to result in significance on the tests. Results of the data supported the null hypothesis of no significant differences between the groups.

This study did not prove the effects of time, however, i.e., the effects of shorter-vs-longer trial periods. It is most difficult to obtain permission to experiment with an entire class in a given high school for say several hours or days. The trials toward Hypothesis I were only one

hour. This is probably the minimum time for an individual to become familiar with such an apparatus as was used here and begin to utilize it in studying. If there exists a learning factor, i.e., a tendency to improve with practice, one would expect the results to increase in favor of the treatment group with longer trials. Only one-hour trials were conducted in the visual mode.

On the basis of results of analysis of the data of sample 1, the null effect of visual control, as stated in Hypothesis I, is apparent. Hypothesis I was accepted.

Hypothesis II

As stated previously, the only case where IQ category was significant in the entire study was found in sample 6. The reason is not readily apparent. The proportion of individuals in the medium and low categories was not greatly different from other samples, but there were fewer individuals in the high category. Cell A_1B_1, i.e., the high category of the treatment group, had the lowest frequency in the sample with only seven observations and the highest mean. Its mean was 27-plus compared to 9-plus for A_1B_3 which was the next lowest cell frequency with only 9. One might suspect disparity between categories in the sample as contributing to a chance occurrence to cause the condition. But, the disparity is great between the highest and lowest cell frequencies also, 3 to 1, and there was no interaction noted. So there is a contradiction to the theory that disparity between numbers in the categories caused the significance.

In arguing that an advantage exists in favor of the treatment ("experimental") group over the control group whenever a complicated apparatus is

to be utilized by the treatment group, the effects of such an advantage should certainly have appeared in some of the seven samples analyzed toward Hypothesis II. The apparatus was impressive; commercial ear pads, supported over the top of the head with a padded, adjustable spring steel support was first put on the subject. Then the visual shield was placed over the assembly. The effect was once described as one of being "harnessed in". There was no significant differences found between the treatment group and the control group in any of the seven samples. There was significant difference found between the groups in the "sound" configuration, i.e., the one with sound input, in which the configuration apparatus was not as bulky.

The effects of extended practice were not determined in the part of the study applying to Hypothesis II. Lengths of the trials were one and two hours only. Again, one can only speculate as to the effects of extended study with visual shielding and audio blocking, since neither the one- nor the two-hour trials were significantly effective. As to representation, all three classifications of students were represented in the seven samples toward Hypothesis II.

One of the major characteristics of these data is the difference in the results of analysis toward Hypothesis II and III. Toward the former, there was no significant difference found between the experimental groups and their counterparts, the respective control groups, using the analysis of variance to test for significance. A significant difference was detected in one sample, sample 5, and the cumulative analysis, i.e., all samples together, using the t-test.

The t-test does not account for characteristic variations of individuals within a group, such as IQ. Being less sensitive, it can thus be

expected to sense significance which is really due to these organic variables and not the effects of the treatment.

A check on the IQ characteristics of individuals in sample 5 reveals a wide variation in the IQ groupings of these academic students. Sample 5 had 70 sets of observations from academic students in the Des Moines North High School and the Gilbert and Story City Community Schools. While the majority of individuals in the Gilbert and Story City trials were about equally placed in each of the three IQ categories, the three trials from Des Moines North contained individuals with IQs all in the lower category. The IQs ranged only from 79 to 99.

This variation in performance due to mental ability level would not be detected by the t-test but would be sensed as a significant difference. The results of analysis of the data toward Hypothesis II suggests that such individual differences are present in the data and that those differences were effectively accounted for by blocking in the three IQ categories. This condition is evidenced by the failure to sense a single significant difference between the levels of A with the AOV, but the t-test had sensed significant differences in the two instances.

In the test for homogeneity of variance of sample 5, a significant F-value resulted. There was unequal variance in the data. Therefore, the pooled variance model could not be used for the test, but the statistical model used for testing between two means with separate group variance had to be used. This condition supports the above theory that the significant difference sensed by the t-test for sample 5 was due to internal variances of individuals and not due to the effects of the treatment.

Hypothesis II stated the null effect upon learning of using visual control and audio control with sound blocking. There were no significant differences found between the experimental groups and their respective control groups in samples 2-8, using analysis of variance. Using the t-test, sample 5 was found to have a significant difference and the cumulative test of all samples, i.e., 2-7. On the basis of these results, Hypothesis II was accepted.

Hypothesis III

Hypothesis III stated the null effect upon learning of visual control and audio control using a sound input to the subject's audio system. The analysis of variance test sensed significant differences between the experimental groups and their respective control groups in two cases, sample 9 and the cumulative analysis of all samples.

