

THE UNDERGRADUATE CHEMISTRY SEMINAR: A SURVEY¹

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WHILE several articles on undergraduate chemistry seminars have appeared in THIS JOURNAL,^{2,3,4,5} they have described more or less special adaptations to fit particular needs. Since no single case-study gives an adequate appreciation of the more general application of the seminar to the undergraduate training of the chemist, it was suggested that a survey be made of existing practices in colleges and universities, taking as a suitable sample the departments accredited by the American Chemical Society.

Accordingly, a two-page mimeographed questionnaire was sent out late in October, 1956, to each of the 233 departments of chemistry listed as approved by the A.C.S. Committee on Professional Training. Of these, 188 (81%) replied. Several department heads sent along elaborating letters, and others volunteered information by write-ins on the questionnaire. The evidence suggests considerable interest in the subject, but there was no unanimous mandate for the seminar as essential to the undergraduate preparation for the chemical profession.

Forty-five per cent of the chemistry departments returning the completed questionnaire (85 schools) offer an undergraduate seminar. There was no evidence for geographical or regional influence on the frequency of undergraduate seminars, and so the analysis of the returns is based principally on distribution according to total enrollment of the colleges and universities.

These are arbitrarily grouped into four classes: class #1, schools with enrollments up to two thousand (67 schools); class #2, enrollments between two and five thousand (48 schools); class #3, between five and ten thousand (46); and #4, more than ten thousand (27). The proportion having seminars in each of these four classes is: #1, 61%; #2, 48%; #3, 28%; and #4, 30%.

Relatively more of the smaller colleges use the sem-

inar than the larger schools. A more complete breakdown of the undergraduate seminar frequency in schools of various sizes is given in Figure 1. It can be seen that no group of schools has a monopoly on the undergraduate seminar, despite the evident trend.

The frequency of undergraduate seminars was examined relative to the existence of a graduate program leading to a doctorate in chemistry, a master's program only, or no graduate program. These results are given in Figure 2. The proportion of schools having seminars to those not having seminars, distinguished according to the levels of graduate instruction for each class of schools, indicates that fewer schools with graduate programs offer the undergraduate seminar than those without; and that the full graduate program is of

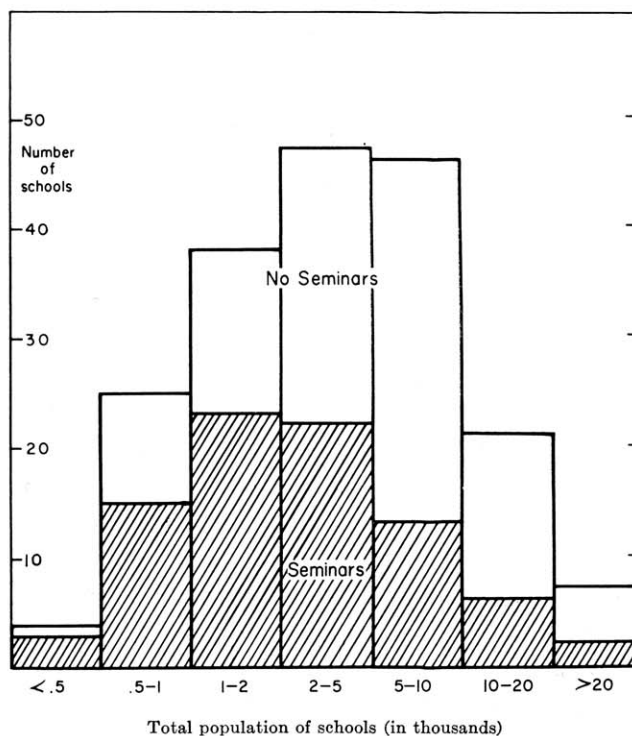


Figure 1. Frequency of Undergraduate Seminars Relative to Size of School

¹ Presented as a part of the Symposium on New Ideas in the Four-Year Chemistry Curriculum before the Division of Chemical Education at the 132nd Meeting of the American Chemical Society, New York, September, 1957.

² SAMPEY, J. R., J. CHEM. EDUC., 8, 520 (1931).

³ IGNATIA, SR., M., *ibid.*, 23, 149 (1946).

