THE RELATIVE EFFECTIVENESS OF THE TRADITIONAL METHOD AND THE MODERN METHOD OF TEACHING GRADE THREE ARITHMETIC ON THE ACADEMIC ACHIEVEMENT OF PUPILS[1]

by Luis Escomes[2]

A. THE PROBLEM

The purpose of this study was to compare the effectiveness of the modern method and the traditional method of teaching grade three arithmetic on the academic achievement of pupils, through an experiment. An answer to this question was sought: Which of the two methods is more effective (effectiveness being understood to mean satisfactory outcomes in terms of achievement in arithmetic), the modern method or the traditional method?

At the start of the experiment, the null hypothesis adopted was: The modern method (method 1) is as effective as the traditional method (method 2) in teaching grade three arithmetic. If the difference in achievement in the teacher-made achievement test is significant at the .05 level of significance, the null hypothesis would be rejected and the method which produced the higher mean would be concluded to be the better method; otherwise, the null hypothesis would be accepted, that is, method 1 is as effective as method 2 in teaching grade three arithmetic as far as academic achievement of pupils is concern-

[1]A condensation of the M.A. thesis of Mr. Escomes, which was presented to and approved by the Graduate Committee, School of Graduate Studies, Central Philippine University, on June 24, 1968.

[2]Mr. Escomes is presently a Public School Teacher in Dalapitan Elementary School, Matalam District, Cotabato Second Division. He is a Junior and Senior Teacher Eligible with 17 years of experience in the Bureau of Public Schools. Presently, he is doing part-time teaching at the College of Education of Notre Dame of Mlang College, Mlang, Cotabato.

ed. The null hypothesis converted into a formula says:

Method 1 = Method 2

B. IMPORTANCE OF THE STUDY

In the learning-teaching situation, method is important since it may mean economy of time and effort both on the part of the learners and the teacher. It sometimes means a difference in learning-teaching outcomes. Methods and techniques are being tried by our educators, educational leaders, and educational scientists to discover those that would highly be useful in the arena of education.

Opinions and ideas about modern mathematics and the traditional method of teaching arithmetic have many limitations since most, if not all, have no scientific proof. In this experiment, an attempt has been made to measure the effectiveness of either the modern method or the traditional method in teaching arithmetic, on the basis of academic achievement of pupils as revealed by teacher-made tests.

The results of the investigation might prove useful to grade three teachers. Furthermore, it might be a good basis for further research by other teachers who are interested in the subject. It might also be a useful guide to the mathematics teachers. It would give a good idea in the choice of method and technique in teaching arithmetic in the elementary grades.

This investigation might be an eye-opener to the teachers who are more or less traditional and usually object to any innovation in the field of education. Taken with broadmindedness and a scientific attitude, it might serve as a motivation for further scientific investigation not only in the field of mathematics or methodology but also in some other fields of education which need further research such as individual differences, curriculum making and revision, administration and supervision of rural elementary schools, and other similar educational endeavors. It might awaken classroom teachers to the fact that research in education is not a monopoly nor the exclusive

function of the so called educational experts; rather, that classroom teachers should be the most potent, the most dynamic, and the most concerned in any educational undertaking since, in the last analysis, it is the classroom teacher that carries out the serious and sacred burden of educating our people. Furthermore, the result of the experiment will serve as a good reminder to our mentors that any educational program should be viewed with concern and earnestness, not as a mere fad; that they are dealing with the most sacred creation of the Almighty, the human being, and so they must strive to give only the best in education.

C. PROCEDURES

In order to make the experiment possible, the subjects chosen were grade three pupils from Dalapitan Elementary School, Matalam District, Cotabato Second Division. There were 62 pupils involved, 30 girls and 32 boys, divided into two parallel groups, the person-to-person matching based on the following criteria: age, sex, and standard scores in the initial test, average in grade two and socio-economic status. Those pupils having almost the same or exactly the same points in the initial test, average in grade two, and socio-economic status, and with almost the same or the same age were paired. Initial test and average were each given a weight of two and socio-economic status was given a weight of one. No intelligence test was given because there were no facilities for this. To take care of imperfections in the grouping the statistical measure used was the analysis of covariance.

