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ABSTRACT

In an effort to determine success characteristics of introductory chemistry students, 135 enrollees in seven introductory chemistry classes at Oakton Community College were surveyed in the spring semester, 1977. Of the 120 respondents, it was found that 75% had enrolled because of curricular requirements in a career field, and only 8% did so because of interest in the subject. Only 68% had met course prerequisites, regardless of the type of registration process (regular, open, late) through which they had been admitted. Sixty-four students successfully completed the course, and of these, students who did not have prerequisites were as likely to be successful as those who did. Of the 16 who failed who did not have prerequisite instruction, 13 were from two of the seven chemistry sections. Ten out of 11 students enrolling for transfer credit were successful. Of students under age 25, 51% were successful, while 65% of those above 25 received passing grades. Of the latter, 15 or 88% earned A or B grades, while only 50% of the 48 younger successful students received an A or B. Efforts to follow-up students who dropped the course were unsuccessful. The survey and drop-out questionnaires are appended. (RT)

AN ANALYSIS OF PREREQUISITES AND PERFORMANCES BY INTRODUCTORY CHEMISTRY STUDENTS: SPRING 1977

by

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The research project reported in this paper was undertaken because of questions and concerns we had regarding several aspects of students' enrollments and performances in introductory chemistry classes. These concerns focused on several main topics, each of which will be discussed below. First, however, we will describe the methods by which data were collected.

In the first two weeks of the spring semester, 1977, faculty teaching introductory chemistry classes were asked to have their students complete a short questionnaire which provided information about students' career goals, reasons for taking the course, enrollment process, and completion of and performance in prerequisite courses and other chemistry classes (see Appendix I). There were nine introductory chemistry courses in this term and seven were included in this study (see Table 1). Of the 135

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Insert Table 1 here
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students enrolled in these seven classes as of February 2, 120 (88.9%) completed the questionnaire. We also attempted to contact students who dropped the course to determine the primary and secondary reasons they did so; however, this proved a very time consuming task and the low number of respondents makes further analysis of these data unwarranted (see Appendix II for the questions asked).

Questionnaires were not anonymous; this was true for two reasons. First, to enable us to correlate the second (drop-out) half of the survey with the appropriate first part, and second, to enable us to determine each student's final grade in the course. The admissions office provided us with these.

Having described the reasons for this study, strategies and instruments for data collection, and types of data analyzed, we turn now to

our findings. These will be treated under the major topics of concern which led us to the study in the first place.

Reasons for Taking Chemistry

We asked students why they enrolled in chemistry; fully three-quarters did so because it is a career prerequisite, and only 8% did so because of interest in the subject. We also asked what students' career goals were; as expected, nursing was the most frequent choice, with some 30% indicating this. Eighteen separate career goals were noted in total, and only 15 people gave no specific answer. A total of 74 respondents, or 55% of the total number, indicated some type of health-related field as a career goal. The only other field with a sizable number of aspirants was engineering; 14 respondents designated this as their primary interest. It appears, then, that enrollment in introductory chemistry courses is motivated primarily by students' needs to meet curricular requirements. They are taking chemistry because they have to. This by itself, however, gives little insight into other aspects of our inquiry.

Prerequisites and Enrollment

A major concern through past years is that students seemed to enroll in chemistry courses without having met course prerequisites. We attempted to document the extent to which this was happening, the reasons for its occurrence, and the affect of not having prerequisites on students performances.

While administering questionnaires faculty were asked to list course prerequisites; students were then asked a series of questions about them. Eighty percent claimed to have known what the prerequisites were; and an additional 8% knew some of them. However, only 68% of students had met

prerequisite requirements prior to beginning the spring chemistry classes. We attempted to account for the means by which nearly one-third of the students were able to enroll without these requirements by asking them how they were able to register for the class. Eleven, 25% of those without these requirements, said they did have them when they registered. Nineteen, 44% of the group, were not asked about prerequisites. Eight were told they did not need them. It appears, then, that during the registration process a fairly sizable number of students who do not have stated prerequisites is able to register anyway, and that in 71% of these cases respondents did not even have to pretend to have them.