Sample 9 contained observations of electrical/electronic students. There was a small span of IQ ratings in the sample; most ratings were in the medium range, i.e., 103-113. The data were also homogeneous with respect to variance. The pooled variance model for the t-test resulted in a nonsignificant sensing.

It was decided at this point to partition sample 9 to try to find the reason for the contradictory results of the tests. All computer runs had been completed at this time, and the results had been written. A recheck

of the two component parts of sample 9, trials 6 and 9, revealed they were of different lengths. Trial 6 was a one-hour trial and trial 9 was a two-hour trial. By design of the analysis, it was not intended to combine trials of different lengths for analysis.

Testing of the component parts of sample 9 was then performed using the t-test. Trial 6 tested not significant, but trial 9, the two-hour trial, tested significant. On the basis of the significant AOV and t-test for trial 9, the null hypothesis was rejected for these electrical students.

The question was then, what conditions caused the disparity in results of the F-test and the t-test of sample 9? The cause seems apparent after consideration of the means in each of the cells. First, a summary of the results seems apporpriate:

1. Trial 6 (of sample 9) tested not significant.
2. Trial 9 (of sample 9) tested significant.
3. There was not enough difference sensed between the A_1 and A_2 for significance when the trials were combined in sample 9.
4. There was not enough difference sensed between the levels of B for significance.
5. No significant interaction was sensed.
6. Sample 9 (trials 6 and 9) tested significant with the F-test.

The answer seems to be apparent when one considers the cell means in the test matrix:

Table 38. Cell means of the test matrix for sample 9

	A_1 experimental	B_1 control
B_1 Trial 6	28.82	32.40
B_2 Trial 9	23.07	4.88

Since the t-test senses difference between the levels of A, there was not enough difference between the means A_1B_1 and A_2B_1 for significance in trial 6. There was great difference between the means of cells A_1B_2 and A_2B_2, i.e., 23.07 and 4.88. Therefore, there was a significant difference between the levels of A for trial 9.

With the trials combined, however, the t-test "lumps" all means together within a given level of A, and the difference of the lumped means of A_1 and A_2 is tested. In this case, the mean of A_1 was 25.34 and A_2 was 18.22. Although there had been great disparity between the means of the two cells of A_2, i.e., 32.40-vs-4.88, when the two means were combined, the average was not significantly different from the average of the cells of A_1.

Thus the t-test of sample 9, testing the difference between A_1 and A_2, i.e., 25.34 and 18.22, did not sense significance.

However, since blocking by trial was used in the AOV, the comparison was then between A_1 and A_2 in each of the levels of B. There was enough difference between A_1B_2 and A_2B_2 to sense high significance in the F-test.

It is noted that the unique contributor to the difference between trials 6 and 9 was length of the trial. This suggests a learning factor

was present; perhaps if the learning unit which the subjects study were lengthened to two or more hours, a greater difference would result between the experimental group and the control group.

The results were significant using the t-test in four instances other than the sample 9 which was previously discussed. Of all the analyses toward Hypothesis III, five were significant (three at the .05 level and two at the .01 level), and five were not significant.

Samples 10 and 11, science students, were not significant. But, when the two samples were combined and the chemistry observations removed for a more homogeneous grouping of modern science observations, the sample (12) tested significant. For the modern science students, the audio-visual control using sound was effective. Hypothesis III was rejected.

Sample 13 tested significant with the t-test but not with the F-test. This sample also contained modern science students. A check of the cell means of the test matrix suggests a similar condition to the one found in sample 9; there was considerable difference between the means of A_1 and A_2 taken over all levels of B. The t-test sensed this difference as significance. But, when blocking into three levels of mental ability was used for the AOV, there was not enough difference between A_1 and A_2 within each category of mental ability to be significant. Thus the F-test was not significant, but the t-test was. For this group of science students, Hypothesis III was not rejected.

Sample 14 was not significant using either test. For these academic students, Hypothesis III was accepted. The audio-visual control was not effective in increasing learning. It was noted in the observation notes and the post-experimental remarks these students seemed preoccupied with

the apparatus. They adjusted the volume often, they discussed the apparatus, they looked over the mechanism, and called for experimenter help often.

It is the impression of the experimenter that these academic subjects need a longer training orientation period to become acquainted with and used to the apparatus. Then, the true effect of the audio-visual-sound principle, as it applies to these academic students, can be assessed.

Sample 15 was not significant using the t-test. Records of mental ability were not available for these voc-tech students at the area community college level. Therefore, there was no grouping by category, and only the t-test was applied to the data. For these students, Hypothesis III was accepted. The audio-visual-sound control was not effective.