In the final person-to-person matching of pupils Group A seemed to have been favored in the total points in the initial test and average. Group B had an edge over Group A in the total points for socio-economic status of pupils. If individual pairing were scrutinized, it would be found that Group A seemed to be superior to Group B in both initial test scores and average in grade two. In the

over-all total points, the same situation seemed to obtain. Therefore the mean and standard deviation of each group in their initial test scores, average, and socio-economic status were taken. The differences of the means between the two groups were tested at .05 level of significance using the *t*-test. The following table shows the significance of the differences between the means of Groups A and B in the initial test, average, and socio-economic status.

TABLE I

MATCHING OF GROUP A & GROUP B

	Initial Test			Average			Socio-Eco. Stat.		
	M	SD	SE_M	M	SD	SE_M	M	SD	SE_M
Group A	28.95	14.26	2.56	79.64	4.28	.77	6.42	2.98	.54
Group B	28.30	15.14	2.72	79.13	3.91	.70	6.65	2.83	.51
Diff.		.65			.51			.23	
SE		3.74			1.04			.74	
t-ratio		.12			.49			.31	
	df = 60			*t* at .05 level = 2.00					

As seen from the foregoing table, there was no significant difference between Groups A and B in the initial test, average, and socio-economic status. The two groups were then presumed equated and parallel for the purpose of the experiment.

There was no intelligence test given to the subjects since there were no facilities for this. The pupils involved were nine- and ten-year old children who had not had any contact at all with modern mathematics prior to the experiment. In grades one and two these pupils were taught arithmetic the traditional way.

Method 1 was introduced in Group A and method 2 was used in Group B. Although the subject matter for the traditional method was taken from the Course of Study in the Elementary School Subjects [1:213-18] and the sub-

ject matter for the modern method was taken from the Curriculum Guide for Grade III Teachers [6:1] issued by the Bureau of Public Schools, the daily subject matter was made comparable insofar as possible. While Group B was working on the unit on Sets and Set Operations, Group A had a review on grade two work especially on the mastery of addition, subtraction, multiplication, and division facts which should have been mastered in grade two. The unit for set and set operations is absolutely necessary for modern mathematics since it is the very basis for the understanding in addition and subtraction.

For Unit II, the Group B pupils learned grouping of objects into twos, threes, fours, fives, sixes, etc. The corresponding lesson in Group A was learning to count by twos, by threes, by fours, and by fives. To understand place value, the place-value chart was used for both groups. After the knowledge development of place value with the use of the place-value chart and also the use of the simple abacus, Group A pupils were given more drills on how many tens are in a given number, how many fives are in a given number, and the like. The Group B pupils, on the other hand, were given manipulation exercises on grouping objects into tens, hundreds, twenties, and the like.

The work on Roman numerals was similar for both groups. Identification of even and odd numbers was one of the skills developed in the new math. There was also the knowledge of inequality, one which added more understanding in addition and subtraction.

Most of the time much self-activity was done by pupils in Group B while more teacher effort in guiding the learners was done in Group A.

In addition and subtraction, the development of skill in Group A was done first by mastering the addition and subtraction facts with sums and minuends from 12 to 18. The usual traditional method was utilized; from concrete to semi-concrete, then to the abstract concept. For Group

B addition, subtraction, multiplication, and division facts were developed through the use of sets, the number line, the commutative property of addition and multiplication, and the use of arrays and pairing for multiplication and for division. Addition facts with the sums from 12 to 18 were the ones mastered and subtraction facts with minuends from 12 to 18 were also the ones taught. Multiplication facts with products up to 45 and division facts with divisor up to 45 were mastered.

Higher addition was taught either by addition by complement or by expanded notation for modern mathematics. Ex. 49 + 26. The exercise can be solved this way: 49 + 26 = (50 + 25). The answer is 75. This is called addition by complement. This is easier addition because the pupils have already known that adding a number to zero equals the number. Another way of doing this is by expanded notation. It is done this way:

$$\begin{array}{rrrrl} 49 & = & 40 & + & 9 \text{ (renaming)} \\ + \ 26 & = & + \ 20 & + & 6 \text{ (renaming)} \\ \hline & & 60 & = & 15 \ (15 = 10 + 5) \\ & & (60 & + & 10) + 5 \text{ (regrouping)} \\ & = & 70 & + & 5 \\ & = & 75 & & \end{array}$$

Higher subtraction was taught also by expanded notation:

$$\begin{array}{rrrrl} \text{Example: } 43 & = & 30 & + & 13 \quad \text{(renaming)} \\ -28 & = & 20 & + & 8 \quad \text{(renaming)} \\ \hline & = & 10 & + & 5 \\ & = & 15 & & \end{array}$$

After these processes have been understood then the algorithm of the short conventional form is taught.