In order to understand this further, we explored whether students without prerequisites clustered their registration in one of the three types of processes: regular, open, or late registration. We found virtually no differences. That is, students without prerequisites were registered in chemistry courses in all three types of registration: regular, open, and late. This suggests that no one type of registration facilitates this enrollment; students in the massive open enrollment are no more likely to lack prerequisites than those enrolling in regular or late registration where, presumably, more careful controls by faculty or peer advisors can be imposed.

Prerequisites and Performance

Concern about course prerequisites is based on the assumption that these prerequisites provide information and skills necessary for success in the chemistry course itself. In order to validate this empirically, we divided students into two groups based on their final course grades. Students who received grades A,B,C, and D were designated "successful," and placed in one group. One might quarrel with our definition of D as

a successful mark; it does provide credit, however, and in any case only four students received Ds. Students who received an R,W,N at midterm, dropped the course, or received an X were designated "unsuccessful." We included the X grade in this group because credit in the regular term was not earned and because a large number of X grades ultimately become R grades anyway. We then looked at the relationship between the success variable and prerequisites, hypothesizing that students without prerequisites would fall disproportionately into the "unsuccessful" category. To our surprise, this was not the case. As Table 2 shows, students who have not completed prerequisites are as likely to complete their chemistry courses successfully as students who have their prerequisites. Of the 64 students who successfully completed the course

Insert Table 2 here

and for whom prerequisite data were provided, 69% had prerequisites. The percentage of unsuccessful students who had prerequisites was also 69%. Put another way, 31% of the successful students and 31% of the unsuccessful students did not have course prerequisites.

Because this finding so contradicted our expectations we decided to investigate other variables which might explain it. We turned to the variables sex and age; intuitively, we believed that older students returning to school, especially women, might account for the lack of association between prerequisites and performance. We divided our respondents into two groups based on age: those below age 26 we designated "young," and those above age 25 we designated "returning." This follows the Oakton practice of designating women above age 25 as "returning women." We found that 23 of the 26 returning students were women, and that 12 of

these women and one returning man did not have prerequisites. That is, 50% of returning students did not have prerequisites, while only 26% of young students did not. We anticipated that returning students might perform successfully in their courses regardless of prerequisites, making up for this lack through superior study habits and conscientiousness. However, we found that returning students who did not have prerequisites were equally as likely to be unsuccessful as young students without prerequisites. (45% of returning students without prerequisites were unsuccessful; 46% of young students without prerequisites were unsuccessful).

We then turned to where prerequisites were taken to see whether this might help explain the lack of correspondence between prerequisites and success in the courses. We found, however, that whether a student had taken prerequisites at Oakton, another community college, a four-year college, or in high school, made little difference in success rates.

We found some indications that students who had taken their prerequisites less than two years prior to the course were more likely to be unsuccessful than those who had taken them more than two years ago. This suggested some relationship between performance and age, since quite obviously older students were more likely to have taken their prerequisites earlier. This is a finding to which we will return later.

We also reevaluated recipients of the X grade in relation to prerequisites, thinking that these individuals might be highly motivated but unsure of fundamental skills and, therefore, in need of additional time to successfully complete their courses. Again, however, we did not find support for this: seven of the eleven X-grade recipients did have course prerequisites.

As a final attempt to understand our finding we checked whether in

specific sections of chemistry courses prerequisites were related to success. Here at last a pattern began to emerge. As Table 3 indicates;

Insert Table 3 here

the predicted relationship between prerequisites and course success (i.e., that not having prerequisites is correlated with unsuccessful performances) does occur in two of the three chemistry 101 sections; it is reversed, however, in other chemistry courses, all but one person without prerequisites successfully completing other chemistry courses. While this finding is suggestive and warrants additional investigation, even speculations about why this is so are premature at this time.

Other Factors Related to Performance

In order to achieve a more complete understanding of student characteristics which are empirically related to successful performances in chemistry courses we investigated a variety of other variables. In each case we related the variable course success (again defined as A through D = successful; X, W, N, R, or drop = unsuccessful) with a theoretically significant characteristic of the student.

Our findings are more interesting for relationships not demonstrated than for those few which received empirical support. We found no consistent relationship between course success and any of the following: full or part-time student status; semester at Oakton (first, second, etc.); career goal; or whether the individual had the same instructor for the first term of a sequence course.

