

LVIII. AN EXPERIMENT IN THE OBJECTIVE MEASUREMENT OF A RESULT OF TEACHING.

George Frederick Miller,
School of Education, University of Oklahoma.

The aim in the experiment described here was to measure objectively one result of teaching. The two aspects of the report which follows are the method used and the results obtained. Since only a small number of pupils was available for the tests, and for that reason the results are not significant, the report is principally a description of the method used. The method is applicable to a wide range of conditions and subject matter.

About 35 pupils in a sixth grade in Norman were used in the experiment. They were first given an intelligence test consisting of tests 2, 3, 4, 5, 7 and 9 of the Otis Group Intelligence Scale, Advanced Examination, Form A. Five days later they were given the following vocabulary test:

TERMS AND THEIR DEFINITIONS

Preliminary Group.

- | | |
|-----------------|-------------------------------------|
| ---- 1. bug | 1. A bad person. |
| ---- 2. clock | 2. An animal used for food. |
| ---- 3. feather | 3. An instrument for telling time. |
| ---- 4. finger | 4. The blossom of a plant. |
| ---- 5. flower | 5. A season of the year. |
| ---- 6. hog | 6. A part of the plumage of a bird. |
| ---- 7. sinner | 7. An insect. |
| ---- 8. winter | 8. A part of the hand. |

Group I.

- | | |
|--------------------|---------------------------------------|
| ---- 1. bee | 1. A device for hearing faint sounds. |
| ---- 2. patricide | 2. A figure composed of many lines. |
| ---- 3. polygram | 3. An insect that makes honey. |
| ---- 4. mud | 4. One who kills his own sister. |
| ---- 5. polyglot | 5. A carpenter's tool. |
| ---- 6. microphone | 6. A mixture of soil and water. |
| ---- 7. sororicide | 7. One who kills his own father. |
| ---- 8. hatchet | 8. Expressed in many languages. |

Group II.

- | | |
|---------------------|---------------------------------------------------|
| ---- 1. infanticide | 1. An expression seemingly absurd. |
| ---- 2. micrometer | 2. One who kills himself. |
| ---- 3. novice | 3. A general hospital where diseases are treated. |

- | | |
|--------------------|-------------------------------------------------|
| ---- 4. paradox | 4. An instrument for measuring small distances. |
| ---- 5. polyclinic | 5. On who kills an infant. |
| ---- 6. microcosm | 6. A figure having many angles. |
| ---- 7. suicide | 7. A small world. |
| ---- 8. polygon | 8. A beginner. |

Group III.

- | | |
|-----------------------|---------------------------------------------|
| ---- 1. microscope | 1. A colorless gas. |
| ---- 2. ozone | 2. One who kills his own mother. |
| ---- 3. recession | 3. An instrument for seeing minute objects. |
| ---- 4. micrograph | 4. The act of keeping back or concealing. |
| ---- 5. reservation | 5. Based on many cones. |
| ---- 6. polyconic | 6. A very small animal or plant. |
| ---- 7. microorganism | 7. An instrument for minute writing. |
| ---- 8. matricide | 8. The act of withdrawal. |

Group IV.

- | | |
|---------------------|-------------------------------------------------|
| ---- 1. eye | 1. Many colored. |
| ---- 2. polycord | 2. A game played with balls and rackets. |
| ---- 3. potato | 3. One who directs the course of a ship at sea. |
| ---- 4. polycrome | 4. A musical instrument of many strings. |
| ---- 5. fratricide | 5. A common vegetable. |
| ---- 6. polygastric | 6. The organ used for seeing. |
| ---- 7. navigator | 7. One who kills his own brother. |
| ---- 8. tennis | 8. Having many stomachs. |

It is important to notice that the above test consists of five groups of words, eight words in each. Opposite each group are eight definitions, one for each of the words. In each group the words are numbered consecutively beginning with 1, and the definitions are numbered in the same way; but the definitions are not placed opposite the words to which they belong, nor do they have the same numbers.

The preliminary group at the beginning of the test, consisting of the eight simple words, was used to illustrate the method that was to be used for the other four groups. After each pupil was provided with a copy of the test and a pencil, and general direc-

tions were given, attention was called to the first word in the first column, "bug". The definitions in the second column were examined to see which belonged to bug. It was pointed out that definition 7, "An insect", was the right one for bug, and the pupils were directed to write the 7 on the dotted line before the figure 1 of the first column. The words "clock" and "feather" were used to further illustrate the process. The pupils were then given time to write the numbers of the remaining definitions of the preliminary group above the dotted lines before the words to which each belongs. The necessary explanations were then given for writing numbers for the next four groups to express the definitions. At a signal the pupils began work on the four groups, and after 10 minutes all stopped.

