Advisors and Mentors: Their Role in the Retention and Success of Chemical Engineering Students

Dana E. Knox

Otto H. York Department of Chemical Engineering
New Jersey Institute of Technology
Newark, NJ 07102

Abstract

This paper will discuss a variety of changes that have been implemented in the way students have been advised and mentored over the last several years in the chemical engineering department at NJIT. These changes have included: use of a single person to advise all undergraduates; institutionalization of certain feedback mechanisms; introduction of a freshman orientation course in chemical engineering; several changes in the course registration process; follow-up letters and advisement sessions in certain cases; faculty and student mentoring; and a variety of other changes as well. The motivation for each change is discussed, together with a brief summary of how it was implemented. Survey data, together with statistical, as well as some anecdotal, evidence as to the success or failure of these changes is presented and discussed, with particular attention paid to student retention and success.

Earlier Situation

At one point, the advising process for chemical engineering students was extremely poor. From the student perspective, each semester he/she was assigned an advisor for that semester. Advisors were assigned alphabetically in order to ensure that no one faculty member was "burdened" more than another. As a result, students could have a different advisor every semester. Students had to seek out their advisor at registration time; advisors never contacted students. In order to be able to register for classes, students need their advisor's signature on the appropriate form. Most advisors merely signed whatever the student showed them, offering little or no advice. This form was then submitted to the registrar's office, which then allowed the student to register for their selected courses. The system was easily circumvented, as no one in the registrar's office could be expected to be familiar with the signatures of every faculty member.

Matters not related to course registration were often neglected. In theory, students were able to consult their advisors about these other matters, but the typical faculty member was (and still is) poorly equipped to deal with matters such as financial aid, problems with professors or other students, work problems or other personal problems. Also in theory, advisors were to oversee

student progress and check such issues as prerequisite satisfaction, progress towards graduation and missing transfer credit, among others. If a student wished to provide general feedback of any sort to the department, it required a significant effort on their part, normally requiring that they request a meeting with either the department chair or associate chair. Faculty also had to request meetings to discuss problems. All in all, the system was quite poor.

Serious changes had to be implemented, and they were. The remainder of this paper will focus on the changes that have been made.

Elimination of Multiple Advisors

Many of the problems could be attributed to the distributed advising system. Advisors who have only a few students are not motivated to invest the significant amount of effort required to learn all the nuances of the curriculum, to discover how financial aid works, to become familiar with the available campus resources, or to follow up on student actions and inquiries. The first change instituted was thus to establish the practice of having a single advisor for all undergraduates, with concomitant release time. This person is available regularly throughout the semester to discuss any issue that a student wishes. As registration time approaches, he/she maintains an extensive schedule for registration advisement appointments. Each student receives careful, detailed, personalized advising that includes multi-year plans if needed or desired. Through experience, many potential problems are avoided that would not have been under the old system.

As part of this change, the department now also advises all of its freshman students. The university has a practice of assigning freshman advisors randomly from among all the available freshman advisors in the entire university. The department, however, has arranged that all freshman chemical engineering students be assigned to the chemical engineering department advisor.

These changes were primarily motivated by complaints from students that they received inconsistent, or even incorrect, advice. Advisors from other colleges and departments are not familiar with the requirements particular to chemical engineering. Even faculty within chemical engineering can give inferior advice if they are not experienced in the advisement process. Also, quality advising requires good interpersonal skills and genuine concern for, and interest in, the students. Not all faculty members make good advisors.

Registration Process Changes

All students are now required to meet with the advisor for in-person registration advisement prior to being allowed to register for courses. Plenty of advance notice is given of this requirement, typically 5 - 6 weeks before the beginning of registration. The advisement schedule begins 3 weeks prior to the registration period, and is available 2 - 3 weeks before that for students to sign up for their preferred time slots. During the meeting, the advisor and the student review the student's progress. This includes, at a minimum, discussion of the previous semester's grades and the current semester results to date. Progress towards the degree is checked, and a tentative plan for the remainder of the curriculum is formulated. Together they decide on the most appropriate

courses for the subsequent semester, and both of them sign the registration advisement sheet. This sheet lists the course selections for the next term and is kept in the student's file. At this point, the electronic hold on the student's ability to register is removed, and the student is able to register for courses.

The above process was developed in response to practical concerns. In the past, students would be advised to register for certain courses, and then fail to do so, possibly resulting in a delay of their graduation. Occasionally, the problem would be the reverse. The advisor would overlook a requirement for a subsequent semester, again possibly resulting in a delay of the student's graduation. In either case, the careful, joint review of the student's progress each semester helps to prevent those problems. Also, the signed advisement sheets indicate where the problem occurred, if one does develop.

