LOCAL EFFECTS OF THE NEW ACS CURRICULUM

SHELBA JEAN CHOATE MUSULIN AND BORIS MUSULIN
Department of Chemistry, Southern Illinois University, Carbondale, Illinois 62901

ABSTRACT.—The questionnaire method was used to study high school background of and the effects of course prerequisites and content upon students in two successive fall terms of the freshman chemistry class. The data were analysed with means and correlation coefficients, and statistical interpretations thereof. Well-known effects upon student performance were more relevant than the criticisms of a vocal minority.

In Fall, 1965, the Department of Chemistry of Southern Illinois University, Carbondale, changed their undergraduate curriculum (Southern Illinois University (1965)), in accordance with changes suggested in standards for accreditation of bachelor degree programs by the Committee on Professional Training of the ACS (American Chemical Society (1965)). The changes were the culmination of efforts by members of the ACS, along with highly qualified secondary school chemistry teachers, to develop two modern secondary school curricular plans (CHEMS, 1960; CBA, 1964). The ACS (1960) strongly stressed that a perspective science major should be prepared in one of these new curricular studies; thus, by 1965 the supposition that entering college science majors were better prepared seemed valid.

The new SIU freshman curriculum assumed that only a student without secondary school preparation was deficient and could enter for credit the first course of the major sequence. Student complaints, the majority of which centered upon this selection process, were of continuing concern. Therefore, the purpose of this research was to ascertain the suitability of the selection method and, in addition, to ascertain certain student attitudes which were developed by the inauguration of the new program.

THE QUESTIONNAIRE

A questionnaire was sent to every student whose name appeared on the final class listing of the Fall, 1965 and Fall, 1966 second course classes. No mailing was made to Winter classes whose student population differed markedly, *viz*, no high school background, general science converts, and Fall failures. The first year mailing was made in the subsequent Winter quarter to a campus address. The returns which came over a prolonged time period included many rejections for insufficient address therefore necessitating many repeat mailings. Returns from the second year mailing, made to a home address during the holiday period, came quickly with only two mail rejections, but with a smaller percentage return (70% *vs.* 63%). Total mailings were 402 and 398, respectively, with no follow-up mailing because of the high initial responses.

The questionnaire was divided into three parts: factual information concerning the student and his background; subjective opinions related to background, instructors, and instructional materials; and subjective opinions related to performance level. The final part was to be answered only by those students who received a grade below C. The second year mailing differed in two respects: an added question categorizing, if possible, the student's high school course as CBA, CHEMS, or other, and the addi-

tion of Biology as a choice of collegiate major. Other factors such as secondary school physics and mathematics which have been shown to influence collegiate chemistry grade performance (Hadley, *et al.* (1953)) were not investigated.

In the treatment of data, each response in each item was given a numerical value and all responses for one student placed on a single punched card. A missing data correlation program (Wright (1962)) was run on an IBM 1620 digital computer with 40K storage and a PR 025 monitor. This program yields the mean of each variable, the standard deviation of each variable, and the bivariate (Pearson) correlation coefficient (Baten (1938)) for each variable pair.

Sample Profile

The profile of the average student, constructed from an analysis of variable means, for each class is presented in Table 1. Response spread may be found from one standard deviation of each item. The difference between the means in Table 1 are all significant at more than the 1% level (Baten (1938)). A few items are compared to replies obtained in a one-year survey taken by the Department of Chemistry (1965). Briefly the means indicate that the two student samples are very similar but with the more recent class containing a somewhat higher quality (academically) student from a more populated county (geographically, more central) of the state. This improvement in academic quality is to be expected from the national trend of rising admission standards.

Comparison to a sample profile of the entire freshman class (Chamberlein (1965, 1966)) indicates that the average chemistry student is more likely to be a male, to major in a science-related field, to be above average in academic quality, and to come from a small secondary school in the immediate geographic region of the university. The mean high school chemistry background reflects the time-lag in curriculum change in these smaller, regional secondary schools and would indicate a high probability that the

Table 1. A Profile of the Average Introductory Chemistry Student

Item	1965-6	1966-7
Sex (% Males)	89 61*	85 58*
Age (Years)	19.3	19.3
College Credit Earned (Quarter Hours)	34.2	41.0
Percent with Academic Scholarship	28	32
Percent Working	40	44
Ill. High School Metropolitan Area (In Kilopeople)	40.5 72.1*	54.2 72.9*
Size of High School	196	212
High School Rank (Percentile)	68.2 60.0*	73.5 65.2*
Years of High School Chemistry	1.15 1.18**	1.02
High School Chemistry Average (A = 5.00)	3.80	3.86
Attendance in other non-High Chemistry (Percent)	30	30
Grade Average in Introductory College Chemistry (A = 5.00)	2.57	2.87

*Entire Freshman Class
**Independent Survey of Introductory Chemistry Class

average freshman chemistry student might be deficient in modern high school chemistry. The slightly higher 1965 mean is explained by an abnormal influx of Oriental students as a result of a revised immigration statute. The mean credit hours earned indicate a sizeable number of non-first term freshman and those with previous collegiate chemistry creating a heterogeneity contrary to a goal sought by the curriculum changes.