The subject-material in the learning unit of sample 15 was accounting procedures. There was a majority of girls in the class. It is the opinion of the experimenter the two trials of this sample were biased in that the girls "didn't take to" the apparatus. There seemed to be excessive self-consciousness on the part of the girls when they were drawn in the experimental draws. And, they fussed over hairdos and complained that the wings of the apparatus messed up the hair. It was a policy of the experiment, during all trials of the study, not to accept escapes. Once drawn into the experimental group, no substitutes for individuals or transfers were accepted. This practice controlled biasing due to volunteering of the confident students and escapes of the shy ones, but it resulted in excessive complaining in these trials where most of the students were girls.

The solution for a better evaluation of the effectiveness of the audio-visual-sound concept, where there is a considerable number of female subjects present in the trial, calls for modification of the apparatus to bet-

ter accommodate the female coiffure and practice to encourage her to become more at ease with the apparatus.

In sample 16, the t-values did not reach significance, but the t-test was significant at the .01 level. This test involved a large N, 138. Since these was a combination of three samples and since the F-value did not quite reach significance, the high t-value could be due, at least in part, to internal variances of individuals. However, the data tested homogeneous using Hartley's test before the pooled variance model was used. So there was significance, at least to some degree, when the large N of 138 was tested. For this sample, the hypothesis was rejected. The principle of control using audio-visual-sound was effective for this group of science students.

Sample 17 was a combination of all samples, technical, vocational, and academic. The idea was to see if the experimental groups, of all samples using audio-visual-sound, would perform significantly better than their respective control groups in each of the trials of each sample.

The AOV test was significant with at .05, and the t-test was significant with at .01. For all samples toward Hypothesis III, considered together, the principle of environmental control for individuals using audio-visual with sound was effective in increasing learning. Considering all samples, Hypothesis III was rejected.

Hypothesis IV

Hypothesis IV stated the null effect of interaction between mental ability categories and the treatments. No interaction was found in the entire study. Hypothesis IV was accepted.

SUMMARY AND RECOMMENDATIONS

Purpose

The purpose of the study was to see if learning could be improved by controlling the environment at the individual student's level. The idea was to control against random, unwanted, visual and audio stimuli.

An experiment was designed to take observations of student-subject's performance in certain Iowa schools. If control of a subject's environment at the individual's level was effective in increasing learning, attention could then be directed to help various groups and individuals learn faster.

The intent was to find out the effect of such control upon students in their school environment, i.e., the classrooms and study halls. Some 900 observations were made in technical-vocational schools, in area community colleges, and in high schools of Iowa.

Design

The study was designed to utilize an experiment in the schools. Data from the experiment would be analyzed and the results applied toward the hypotheses concerning the effectivity of such environmental control. Four hypotheses were formulated:

Hypothesis I - Video control of ambient visual stimuli is not effective in increasing learning for students.

Hypothesis II - Video and audio control of ambient stimuli is not effective in increasing learning.

Hypothesis III - Video control of ambient stimuli with an audio-blanket sound input is not effective in increasing learning for students.

Hypothesis IV - There will be no interaction between the treatments and the levels of mental ability.

Method

To obtain data to apply to the hypotheses, the pre-test, post-test, random-choice design was chosen. Each trial involved an experimental group and a control group. Each trial involved an entire class of students at a given time. Lengths of the trials, i.e., the study period, was one and two hours.

The subjects were first pre-tested, then they studied the learning unit, and then they were post-tested over the subject-matter of the learning unit. The gain, i.e., the difference between an individual's pre-test and his post-test was the "score" used in analysis. The mean gains of the experimental groups and the respective control groups were analyzed for effectivity of the treatments.

Analysis

In analyzing the data, analysis of variance and the t-test were used to analyze for significant differences between groups, between the levels of mental ability, and interactions.

Apparatus

An apparatus was developed and patented to control the experimental subject's environment. Three configurations were used: the visual shield, the visual shield and audio-blocking, and the visual shield audio control using sound.

Grouping

When mental ability records were available, subjects were grouped in three categories: the high category ranged from a rating of 114 upward, the medium from 103 through 113, and the low from 102 downward. In those trials involving the area community colleges and the technical institute, such records were not available, and analysis of variance single class and the t-test were used.

Results

A summary of the cumulative analysis of all data is shown in Table 39.

Hypothesis I - was accepted. In sample 1, there were 78 observations. Length was one hour. The subject-matter was technical. The AOV sensed no significant difference between the experimental group and the control group, nor between the levels of mental ability, nor interaction. The t-test agreed with respect to the null effect of visual control. The null hypothesis was accepted.