Prerequisite Checking

Prerequisite checking has long been an item of particular concern at NJIT. The software in use for registration has not allowed automatic checking to ensure that the prerequisites have been satisfied. Thus, a two-level system has been implemented. During the advisement session, prerequisites are checked when developing the list of courses for the subsequent semester. Also, during the first week of the semester, department staff carefully checks the enrollment of each student to ensure that course prerequisites have been satisfied.

Without automatic checking of prerequisites, these steps were necessary to prevent unqualified students from taking courses for which they did not have the prerequisites. This not only is a requirement for ethical and accreditation purposes, but students can seldom do well in courses for which they lack prerequisites.

The department also periodically reviews, and revises as appropriate, the structure of prerequisites and corequisites for its courses. For instance, last year several prerequisites that were frequently waived were converted to corequisites. In each of those cases, the material required from the corequisite course is covered earlier in the semester than it is used in the subsequent course.

Follow-up Advising

Many types of problems related to registration and course advisement can not be handled in the framework of "regular" advisement as discussed above. Such problems include, but are not limited to: failures in courses expected to be passed at the time of advisement, graduation checks, transfer credit problems, and others.

These issues require follow-up on the part of the advisor. Files are reviewed between semesters, and students contacted if problems are detected. Some issues can be handled via e-mail or telephone, while others require that the student come to campus for an in-person meeting.

Student Feedback Mechanisms

Mechanisms must exist for students to express opinions, frustrations, praise and other types of feedback relative to their experiences with the department and university. A variety of different mechanisms have been instituted over the past several years. The most obvious one, feedback through the advisor, has been strengthened through the consolidation of the advisor role into a single individual. Under the previous system, if an advisor heard a comment it was probably the only one he/she received due to his/her limited number of advisees. With a single advisor, it is far more likely that similar comments would be received from more than one student, making it more clear when a serious problem exists, and easier to gauge the relative significance of multiple comments.

Formal feedback sessions have been institutionalized as well. At least once per semester, a department feedback session is held. Only the department chair is allowed to attend from the faculty, and the students are allowed to express any comments they like with the guarantee of anonymity. Notes are carefully taken, and acted on appropriately by the department chair. There is also at least one college-level feedback session as well, at which the dean (only) is present. These sessions provide much more useful feedback than the old system, which relied upon the students to seek out individual meetings with the chair. The current system not only encourages student participation (free food and drink!) but has resulted in much more positive feedback that was ever received under the old methods.

Additional surveys have also been institutionalized. Laboratory surveys are now a regular feature of laboratory courses. These quickly pinpoint problems with equipment or other facilities, teaching assistants, potential safety hazards or other aspects of laboratory courses. Graduating student surveys give all students a chance to comment anonymously on all aspects of their educational experience. Exit interviews are conducted by the advisor (in the last advisement session) and the chair (near the end of the last semester) to give/get personal feedback.

These surveys were instituted for a variety of reasons. Some issues with the laboratory were not discovered until the surveys were instituted. Minor problems were reported that had gone unnoticed. Problems with certain teaching assistants were also discovered this way. The senior interviews have been a mechanism not only for feedback on the program, but also to determine progress in obtaining jobs or admission to graduate school.

Faculty Feedback Mechanisms

There also is a need for faculty feedback, both to students and about student performance, outside of the classroom setting. To address these needs, course supervisor meetings have been institutionalized in the chemical engineering department. Each semester, the course supervisor of each course in the department convenes a meeting about the course. Expected to be present are anyone who has taught the course during the current or previous semester, and the course supervisors for each of the prerequisite and corequisite courses. At the meeting the focus is on whether the students are achieving satisfactorily in the course and what changes may need to be adopted in either the course or its pre- and co-requisites. Very often, unnecessary duplication is

identified as well as gaps in coverage of specific topics. These meetings have proven to be especially valuable, in particular for the first few years of their existence.

Motivation for these meetings had come about through the gradual realization that without such an institutionalized mechanism, instructors of the various courses were not communicating with each other about the details of the courses they were teaching. Each individual professor would cover what he/she thought relevant, and there was no interaction with the subsequent related courses. Common feedback from students would be that in some classes the first half of this semester would be a waste (due to unnecessary duplication), and then required material for a subsequent course was not learned. It was a vital improvement to force communication among the faculty about their courses.

Informal communication is also very important, and a valuable avenue for feedback to students about their performance. This is most readily accomplished in a relaxed, social setting. It is thus a priority in the department that there be a number of such events each semester whereby faculty and students can interact informally. A sense of collegiality is important and should not be overlooked. This is one area where the department had been traditionally quite strong, but the tradition has weakened in recent years as the emphasis on developing a strong research agenda began to predominate. This has been countered by trying to ensure that all faculty members teach at least one undergraduate course, and strongly encouraging attendance at all events by everyone.