⁴ SCHAAP, W. B., AND H. G. DAY, *ibid.*, 33, 84 (1956).

⁵ FROMM, F., *ibid.*, 33, 347 (1956).

greater effect on this distribution than the master's degree program.

The average number of years the 85 departments of chemistry have been offering the undergraduate seminar is 14. The average varies significantly from this value for only class #4 schools, the average for this group being three years. Seven schools have been using the undergraduate seminar for 30 years or more. Twenty-three programs (27%) have been inaugurated within the last five years, seven of these occurring among the eight largest schools now offering seminars. It would seem that here the smaller schools are paving the way.

MECHANICS OF THE SEMINAR

Most undergraduate seminars are run on a weekly basis. A few are biweekly two-hour sessions. Some are irregularly spaced by reason of the few students involved.

Participation in the seminars is limited to seniors in 80% of the schools, and to juniors and seniors in the other 20%. Freshmen and sophomores sometimes attend, or are at least welcome, but generally do not take active part. In schools where there is no undergraduate program, seniors are usually urged to attend the graduate seminar and occasionally are invited to give papers in the graduate seminars as a reward for an exceptionally fine piece of undergraduate research or because of manifest special interest or ability.

Approximately one third of the student seminars are directly related to undergraduate research. Most are reports of a literature search on a special topic. Others operate within courses of advanced chemistry, especially organic.

Two-thirds of the seminar programs depend at least in part on speakers other than the undergraduates themselves. Seventy-seven per cent operate independently of A.C.S. student affiliate groups and chemistry clubs. The activities of such groups are very often mentioned as the equivalent or a substitute for the undergraduate seminar by departments which do not have the seminar.

In the small colleges (class #1) the entire chemistry faculty generally attend the seminars. This is often true in class #2 schools also. The per cent of faculty in attendance falls off in the larger schools where the seminar is frequently attended only by the staff members in charge of the program. The average faculty attendance is 63%, varying according to the size groups from 83% to 33%.

In 85% of the seminars, participants are evaluated critically by members of the chemistry staff. This is usually done in private. In at least one case a form is provided. The practice of offering constructive criticism drops from 100% to 62% as the size of the school increases.

Academic credit is given by 73% of the schools. There is a greater frequency of assigned credit among the larger schools, varying from 67% in class #1 schools up to 82% in class #4 schools. Abstracts or outlines of seminars are required by more than half (54%) of the reported programs. This factor varies between 41% and 70% but does not seem to follow a trend which is dependent on the size of the school.

VARIETIES OF SEMINARS

The undergraduate seminar has been adapted to a

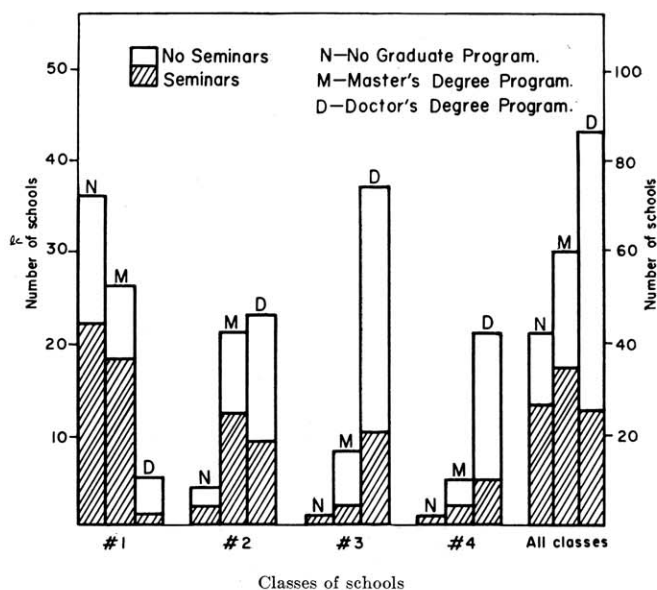


Figure 2. Frequency of Undergraduate Seminars Relative to Graduate Programs

variety of purposes and circumstances which are indicated in the preceding sections of this report. A brief summary of some interesting features of several programs is reported here which may suggest still other possibilities.