Hypothesis II - was accepted. Some significance was sensed between the experimental group and control group, however. In samples 2-8, no significant differences were found by the AOV between the experimental groups and their control groups. The t-test sensed significant differences in sample 5 and the cumulative sample. It appeared that interval variance of individuals within groups caused the significant sensing. Hypothesis II, which stated the null effect of audio-visual control using sound blocking, was accepted for these data.

Hypothesis III - was rejected for the technical students and the science students but not for the academic students.

Table 39. Cumulative summary of the analyses of all data

Hypotheses	Sample	AOV Source[a] A	B	AB	t
I	1	b	1.10	b	1.66
II	2	b	1.77	2.21	1.91
	3	b	b	b	1.34
	4	1.04	1.28	b	b
	5	b	b	b	3.03
	6	b	9.20	b	b
	7	b	b	b	1.43
	8	b	b	b	b
	2-7	2.52	3.35	b	3.29
III	9	7.40	b	b	1.22
	9b	c	c	c	2.21
	10	b	b	b	1.52
	11	b	b	b	1.41
	12	c	c	c	2.35
	13	b	b	b	2.03
	14	1.73	2.35	b	1.49
	15	c	c	c	b
	16	2.32	2.99	1.77	2.63
	9-15	4.50	b	b	3.09

Samples 10 and 11 tested not significant singly, but when combined and the sample "cleaned up" by removing some chemistry observations, the modern science-subject observations tested significant.

Sample 13 tested significant with the t-test. Samples 14 and 15 tested not significant. Sample 16 and the cumulative sample tested significant. The t-test was highly significant, but the F-test failed to quite reach significance. The cumulative test, samples 9-15, tested significant with both tests.

Hypothesis IV - was accepted. Hypothesis IV stated the null effect of interaction between mental ability and the types of treatment. No interaction was found in the entire study. The null hypothesis was accepted.

Summary

Hypothesis I was accepted. Visual control was not effective in increasing learning.

Hypothesis II was accepted. Audio-visual control using commercial ear pads to block sound was not effective in increasing learning.

Hypothesis III was rejected for the technical students and science students but not for academic students. Audio-visual control using sound input to the subject's audio system was effective in increasing learning for those two classifications of students.

Hypothesis IV was accepted. There was no interaction found between mental ability levels and the types of treatments.

Recommendations

The findings, in regard to the principle of increasing learning by controlling environmental distractions at the subject's level, suggest several possibilities for gainful use of the principle.

Without regard to individual's IQ rating, students can benefit by use of these controls. The apparatus would not be expensive to provide for entire classes; the cost would probably be on the order of ten dollars per unit.

The results suggest that longer study-units, with students using the apparatus, would result in more significance; i.e., higher rates of learning gain for individuals.

Uses

Some general uses are suggested: college students, who have trouble concentrating in atmospheres of high distractions such as dorms, libraries, or even at home and adults, who are out of practice studying and have difficulty concentrating on written subject-matter or who try to study in atmospheres of high distractions.

For school uses, the principle proved effective for entire classes. The regular classes, where all levels of ability are present, could benefit. Split classes in the cases where some students of the class are either ahead or behind in the subject-matter and need to study during the class period. In this way, the teacher can continue with a presentation while parts of the class are attending to other written matter. In special classes, perhaps low-ability or brain damaged students could be helped to concentrate more intensely on written material.

In many study halls, the atmosphere is not conducive to study. The apparatus would control distractions for individuals.

Programmed study, with little modification to the apparatus, could be utilized. The unit could be connected to a central program station-outlet. Some students in a class could receive programmed instruction through the earphone system of the apparatus while some attend to presentation by the teacher and still others could attend to written matter.

Effectivity of the principle appears greatest and most immediately for the technical and science students. There appears to be a learning factor involved; the longer the usage of the apparatus, the more effective it is. Perhaps the academic students need longer study-units with the apparatus, i.e., to become acquainted with the unit and get used to it and practice for more effectivity.

Summary

Principle

The principle of environmental control at the subject's level should prove beneficial for students in many categories. There seems to be always a need to increase learning efficiency for individuals.

IQ

Only one sample in this study reflected a significant difference between mental ability levels; that difference was found to be in favor of the higher ability category subjects. This seems surprising in that one might expect the lower category individuals to show a greater response to any innovation which could tend to help them gain toward higher achievement. They have lower pre-scores from which to gain and need to improve the

scores over a smaller range in order to show a given percentage of gain. It should be easier for a low category student to double his score by gaining from 20 to 40 than for a higher category student to gain from 50 to 100%. But, the higher category students gained more in the one sample where IQ was significant.