In the traditional method, addition with carrying is taught this way:

$$\begin{array}{r} 49 \\ + \ 26 \\ \hline \end{array}$$

9 + 6 = 15; write 5 in the column of ones; carry 1 to the tens place; 1 + 4 + 2 = 7; write 7 in the column of tens; the answer is 75.

The traditional method of teaching subtraction is like this:

$$\begin{array}{r} 43 \\ -28 \\ \hline \end{array}$$

We cannot subtract 8 from 3; 3 will borrow one 10 from 40; 3 + 10 = 13; 13 — 8 = 5; 3 — 2 — 1; the answer is 15. Much drill is done for the mastery of the process.

In multiplication and division, no higher problems were taught. Pupils were able to learn only the multiplication and division facts with products up to 45. This was because of the time element spent for the experiment. Anyway, the differences between the two approaches in these two fundamental processes can easily be drawn.

Problem solving was part of all the activities since pupils in both groups used their knowledge newly acquired in solving life-like problems. There were teacher-made problems as well as problems made by pupils themselves.

The textbook used was one intended for the traditional class since there were no textbooks yet for the modern approach. This same textbook was used for both classes when there was a necessity. Because of this situation, the textbook was used sparingly.

The tests used were all teacher-made tests. The initial test was composed of eighty items involving the recognition of missing numbers in a number series, writing numerals from words, addition, subtraction, multiplication, division, simple fractions, and problems having only one step. The test was worded in Pilipino since that was the language of instruction in grade two.

The test was compiled from the file of grade two tests coming from the grade two teachers of Dalapitan Elementary School. A copy of the test was shown to grade two teachers of the District of Matalam, Cotabato Second Division, to ask their judgment as to whether it was representative of the subject matter taken up in grade two. The opinion of grade two teachers was almost unanimous

in the decision that the test was suited to grade two and that the items included in the test were those taken from the grade two subject matter. As mentioned, the test result in this initial test was put under a t-test and it was found that the difference was not significant at .05 level. Group A and Group B were then considered as having come from the same population.

Since the experiment covered three grading periods, three periodical tests were given. The tests did not show any conclusive proofs that either group was better than the other since the differences in the means for each grading period was not significant at the .05 level, using the t-test. The only fact that the tests showed was that Group B was consistently getting a higher mean than Group A.

A final achievement test was given in the early part of December when the experiment was culminated. The test was made of more or less equivalent form with the initial test. The final achievement test was worded in English. It dealt with understanding place value, comparison of numbers, order of numbers, writing numbers from words, computations involving the four fundamentals, and some problems involving only one step. Only one form of the test was made, suited to both Groups A and B. It was constructed in the traditional arithmetic way. This was still all right for either group since those who were instructed in modern mathematics could easily understand tests oriented the traditional arithmetic.

The validity of the test was judged by comparing the items with the objectives of the course both in modern mathematics and traditional arithmetic. The test was shown to Miss Gregoria Gaudia, demonstration teacher in modern mathematics in grade three in Kabacan Elementary School, Kabacan District, Cotabato Second Division. It was also seen by Mr. Francisco Marcial, the Mathematics and Science Supervisor for Cotabato Second Division. The grade three teachers in Matalam District, Cotabato Second Division, were also asked about their opinion pertaining to the coverage of the test. (Incidentally, only two of the teachers were using the modern method in

arithmetic. Most were teaching using the traditional method.) A copy of the test questions was shown to Miss Enriqueta Griñen, Critic Teacher at the Laboratory School of the West Visayas State College, to Professor Emma Ortigoza, of the CPU Graduate School, professor in modern mathematics on the graduate level, and Mrs. Charlene Holmes, Peace Corps Volunteer, who was teaching modern mathematics at the West Visayas State College. These persons made some comments about the test items included in the final test. They are of the opinion that the test covered the important items of the course covered for the period of the experiment, both for the traditional group and for the modern group. The final test, though not a perfect one, can be considered valid for the purpose of the experiment.