We did find some relationships between course success and reasons for taking the course, with students enrolling for transfer credit successful in ten of eleven cases.

Finally, we returned to the variable of age (again using the year 25 as the cut-off for "young" students) and related it directly to performance. We found that 51% of young students were successful in their courses, and 65% of returning students were successful. Not only were returning students more likely to be successful than younger ones, they clustered in the higher grade categories. Of the 17 successful returning students, 15 (88%) earned As or Bs. Of the 48 successful young students, only 50% earned As or Bs. Put another way, 95% of the Cs and 3 of the 4 Ds awarded were earned by young students. In sum, returning students are more likely to pass their chemistry courses and, within the pass category, to earn a disproportionate share of As and Bs. While this finding comes as no surprise, it is one of our few findings which was fully consistent with our expectations.

Summary and Conclusions

Our findings, briefly summarized, include the following:

1. Three-quarters of students enrolled in introductory chemistry courses did so primarily because the course was a career requirement.

2. Slightly over half the students enrolled in introductory chemistry courses planned on a career in the health fields.

3. One-third of students enrolled in introductory chemistry courses did not have all course prerequisites prior to the beginning of the course.

4. Students who did not have prerequisites registered in all types of Oakton registration: regular, open, and late.

5. Students who did not have prerequisites were as likely to complete their courses successfully as students who did have prerequisites.

6. Nearly all students who did not have prerequisites and who were

unsuccessful in their courses were enrolled in two chemistry 101 sections. In other chemistry courses students who did not have prerequisites were almost always successful.

7. Students who enrolled in chemistry courses to obtain transfer credit had the highest rate of success of any group of students.

8. Returning students were more likely to pass their chemistry courses than young students.

9. Of all students who passed, returning students earned a disproportionate share of As and Bs and young students earned a disproportionate share of Cs and Ds.

Our findings cause us to recommend several additional avenues of research. These include:

1. Replication of this study to determine whether are findings hold true across several semesters.

2. Expansion of this research model to other disciplines. We found that gathering basic data at the beginning of the term enables us to include students who later drop out and who are, therefore, not part of a typical end-of-term analysis.

3. Focusing on prerequisites, including <u>what</u> is required as a prerequisite, <u>why</u> these prerequisites are required, and possible reasons why the prerequisite/performance pattern fails to conform to expectations.

4. Review of the registration process to determine how one-third of chemistry students were able to enroll in courses without having course prerequisites.

One additional methodological note should be added. One of our major original intents was to gather data pertaining to the reasons

for students' dropping chemistry courses, and our research design provided for this through Part II of our questionnaire. We even obtained students' phone numbers on Part I to facilitate telephone follow-ups. We found, however, that neither telephone nor mailed follow-ups generated enough response to warrant analyzing our meager data. We still believe this is a viable method for obtaining valuable data about our high drop-out rate, but adequate resources, especially personnel, must be allocated if this is to prove effective.

TABLE 1

COURSES AND STUDENTS

Course	Section	Enrollment[a]	Completions
101	01	24	27[b]
101	02	22	20
101	50	24	18
102	01	14	11
102	50	13	9
105	50	14	12
121	50	24	19
No course or section identified			4
			120

[a]As of February 7,1977

[b]Possible because of early drop-outs and late registrants

TABLE 2

PREREQUISITES AND PERFORMANCE

Performance	Prerequisites Completed			
	All	Some	None	Total
Successful	44	11	9	64
Unsuccessful	38	10	7	55
Total	82	21	16	

TABLE 3

COURSE SECTIONS, PREREQUISITES, AND SUCCESS

Course	Section	Performance[a]	
		Successful	Unsuccessful
101	01	3	10
101	02	1	3
101	50	5	2
102	01	2	0
102	50	1	0
105	50	3	1
121	50	4	0

[a]Entries are only for those students who did not have all prerequisites

For office use:

Name: _____

ID# (1-3) _____
Chemistry (4-6) _____
Section (7) _____

CHEMISTRY SURVEY

In order to help us improve our counseling and registration procedures and to help us learn more about students enrolled in chemistry, we need your help. Please complete this questionnaire. We assure you that all responses will remain confidential. Thank you.

Are you enrolled at Oakton as a fulltime or a parttime student?