However, the lower category individuals probably benefit more from a given amount of gain. The individuals in higher categories seem to manage well, with or without innovations. But, any gain the lower category individuals can make can be of great benefit to them. The educational value to these individuals may be greater, whatever the amount of gain.

It was not demonstrated how this environmental control affects brain damaged or mentally deficient students. Perhaps the opportunity for added concentration would help them to a better footing in given subject-areas of study. If these students are characteristically more easily distracted from intense concentration, then this principle should prove useful. It was noted throughout the study that the control groups consistently read faster than the experimental groups. No statistical analysis was made of this observation, but it seems to suggest that the experimental groups were concentrating more intensely than the control groups.

Hypothesis I

Hypothesis I was accepted on the basis of the analysis. The hypothesis stated the null effect of environmental control by visual shielding of the subject only. The AOV and the t-tests of the data proved not significant. There was no significant difference between the A groups, therefore, Hypothesis I was accepted.

Hypothesis II

Hypothesis II, which stated the null effect on learning of audio-visual control using sound blocking, was accepted. It was in this group of samples that the single case of significance of IQ was found. Succeeding analyses of like subjects in similar classes revealed no other cases where the IQ category was significant.

In two samples, 5 and the cumulative sample, there was significant difference found between the experimental groups and the control groups using the t-test. The t-test does not account for characteristic variations of individuals within a group, such as IQ variations which might exist. In sample 5, there was wide variations in the grouping of those academic students. Using Hartley's test for homogeneity, the data were shown to have unequal variance within. This variance appears to be the source of the significance between the experimental groups and the control groups, rather than the true effects of the treatment. This theory is supported by the lack of significance sensed by the AOV.

In the cumulative samples, where N = 290, there was also wide variation within the samples. The within variation of this sample is also probably the source of the significance sensed by the t-test.

The effects of extended practice over longer study periods were not investigated. Perhaps if the trials were extended from two to several hours duration different effectivity would result. But, under the conditions of this experiment, audio-visual control using the commercial ear pads to block sound to the subject's audio system was shown to be ineffective in increasing learning. Hypothesis II was thus accepted on the basis of these results.

Hypothesis III

Hypothesis III, which stated the null effect of audio-visual control with sound, was rejected. The control was effective in increasing learning.

In sample 9 and in the cumulative sample, the AOV sensed significance between the experimental groups and their respective control groups.

In five samples of the total of ten, the t-test sensed significance between the experimental groups and their respective control groups.

There was no significance sensed between the levels of IQ in any of the ten samples.

There arose the question, in analysis of sample 9, as to why the t-test was not significant when the ADV had been highly significant. Partitioning and reanalysis of the sample revealed that one- and two-hour trials had been mistakenly combined - initially. The partioned trial containing the one-hour observations proved not significant; the trial containing the two-hour observations proved significant with both the AOV and the t-test. This outcome suggested that there was a learning factor and that the results would vary with the length of the trials, i.e., study periods.

Not only should an increase in study time prove more effective for the technical students, but it appears that the academic students may improve their performance with such as increase.

Samples 10 and 11, containing observations of science students, were significant singly. But when combined and the sample made more homogeneous by removing a certain trial of chemistry observations, the sample tested significant with the t-test. For those modern science students, the audio-visual control using sound input was effective.

Sample 13 also tested significant with the t-test. But this significance could not be claimed as being entirely due to the effects of the treatment. After the blocking by category in the AOV, no significance was detected by the AOV. For that group of students, Hypothesis III was not rejected.

Sample 14 was not significant using either test. It is the opinion of the experimenter that academic students need longer training/orientation periods, to become acquainted with and used to the apparatus.

Sample 15 was not significant. This class contained a majority of girls. It is felt that they attended more to the apparatus and to their hairdos than to the subject-matter. Modification of the apparatus and longer training periods may result in improved performance by the girls.

Sample 16 was highly significant using the t-test. It had a larger N, i.e., 138. For this sample, Hypothesis III was rejected. The control using audio-visual with sound was effective.

Sample 17 was the cumulative sample of samples 9-15. The AOV was significant, and the t-test was highly significant. Considered over the larger number of observations, i.e., N = 267, the principle of environmental control using audio-visual with sound was effective in increasing learning. Hypothesis III was rejected for these samples.

Hypothesis IV

Hypothesis IV, which stated the null effect of interaction, was rejected. As stated previously, no interaction was found in the entire study.