The internal consistency of the test was computed in order to find out the reliability of the test. After the computation, the mean for Group A was found to be 29.25 and the standard deviation was 17.73. The Group B mean was 35.85 and the standard deviation was 13.84. For the whole group the mean was 32.55 and the standard deviation was 16.64. All of these data were subjected to statistical analysis using Garrett's formula [2:241].

The reliability coefficient of the test was found to be .95. To further test the dependability of this reliability coefficient, the standard error of the coefficient of correlation (SE of r) was computed and was found to be .012. At .05 level, the limits of the confidence interval are .93 and .97.

It is certain then that r is as large as .93 and not larger than .97. Taking the .01 level of confidence, the limits of confidence of interval are .92 and .98. It is certain that the r is at least as large as .92 and not larger than .98 [2:198].

To test the significance of this reliability coefficient, Table 25 of Garrett was used. [2:201] With df = 60, at .01 level of significance, the r should be .33. The reliability

coefficient of .95 is therefore significant at the .01 level since it is very much larger than .33.

The internal consistency of .95 therefore, shows relatively high consistency and for the purpose of the experiment the final achievement test was presumed reliable.

D. INTERPRETATION

After subjecting the data for the initial test and the achievement test to statistical computations using the formula of Garrett, [2:296] the mean of the initial test for Group A was 29.26 and for Group B it was 28.32. (There was a slight difference in this result with the previous computation because of the squaring method used in the latter.) The mean for the final test for Group A was 28.84 and for Group B it was 35.48. (There was also a slight difference with the previous computation due to the same reason as for the initial test.) The mean for Group A on the initial test and the final test combined was 28.79, while that for Group B it was 32.16. Further computations of the analysis of variance of the initial and the final test scores, taken separately, shows that the derived F for the initial test was .06 while the derived F for the final test was 2.67. By Table F [2:453] with df $= \frac{1}{60}$, at the .05 level of significance, the F should be 4.00. Either of the F's obtained was too small to be significant at the .05 level. This was another proof that there was no significance in the difference between Group A and Group B at the start of the experiment and so the parallel grouping was truly successful.

In the further computation for the analysis of covariance, the obtained F for the combined means of the initial test and the final test scores for both groups was 5.39. From Table F, with df $= \frac{1}{59}$, the F at .05 level must be 4.00. The obtained F of 5.39 is significant at .05 level. But there was a need of the adjusted means of the final test in order to test the significance of the difference between the adjusted means of the final test. So an additional step was needed, the computation of the coefficient

of correlation (r) and the regression coefficient (b). The obtained b^{within} was .68. Since b^{within} is the most nearly unbiased estimate of the regression of the initial test scores on the final test scores, it is the one used in the computation for the adjusted means on the final test scores. [2:302] The obtained adjusted means of the final test scores ($M_{y.x}$), was 28.52 for Group A and 35.80 for Group B. There was a difference of 7.28 in the mean scores in favor of Group B.

With df $= \frac{1}{59}$, t at .05 level of significance is 2.00. [2:449] This was multiplied by the SE_D in order to find the t. In this connection, the obtained SE_D was 3.09. The t to be significant should be at least least 6.18 (2.00×3.09). The difference of 7.28 as obtained from the computation of the adjusted means on the final test, is very much greater than 6.18. There is therefore a significant difference between the achievement of Group A and Group B in favor of the latter.

E. CONCLUSIONS

In this experiment an attempt has been made to find out which of the two methods, the traditional method or the modern method, is better in teaching grade three arithmetic. The subjects at the start of the experiment were made parallel, and the tests for the criteria for pairing revealed that the equating of the two groups was successful. The final achievement test was reliable insofar as the statistical test for reliability was concerned, and it was valid as expressed by opinions of persons considered expert in mathematics. The result of the experiment as revealed by the difference between the means of the two groups was significant at the .05 level. The null hypothesis was therefore rejected and the modern method is considered a better method in teaching grade three arithmetic as far as academic achievement is concerned.

F. RECOMMENDATIONS

Since the modern method is a better method in teaching arithmetic, it is recommended that:

a. The modern mathematics approach should be the method used in teaching arithmetic throughout the the elementary grades;
b. Teachers in the field now should be trained in the modern mathematics approach;
c. Teaching materials, textbooks, workbooks in modern mathematics should be made available in the hands of the teachers in the field;
d. Teacher-training institutions should include modern mathematics as one of the required courses in their education curriculum.