(1) A "round-table" seminar, limited to a dozen seniors and two staff members, one a physical chemist and the other an organic chemist, meets weekly for two consecutive hours to discuss the students' independent explorations in a large area of common interest, e.g., chelate compounds. The staff members serve as guides, critics, tutors, and moderators.

(2) The objectives of senior research projects are explained by the students early in the academic year, and their accomplishments are reported at the end of the year. Intermediate talks are given by faculty members on their research. This type of seminar is sometimes limited to the better students. Faculty attendance has also been restricted to encourage more complete freedom of discussion. The program may be tied in with chemistry club activities.

(3) Individual and group studies in a special field or from a prepared reading list are reported and discussed. These have resembled regular classes in scheduling according to the four basic fields of chemistry, and in term papers and examination requirements. Often several short talks (e.g., 15 minutes) make up a single session.

(4) The seminar format has also been used by way of review and extension of course work to prepare for comprehensive examinations. This has been either strictly chemical in character, associated with other sciences, or extended to the general college program as an integrating factor.

(5) Series of special lectures have been given either by staff members to acquaint the students with faculty special interests and a more immediate knowledge of the nature of research, by industrial representatives to inform the undergraduates of future work realities and opportunities, or by outstanding chemists on their particular specialties.

ADVANTAGES OF THE SEMINAR

The questionnaire listed four possible advantages of the undergraduate seminar program which were to be checked only if they were considered to be of practical value. Thirty-nine respondents checked all four. The individual point totals were: 56 for (a) "It develops ability to express ideas"; 59 for (b) "It gives practical training in literature searching and the organization of material"; 46 for (c) "It increases the depth and/or variety of the students' knowledge in their professional

field"; and 53 for (d) "It furnishes helpful information for evaluating students' abilities."

The space provided for writing-in points of value suggested by the correspondents was much used. According to these, the undergraduate seminar stimulates the student's interest in his faculty and their research, in graduate school studies, in employment opportunities, in teaching as a career. The seminars were considered to help in the preparation of undergraduates for comprehensive examinations, for graduate school, for industry. The seminar develops self-confidence, pride, critical ability, faculty-student bonds, esprit de corps. It allows coverage of areas in chemistry not treated in course work. It can be used to point out correlations between the various branches of chemistry and their distinctive but complementary contributions to the solution of common problems. The seminar may even be used to obtain student help in literature searches for overworked professors.

DIFFICULTIES AND OBJECTIONS

The questionnaire provided space for indicating objections and difficulties relative to the undergraduate seminar program for those departments which offer none. For schools offering seminars, the questionnaire suggested three possible disadvantages associated with such programs and a space for writing-in others.

The most frequently mentioned reasons for not having undergraduate seminars were: difficulty in scheduling the program, the lack of time available in the curriculum, the heavy course load of chemistry majors, the teaching load of the faculty, the few students majoring in chemistry. Also mentioned was apathy of the staff and disproportionate emphasis on the graduate program. Whereas some schools never seriously considered the possibility (seminars are not required for A.C.S. ac-

creditation), others emphatically saw no need for them since the same benefits were derived from term papers and class discussions, special courses in "Introduction to Research" and "Chemical Literature," chemistry clubs, and graduate seminars. It was objected that undergraduate seminars take time from fundamentals, that too few benefited, that the students lack sufficient depth of knowledge to handle the discussions, that they interfere with undergraduate research and also, and more seriously, with staff research.

SUMMARY

Forty-five per cent of the schools answering the questionnaire on undergraduate seminars have such a program. Seminars are more popular with the smaller schools but their number is increasing in all classes of colleges and universities. Only two schools have discontinued seminar programs; one of these was forced to do so by reason of the few students, and intends to re-establish the seminar when conditions permit. If graduate programs are in force, the need for the undergraduate seminar is considered less urgent and the graduate seminar often is expected to provide for both groups of students.

Where undergraduate seminars are held, they generally operate on a regular schedule, are given academic recognition, and make use of students, staff, and outside speakers.

Support for the seminar was more explicit, frequent, and enthusiastic than the objections. Many and serious difficulties are readily admitted. The general tone of the survey was decidedly favorable to the undergraduate chemistry seminar as a distinct but not necessarily essential contribution to the education of the chemist.