After the scores for the papers were obtained, the pupils who had taken both the intelligence examination and the vocabulary test were divided into two groups, balanced so far as possible for both intelligence and knowledge of the words used in the test. Table I below helps to explain how the balancing of the two groups was done. It shows the intelligence score and the vocabulary score of each pupil. The totals of the intelligence scores for the two groups were 667 and 666 respectively; and the totals for the vocabulary scores were 183 for each. Although the totals balance, only one pair of individuals who had the same intelligence score and the same vocabulary score could be obtained. "L. M.", the third pupil in the first group, and "M. W.", the second in the second group, each made an intelligence score of 46, and a vocabulary score of 17. Only from a large group of pupils could 25 or 30 of such pairs with identical scores be obtained.

Table I.

The intelligence scores and the two sets of vocabulary scores: (before and after being taught or having studied) for the 30 pupils.

First Group (Were taught)					Second Group (Studied only)				
Pupil	Intl.	First	Sec.	Gain	Pupil	Intl.	First	Sec.	Gain
	Score	Vo. Score	Vo. Score	of Sec.		Score	Vo. Score	Vo. Score	of Sec.
				over First					over First
C. P.	53	21	25	4	E. J.	74	22	31	9
M. M.	72	20	a	a	M. W.	46	17	27	10
L. M.	46	17	25	8	J. G.	50	16	23	7
L. P.	48	16	19	3	M. R.	59	15	28	13
M. O.	50	15	26	11	M. N.	43	15	16	1
L. L.	52	15	19	5	D. D.	57	13	21	8
H. M.	44	12	17	5	C. C.	44	11	15	4
S. M.	51	10	14	4	L. F.	27	12	21	9
L. S.	62	10	13	3	C. A.	35	10	15	5
F. T.	22	10	7	-3	D. E.	36	10	13	3
F. A.	27	9	16	7	R. K.	55	9	14	5
C. D.	34	8	12	4	R. H.	31	9	10	1
W. B.	22	8	18	10	M. J.	25	9	17	8
E. B.	59	7	29	22	N. S.	49	8	20	12
E. R.	25	6	13	7	R. M.	35	7	a	a
Totals	667	183	253	90		666	183	271	95

a. One pupil from each group was absent from the second vocabulary test. "M. M." from the first group, and "R. M." from the second. Had both been present, the scores could not have affected the results in any very significant way.

Twenty-four hours after the first vocabulary test was given, the two groups of pupils were placed in separate rooms. Each pupil of both groups was given the list of words used in the vocabulary test with the definition of each following on the same line with the word to which it belongs. The list follows:

- | | |
|---------------|--------------------------------------------|
| 1 polygastric | 1 Having many stomachs. |
| 2 microscope | 2 An instrument for seeing minute objects. |
| 3 infanticide | 3 One who kills an infant. |
| 4 paradox | 4 An expression seemingly absurd. |

5 navigator	5 One who directs the course of a ship at sea.
6 microphone	6 A device for hearing faint sounds.
7 mud	7 A mixture of soil and water.
8 microcosm	8 A small world.
9 sororicide	9 One who kills his own sister.
10 polycrome	10 Many colored.
11 polycord	11 A musical instrument of many strings.
12 bee	12 An insect that makes honey.
13 polyglot	13 Expressed in many languages.
14 eye	14 The organ used for seeing.
15 suicide	15 One who kills himself.
16 microorganism	16 A very small animal or plant.
17 micrograph	17 An instrument for minute writing.
18 polygon	18 A figure having many angles.
19 micrometer	19 An instrument for measuring small distances.
20 potato	20 A common vegetable.
21 polygram	21 A figure composed of many lines.
22 tennis	22 A game played with balls and rackets.
23 polyclinic	23 A general hospital where diseases are treated.
24 patricide	24 One who kills his own father.
25 novice	25 A beginner.
26 recession	26 The act of withdrawal.
27 fratricide	27 One who kills his own brother.
28 ozone	28 A colorless gas.
29 matricide	29 One who kills his own mother.
20 reservation	30 The act of keeping back or concealing.
31 polyconic	31 Based on many cones.
32 hatchet	32 A carpenter's tool.