Correlation Ranking

Table 2 presents the correlation coefficients between the student's grade performance and each factor affecting grade performance. The table is divided into objective and subjective sections and, within each section, the factors are ordered according to decreasing importance. Individual items are grouped according to approximate level of significance, *e.g.* 0.16 is significant at the 1% level and 0.12 at the 5% level (Baten (1938)) for these sample sizes.

The results show that the most important factor affecting the student's collegiate grade was his grade performance in high school chemistry. Less than 10% of the students responding claimed to have had either CBA or CHEMS which may be the reason for the relatively minor role of high school size and location. Overall the type of background is not as important as the amount of background, and the background factors are not as important as the academic quality of the student. Table 2 also indicates that the better student felt better prepared but neither hours of study nor text opinion had any significant effect on the student's grade performance. The students tended to report a low number of hours of study (3 - 7) relative to the rule of thumb (two hours study per credit hour, *i.e.*, 10) quoted to the students. Uniformly, all students reported an unfavorable impression of the textbook.

Table 3 (in the same format as Table 2) which correlates the student's opinion of his background to various factors again illustrates the most important factor is final grade performance. Maturity factors are significant at the 1% level indicating an increasing ability to judge

Table 2. Correlation Coefficient Ranking of Factors Affecting the Student's Grade Performance

Item	1965-6	1966-7
Objective Items		
High School Chemistry Average	.402	.410
High School Class Rank	.333	.384
Collegiate Major	.235	.166
Years of High School Chemistry	.234	.222
Illinois High School Location	.133	.251
Age	.158	.090
Size of High School	.149	.082
Year in College	.113	.099
Prior Years of College Chemistry	.095	.026
Sex	.044	.065
Type of Instructor	.089	.007
Type of High School Course	....	.005
Subjective Items		
Background	.354	.379
Opinion of Instructor	.262	.223
Opinion of Graduate Assistant	.228	.101
Hours of Study Per Week	.126	.091
Opinion of Text	.065	.110

background. The better prepared student studies a lesser number of hours which creates an inherent bias in that coefficient.

The Below Average Group

In both years, the poorly performing student felt slightly superior, in intellectual ability, to his peers. This tendency manifested itself to a greater degree in the more recent class whose overall academic quality was superior. Contrary to the directions, many selected multiple reasons in appraising thei poor performance with not enough study as the principal cause. Lack of interest and/or poor backgroun were choices within one standar deviation of the mean. Consequent ly, in a random sample (110 and 80 respectively) of poor students, poo background does not emerge a their primary reason for poor per formance. Poor collegiate instruc tion was not significant.

The 1965 class best correlate poor background to the nature o

Table 3. Correlation Coefficient Ranking of Factors Affecting the Student's Opinion of Background

Item	1965-6	1966-
Objective Items		
Grade in College Chemistry	.354	.379
Age	.212	.157
Year in College	.174	.176
Prior Years of College Chemistry	.171	.137
Illinois High School Location	.193	.068
Years of High School Chemistry	.108	.116
High School Chemistry Average	.162	.063
Size of High School	.086	.066
Sex	.073	.059
Collegiate Major	.047	.053
High School Class Rank	.027	.053
Type of High School Course	....	.005
Subjective Items		
Hours of Study Per Week	.189	.262
Opinion of Graduate Assistant	.143	.006
Opinion of Instructor	.009	.152
Opinion of Text	.049	.060

the material given by a particular lecture instructor (for the purpose of judging correlation coefficients, a subjective judgment was made on the amount of theoretical material used by each lecturer in the freshman course). That is, the poorer students in the sections which emphasized theoretical material felt their lack of background to a greater degree than the poorer students in other sections. The significance was approximately at the 1% level. For the 1966 class, the correlation coefficient (.116) was nonsignificant for the sample size thus precluding the same conclusion.

Summary

This study shows that the stu dent's academic quality is far mor important than any other singl factor. The degree of importance i great enough to override limitation imposed by a possible non-norma distribution in the student sampl with respect to secondary schoo background. Collegiate chemistr departments need not be greatl concerned over the type of back ground because the amount of sec ondary school chemistry is mor important than the type of suc chemistry.

Student sampling indicated that the most vociferous comments originated from a minority grouping.

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