(8) ____ 1 Fulltime
____ 2 Parttime

Which semester at Oakton is this for you?

(9) ____ 1 First
____ 2 Second
____ 3 Third
____ 4 Fourth
____ 5 Other

What is your career goal?

(10-12) _____
write in answer

Sex

(13) ____ 1 Female
____ 2 Male

How old are you?

(14-15) ____

Which of the following reasons was most important in your decision to take Chemistry?

(16) ____ 1 Pre-requisite for career
____ 2 Interested in subject
____ 3 Needed course for job advancement
____ 4 Needed for transfer to another school
____ 5 Other (specify) _____
write in other reason

Did you know that the prerequisites for this course are _____?

(17) _____ 1 Yes
_____ 2 No
_____ 3 Knew some prerequisites

Did you have these prerequisites before taking this course?

(18) _____ 1 Yes (If answer is yes, skip next 3 questions - go to A and continue in order)
_____ 2 No
_____ 3 Some

If answer to above is no or some, are you taking any of these prerequisites this semester?

(19) _____ 1 Yes
_____ 2 No

How did you complete registration for this course without the prerequisites?

(20) _____ 1 Was told I wouldn't need them
_____ 2 Wasn't asked about them
_____ 3 Said I had them

If answer to above is 1 (told I wouldn't need them)
Who indicated you would not need the prerequisites?

(21) _____ 1 Counselor (student development personnel)
_____ 2 Peer advisor
_____ 3 Chemistry instructor
_____ 4 Other faculty members
_____ 5 Friends
_____ 6 Decided by self
_____ 7 Other (specify) _____
write in answer

A How long ago did you take these prerequisites?

(22) _____ 1 Less than 2 years ago
_____ 2 2-5 years ago
_____ 3 More than 5 years ago

Where did you take these prerequisites?

(23) _____ 1 At Oakton
_____ 2 At another community college
_____ 3 At another four year college or university
_____ 4 High School
_____ 5 Other (specify) _____
write in answer

How did you register for this semester at Oakton?

(33) _____ 1 Regular registration
_____ 2 Open registration
_____ 3 Late registration (after classes started)

(FOR SECOND SEMESTER SEQUENCE)

Did you take the first semester of this course sequence?

(27) ____ 1 Yes (If yes, go to D)
____ 2 No

When was the first semester taken?

(28) ____ 1 Previous semester
____ 2 Two semesters before
____ 3 More than two semesters before

Where was the first semester taken?

(29) ____ 1 At Oakton
____ 2 At another community college
____ 3 At another four year college or university
____ 4 High School
____ 5 Other (specify) _____
write in answer

What was your grade in the first semester course?

(30) ____ 1 A
____ 2 B
____ 3 C
____ 4 D
____ 5 F
____ 6 X or incomplete
____ 7 Other (specify) _____
write in answer

Did you have the same instructor for the first semester?

(31) ____ 1 Yes
____ 2 No

Why did you drop this course?

(24) _____ 1 Too difficult
_____ 2 Conflict with job
_____ 3 Changed career objectives; course not needed
_____ 4 Personal or family problems
_____ 5 Lack of transportation
_____ 6 Financial reasons
_____ 7 Other (specify) _____

write in answer

If answer to above was too difficult (or didn't like teacher) ask:
Why did you feel the course was too difficult? The major reason?

(25) _____ 1 Was 2d semester course and hadn't had first semester
_____ 2 Too much work
_____ 3 Didn't like instructor
_____ 4 Didn't like book
_____ 5 Too many hours in lecture and lab
_____ 6 Poor math background
_____ 7 Didn't like course approach
_____ 8 Not my thing
_____ 9 Other (specify) _____

Write in answer

What was the second most important reason why the course was too difficult?

(26) _____ 1 Was 2d semester course and hadn't had first semester
_____ 2 Too much work
_____ 3 Didn't like instructor
_____ 4 Didn't like book
_____ 5 Too many hours in lecture and lab
_____ 6 Poor math background
_____ 7 Didn't like course approach
_____ 8 Not my thing
_____ 9 Other (specify) _____

Write in answer

When drop-out occurred

(34) _____ 1 Before or at mid-term
_____ 2 After mid-term