The teacher of the pupils just previously had been given a classified list, which contained the meaning of certain prefixes and suffixes. This list was as follows:

I. Words with prefixes and suffixes.

poly, means many

gastric,	stomach
chrome,	color
cord,	string
glot,	language
gon,	angle
gram,	line
clinic,	hospital
conic,	cone

micro, means small

scope,	for seeing
phone,	for hearing
cosm,	world
graph,	writing
organism,	plant or animal
meter,	for measuring

cide, means to kill (one who kills)

infant,	infant
soror,	sister
sui,	self
patri,	father
matri,	mother
fratri,	brother

II. Simple, easy words

mud	potato
bee	tennis
eye	hatchet

III. More difficult words with no prefix nor suffix which occurs frequently in this group

paradox	ozone
navigator	reservation
novice	recession

The teacher taught the first group for six minutes. The second group received no instruction, but spent the six minutes studying the list of words and definitions. At the end of the six minute period the two groups were reassembled, and given the vocabulary test again just as it was given the day before, except that the preliminary part and accompanying explanations were unnecessary. Table I above shows that the improvement in scores of the two groups was about the same. It is not safe to infer from the results, however, that teaching is ineffective. If the period of teaching and

studying had been longer; if the subject matter had been of a different kind, or of a different amount, or arranged in a different way; if the groups of pupils had been different in numbers or ages; or if the teaching had been of a different kind; the results might be more or less favorable to the teaching.

In order to determine whether there was any difference in the permanency of the learning of the two groups, if the vocabulary test was given a third time three weeks after it was given the second time. The table below shows the results.

Table II.

Results of the vocabulary test required after an interval of three weeks compared with the scores of the second vocabulary test.

First Group (Were taught)				Second Group (Studied only)			
Pupil	Second	Third	Loss or Gain	Pupil	Second	Third	Loss or Gain
	Vocab. Score	Vocab. Score			Vocab. Score		
C. P.	25	25	0	E. J.	31	31	0
M. M.	a	21	?	M. W.	27	25	-2
L. M.	25	20	-5	J. G.	23	24	1
L. P.	19	19	0	M. R.	28	18	-10
M. O.	26	20	-6	M. N.	16	18	2
L. L.	19	24	5	D. D.	21	19	-2
H. M.	17	b	?	C. C.	15	17	2
S. M.	14	16	2	L. F.	21	17	-4
L. S.	13	10	-3	C. A.	15	19	4
F. T.	7	10	3	D. E.	13	14	1
F. A.	16	11	-5	R. K.	14	11	-3
C. D.	12	13	1	R. H.	10	10	0
W. B.	18	9	-9	M. J.	17	15	-2
E. B.	29	21	-8	N. S.	20	13	-7
E. R.	13	14	1	R. M.	a	10	?
Total loss			35	Total loss			30
Total gain			12	Total gain			10
Dif.			24	Dif.			20
			—				—
Average loss			1.8	Average loss			1.4

a, means that the pupil was absent from the second vocabulary test, and b, that he was absent from the third test.

These data show that there was not significant difference in the

permanency of the learning of the group that was taught and the group that studied only.

The same method described above can be used, when a large number of pupils is available, to show the effects of various conditions of learning. For example, 150 pupils could be divided into 5 balanced groups, 30 in each. One group could be used as a control, and receive no practice on the words except during the two test periods. Another group could use the practice period in supervised study; another could be taught by a very superior teacher who had made special preparation for that particular lesson; and the other two could be taught separately by two teachers whose ability in that particular trait was being tested. The teacher who secured the better results would not necessarily be the better teacher in every particular. The other might excell in developing in the pupils initiative, broad-minded interests; in aiding the pupils in the acquisition of knowledge of a different kind; or in exercising some other good influence upon them.

Nor is the method confined to measuring teaching ability in the function for which it was used. The teaching of spelling, facts in geography, mathematics, grammar, and the like can be tested in the same way.

CONCLUSIONS

1. Under the conditions of the experiment the pupils who studied independently learned as much or more than the pupils who were taught.
2. The pupils who studied independently remembered over a period of three weeks a little better than those who were taught, but the difference is too small to be very significant.
3. The number of pupils used in the experiment was too small to obtain very valuable results.
4. The method used seems to be reliable enough to be employed in a more extensive experiment.