It would be useful to education if research can be done on the following:

a. An experiment of similar nature to this experiment, in other grades in the elementary school.
b. A longitudinal study of the effectiveness of either the modern or the traditional method throughout the elementary grades. (Pupils will be followed and taught by the same teacher throughout the elementary grades using either method and comparing results.)
c. An investigation of the attitude of pupils towards modern mathematics and traditional arithmetic (This could be possible in big elementary schools where pupils can be given the option of attending either the modern mathematics class or the traditional class.)
d. An investigation of the attitude of classroom teachers towards modern mathematics and the traditional method of teaching arithmetic.

BIBLIOGRAPHY

A. BOOKS

1. Bernardino, Vitaliano, and Casim, Canuto P. *Course of Study in Elementary School Subjects.* Manila: Abiva Publishing House, Inc., 1962.
2. Garrett, Henry E. *Statistics in Psychology and Education.* London: Longmans Green and Company, Ltd., 1964.
3. Good, Carter V. (ed.). *Encyclopedia of Educational Research.* New York: McGraw-Hill Book Co., Inc., 1959.
4. Lavin, David E. *The Prediction of Academic Performance. A Theoretical Analysis and Review of Research.* New York: Russell Sage Foundation, 1965.
5. Lindquist, E. F. *Educational Management.* Washington: American Council of Education, 1951.

B. PUBLICATIONS OF THE GOVERNMENT, LEARNED SOCIETIES, AND OTHER ORGANIZATIONS

6. Bureau of Public Schools and United States Peace Corps Volunteers in the Philippines. *Elementary Mathematics: A Curriculum Guide for Teachers.* Baguio City: Bureau of Public Schools and United States Peace Corps Volunteers in the Philippines, 1966.
7. Bureau of Education. *Outline of the Course of Study in Arithmetic for the Primary Grades.* Manila: Bureau of Printing, 1946.
8. National Council of Teachers of Mathematics. *Introduction in Arithmetic.* (Twenty-fifth Yearbook). Wash. D. C.: National Council of Teachers of Mathematics, 1960.
9. School Mathematics Study Group. *Mathematics for the Elementary School.* New Haven: Yale University Press, 1962.

C. PERIODICALS

10. Benitez, Paz M. "Salesman for Modern Math," *The Philippine Journal of Education,* 46: 735-737, April, 1968.
11. Constantia, Mary, Sister. Augustus de Morgan and Modern Mathematics," *The Mathematics Teacher,* 56: 31-37, January, 1963.
12. Heimer, Ralph T. "Some implications of Programmed Instruction for the Teaching of Mathematics," *The Mathematics Teachers,* 54: 334, May, 1961.
13. Neureiter, Paul R. "The Proof of the Pudding," *The Instructor,* 74: 12, October, 1964.
14. Nichols, Eugene D. "Student Attitudes and Achievement — A Comparison Between Effects of Programmed Instruction and Conventional Classroom Approach in Teaching Algebra I," *The Mathematics Teacher,* 61: 296-301, March, 1968.
15. Scandura, Joseph M., and Anderson Judith. "Research in

Mathematics and Science Education," *School Science and Mathematics*, 68: 185-191, March, 1964.
16. Sharp, Evelyn. "Progress Report on the Mathematics Revolution," *Saturday Review*, March 20, 1965, pp. 62-63; 74-75.
17. Sneider, Mary Joetta, Sister. "Achievement and Programmed Learning," *The Mathematics Teacher*, 61: 162-164, Febuary, 1968.
18. Solomon, Augusto, Brother, FSC. "Why Modern Mathematics," *The Catholic Teacher*, 12: 13-19, July, 1966.
19. William, Emmet D., and Shuff Robert V. "Comparative Study of SMSG and Traditional Mathematics Test Material," *The Mathematics Teacher*, 56: 495-504, November, 1963.

* * * *

...Looking back to 1936, few will challenge my use of the word "this troubled century."... My call for a community of scholars, however, may seem far too optimistic. For the world is deeply divided on ideological lines, and in just those new fields of advancing knowledge about man, the communications between the two areas of thought are few and far between.... It is the members of a tolerant international community of thinkers who must take up into themselves "all the hopes of the future." Man thinking about man as a part of nature for the benefit of *all* mankind, such is the scholar this and the next century demand!

—*Conant*, "MAN THINKING ABOUT MAN," from *American Journal*, Vol. V, No. 1, June 1965