

A Survey of the Learning of Elementary Chemistry by Beginners Contrasted with the Retention and Learning by Students with Some Previous Training

F. J. ALLEN, Purdue University

Perhaps, in the teaching profession, there is no plaint so often heard, simply or with variations on the theme, as that one which has to do with the problem of students studying a subject for which their previous training has been inadequate.

The students themselves seem to have become obsessed with the idea and especially of late with increasing frequency this writer has heard such statements as "I did not study chemistry in high school and most of the students in my class did." The implication is that it is unreasonable to expect students without previous training in chemistry to compete, during their freshman year at college, with those who had a chemistry course in high school.

Certainly, there are problems to contend with in teaching a class made up of a random mixture of students. First, there is a wide range as to native ability and general fitness for work at the college level, and superimposed upon this, the degree of preparation for chemistry specifically. Occasionally these tend to compensate, ability and ambition making up for lack of specific preparation in chemistry. There is also the reverse case where specific training has badly failed to make up for inherent weakness. The saddest cases are those of serious inability and seriously inadequate previous training. The happiest ones, it might appear, are those where there has been a coupling of excellent ability and excellent previous training. Those who have dealt with a similar situation will perhaps agree with this author in saying that the real triumph; that which brings a major thrill to student and teacher alike is represented by a high measure of success on the part of an able student who, "started from scratch". The most modest teacher, scorning to give voice to such boasting, can yet feel in his inmost heart "I taught him what he knows."

About a year ago an opportunity was provided to obtain an idea as to the value of previous training in chemistry to students taking elementary college chemistry. An examination was available which stressed topics usually presented in the first semester in chemistry courses in the high schools of Indiana.

This examination was taken by about seven hundred and fifty college students of whom approximately half had had no high school training in chemistry. These people, therefore, achieved success on the examination primarily in terms of the chemistry they had learned during about eleven weeks of first semester college chemistry.

The group with high school training in chemistry had it to rely on as well as whatever the eleven weeks of college chemistry might have added.

The nature of the examination is indicated by the outline which follows:

- Part I Distinction between Elements, Compounds and Mixtures.
- Part II Distinction between Physical Property and Chemical Property.
- Part III Distinction between Physical Change and Chemical Change.
- Part IV Balancing of Equations.
- Part V Molecular weights from formulas.
- Part VI Formulas from names.
- Part VII Matching Exercise on General Information.
- Part VIII Completion Exercise on General Information.
- Part IX Matching Exercise on Laws, etc., especially Boyles' Law, Charles' Law and Kinetic-Molecular Theory.

The data are summarized in Table I.

TABLE I

	Women			Men		
	H.S	No H.S.	Diff.	H.S.	No H.S.	Diff.
	Chem.	Chem.		Chem.	Chem.	
1	2	3	4	5	6	7
I	748	633	115	760	675	85
II	778	763	115	766	718	48
III	624	504	120	679	597	82
IV	668	475	193	627	467	160
V	885	812	73	881	831	50
VI	737	564	173	754	524	230
VII	671	546	125	676	525	151
VIII	574	364	210	620	425	195
IX	554	411	143	647	513	134
Sum of the differences			1267	1135		

Explanation for Table I

Column 1 lists the several parts of the examination.

Column 2 gives the score made by those women students with high school chemistry.

Column 3 gives the scores made by the women students with no high school chemistry.

Column 4 shows the differences.

Columns 5, 6, and 7 show analogous data for the men.

A perfect score on any item in Columns 2, 3, 5 and 6 would be 1000.

The scores in Table I are averages based on the results from a total of 720 examinations, 377 from men and 343 from women. Of the men, 175 had high school chemistry, 202 did not. Of the women 217 had high school chemistry, 126 did not.

One is free to speculate as he may choose on the results tabulated. Analysis of the comparative achievement of men and women on each of the several parts of the examination offers food for thought.

Another comparison is of interest.

Achievement on the examination under consideration by 631 high school students from several Indiana high schools after one semester of high school chemistry gave a raw score average of 65.0.

The corresponding raw score average for 328 college freshmen with no high school chemistry but with about eleven weeks of college chemistry was 61.2.

For the 392 with the eleven weeks of college chemistry in addition to one year of high school chemistry the corresponding score was 76.0.

It should be noted that there was a time limit of 40 minutes on the examination. This writer is quite convinced that this time factor exaggerated the difference between the groups with high school chemistry and those without. A study of this time factor is in progress.

In conclusion it should be noted that David Allen and Frances Allen performed much of the tedious arithmetic which this study necessitated.