PRELIMINARY REPORT OF RESEARCH IN METHODS OF CHEMISTRY TEACHING

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The question whether laboratory work should precede the recitation in chemistry has long been a "bone of contention" among chemistry teachers whenever and wherever they have assembled. The first time we hear of its being discussed and subsequent study made was in 1876, but we have not time here to discuss the findings made at that time. The most recent work that has been done along this line is that which was reported by Prof. Frank M. Greenlaw of Rogers High School, Newport, R. I., to the Division of Chemical Education of the American Chemical Society at its Swampscott meeting last year. Should anyone here present wish to read Prof. Greenlaw's report, it may be found in the October, 1928, issue of the Journal of Chemical Education.

This work reported by Prof. Greenlaw is admirable in character and thoroughness and shows the results of conscientious and painstaking study. The results reported, however, are based on the results of questionnaires sent to a large number of teachers, rather than on actual field work, and Prof. Greenlaw himself feels that in the final analysis the questionnaire is "still a matter of the opinion of the teacher," and that the solution of the problem lies in the laboratory procedure itself, as evidenced by the following excerpt from the report:

"Which relative order of laboratory work and recitation gives best results? The writer realizes that this is still a matter of opinion, owing to the lack of experimental studies leading to definite conclusions." In commenting upon the results obtained, he goes on to say, "In the direct question at issue thirty-eight teachers reply that laboratory work should come first, nineteen favor placing laboratory work after the recitation, and one suggests that the order should vary according to the topic. In the proportion of two to one the group of teachers circularized believe that best results are secured by having the laboratory study *precede* the classroom recitation."

He concludes with the following suggestions:

"A series of lessons might be planned covering a limited but typical list of topics, descriptive, quantitative, theoretical. Alternative development plans, framed by competent teachers would be provided for each topic according to the laboratory or recitation method. Cooperating teachers would be asked to use one plan with one or more divisions. Achievement would be measured by uniform objective tests given when each topic was completed, and retention measured by similar tests given after an interval of several weeks. If the co-operation of a sufficient number of schools could be secured the results would lead to a definite conclusion."

Prompted by the suggestions in Prof. Greenlaw's final paragraph, the Illinois Association of Chemistry Teachers appointed a Research Committee to study the problem. The Committee does not expect fully to *solve* this problem, but hopes to throw out some light as to the nature of the solution. It is the "definite conclusion" at which this committee is striving to arrive, and with this in mind has endeavored to put into actual field work, with the regular teachers, and under as nearly ordinary school conditions as it is possible to secure, the ideas suggested.

Time does not permit the explaining in detail of plans and methods used by the Committee. Outlines, laboratory direction sheets, etc., were devised and sent to 22 co-operating schools which included a total of 35 classes of more than 850 pupils. Upon completion of the work as outlined, uniform objective tests were given. Since observation, reasoning, and memory were the faculties to be tested, the tests contained questions to test these things. The tests were graded, tabulated according to the total scores, and coefficients of correlations.

Instead of taking the Terman Group Intelligence Tests or some similar tests as a means of correlation, we have taken the scholastic averages (S. A.) of the students during their high school experience in all subjects.

The findings of the Committee up to the present time are best studied by means of two tabulations which we shall present at this time. However, this report is not to be considered as final in any sense of the word. It is just the beginning, and a preliminary report is being made now, chiefly because of the fact that a number of the teachers who have known of this work are extremely anxious to hear of its progress.

Nine of the twenty-two schools have been graded and recorded. For the rest the scholastic averages and teachers' estimates have not been returned to the Committee, so that correlations have not been possible. Most of the recall tests given six weeks after the first tests have not been received back by the Committee; hence they have not been incorporated into this report. The same is true of the teachers' estimate sheets except for the scholastic averages.

RECITATION-FIRST METHOD.

School	No. of Pupils.		Observation.	Reason.	Memory.	Test.	Scholastic Average.	Corr. Rec.
1	14	Total	307	315	467	1,122	1,152	
		Average	21.8	22.5	33.30	80.14	82.28	.820
2	18	Total	165.5	257	448.5	1,040.5	1,581	
		Average	9.1	14	24.9	57.7	87	—.403
3	48	Total	959	817	1,355.5	3,592	4,133	
		Average	19.07	21.56	27.0	74.8	85.3	.412
4	23	Total	446.5	447	671	1,762.5	1,943	
		Average	19.4	19.4	29.2	76.6	84.5	.897
5	44	Total	708.5	527.5	1,319.5	3,391.5	3,587	
		Average	16.1	11.9	30.0	88.9	81.3	.482
6	27	Total	583.5	593	367	2,276	2,390	
		Average	21.6	22.0	32.1	84.3	88.6	.667
7	13	Total	236.5	213.5	294.5	851	1,063	
		Average	18.2	16.4	22.7	65.5	81.8	.703
8	19	Total	360	312	583	1,355.5	1,561	
		Average	18.9	16.4	30.6	71.34	82.1	.823
9	17	Total	315.5	285.5	466.5	1,203	1,348	
		Average	18.5	16.7	27.4	70.7	79.2	.732
Totals	223		4,082	3,767.5	6,472.5	16,594	18,758	
Averages			18.3	16.9	29.0	74.4	84.1	.570

LABORATORY-FIRST METHOD.

School	No. of Pupils.		Observation.	Reason.	Memory.	Test.	Scholastic Average.	Corr. Rec.
1	13	Total	244	293.5	454.5	1,121	1,175	
		Average	18.8	22.6	34.2	86.2	90.0	.841
2	12	Total	166	144.5	268.5	645	1,038	
		Average	13.8	12.0	22.4	53.6	86.5	—.019
3	54	Total	1,030	1,164.5	1,459.5	4,222	4,609	
		Average	19.1	21.6	27.0	86.4	85.3	.552
4	22	Total	457	363.5	698.5	1,722	1,862	
		Average	20.8	16.5	31.8	78.4	84.6	.501
5	47	Total	719	778	1,406.5	3,096.5	3,910	
		Average	15.3	16.3	29.9	65.8	83.1	.814
6	26	Total	514	436	748	1,931.5	2,170	
		Average	19.76	16.76	28.7	74.3	83.4	.559
7	16	Total	308	323	464	1,230	1,344	
		Average	19.2	20.1	29.0	76.8	84.0	.737
8	24	Total	443.5	234	468	1,274	1,986	
		Average	18.47	9.75	19.5	53.08	82.75	.311
9	17	Total	301.5	367.5	504.	1,327.5	1,317	
		Average	17.7	21.6	29.0	78.0	77.4	.709
Totals	231		4,183	4,104.5	6,471.5	16,569.5	1,940	
Averages			18.1	17.7	27.6	71.7	84.0	.556

Both of these, however, will be used in the next phase of the work, since we believe that the teachers' opinions are of exceeding importance in this study. It is interesting to note that in some cases the teacher's opinion was verified by the results in his own school but not in others. It is also noticeable, and not at all to be wondered at, that if a teacher preferred the laboratory-first method and had been accustomed to using it, then those students in the group have made better averages in the tests than did those in the same school who had recitation first. If the teacher was an advocate of the recitation-first method, the students in that group did better than those of the same school in the other group.

The accompanying tabulations for nine schools show the total scores, and respective percentage scores, made in different types of learning, together with the correlation of the average test score with the average scholastic average, for each school. The total average percentage scores made by pupils under the recitation-first method are shown to be higher than those made by pupils under the laboratory-first method.

While this is a preliminary report, yet we wish to call attention to the following facts that have been brought out in the study so far:

1. Of the nine schools observed, four of the teachers preferred the laboratory-first method, four favored the recitation-first plan, and one would have the nature of the material determine the method to be used.

2. While the scolastic averages in the two groups vary in individual schools yet the total S. A. averages show neither group to be markedly better than the other in ability. If anything, the recitation-first group was a little the better (averages of 84.1 as compared with 84.0.

3. Observation and memory have higher score in the recitation-first method; reasoning has a higher score in the laboratory-first method; but the general average for the tests is 2.7 per cent better in the recitation-first method.

4. The average coefficient of correlation for the recitation-first method is 0.570, and for the laboratory-first method it is 0.556.

5. No attempt has been made to rate schools nor to study the efficiency of the teacher.