Freshman Retention

Retention of freshman students is a particular concern. In 2001, a new "Introduction to Chemical Engineering" course was introduced for all chemical engineering freshmen. The course is very informal, and is devoted to a series of talks about chemical engineering, careers, and topics specific to the department. The goal is to involve the freshmen in the life of the department, to help them reach an understanding of what the field is about, and to assist them in the transition to college as much as possible.

Introduction of the course was motivated by a review of freshman retention rates that indicated much-lower-than-desired figures. Surveys indicated that most of the freshman students, especially those who left the department, had little or no idea what chemical engineers actually did, and had developed no relationships with either faculty or other students in the department.

Mentoring Activities

Mentoring is an excellent way in which to pass on experience. Wherever possible, such types of relationships are strongly encouraged. Two years ago, a transition was made in the role of department advisor. It was accomplished by having the incoming advisor assist the outgoing advisor so that the experience and methods developed were not last in the transition. This approach was also adopted for the transition in the role of graduate advisor as well.

Motivation for this approach was to relieve the advisement burden on any one individual. While for reasons described above, a single advisor is the best approach for the department; it is not

necessarily the best approach for the person in the job. Also, any organization needs backup in any vital position, and the role of advisor to the undergraduate students is certainly no exception.

Student mentoring is also important. The department has established an informal mentoring system and plans to more fully institutionalize the system in the near future. Freshman students are matched with mentors from the junior year who can help them with everything from difficult homework problems to how to deal with roommates.

Various observations have motivated establishment of a mentoring program. A common complaint heard among faculty in any engineering program at any college is that the students haven't properly learned the material despite the best efforts of themselves and their colleagues. The course supervisor meetings described previously can help to determine if the material is at least covered. Covering the material is not enough, however. Students must be motivated to learn the material, and it must be accessible. Very often, students learn most readily when other students explain the material to them. Furthermore, students cannot learn if they are overly distracted from their studies by other aspects of college life. Experience with how to deal with the problems associated with college life can also be invaluable to new students.

Career Advisement

The chemical engineering department at NJIT has established the positions of Associate Chair for Undergraduate Studies and Associate Chair for Graduate Studies and Industrial Relations. The former position is the department advisor to all of the undergraduate students, as mentioned previously. The latter position is the advisor for the chemical engineering graduate students. But of even greater importance is that this position is primarily responsible for maintaining contacts with New Jersey industry. He/she maintains close ties to as many of these potential hirers of our graduates, as well as potential donors to the department, as possible. This person also visits all of the students working in coop positions every semester and works closely with the university career services offices. Both of the associate chairs make active efforts to help department students to make good starts on their careers.

This need was identified when it became clear that the university career services office could not establish/maintain the types of relationships necessary. Their background is by necessity in fields such as human resource management, not chemical engineering. Companies feel much more confident when they can deal with faculty who are familiar with the students they propose to hire, and to whom they can explain the job requirements more fully. This arrangement has been a win-win-win-win situation for all concerned. Companies are more satisfied with the students they hire. The university career services office is less burdened and can report higher numbers of successful job placements. The department sees more of its students land jobs, and develops better relations with local industry. Most importantly, more students get more and better job offers.

Statistics

The question that remains is whether the changes implemented have been beneficial. What effect have they had on student retention and success? The key performance indicators that are tracked

by the university to assess these are: freshman/sophomore and two-year retention rates, and six-year graduation rates. They are also important data needed for most accreditation reviews. Since students do not take any major courses until the sophomore year of the curriculum, also included are data on the 3.5-year graduation rate from passing the first course in chemical engineering (for these data, only degrees in chemical engineering are counted). Presented in the following table are data on retention rates and graduation rates over the past few years.

Table 1. Performance Indicators for Chemical Engineering at NJIT

Base A/Y	1995/ 1996	1996/ 1997	1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002
Freshman/ Sophomore Retention	86%	87%	79%	87%	100%	75%	70%
Two Year Retention Rate	68%	67%	58%	67%	81%	60%	-
Six Year Graduation Rate (any)	68%	70%	42%	> 73%	> 94%	-	-
ChE Grad. Rate from First ChE Course	66%	68%	65%	79%	> 59%	-	-

For comparison purposes, the NJIT averages for these statistics, as taken from the most recent report of the university, are: Freshman/Sophomore Retention, 80%; Two Year Retention, 72%; and Six Year Graduation Rate, 46%. All of the university numbers have been fairly consistent over the years with a small upward trend. Direct comparison with numbers in the above table shows that the department retention figures are comparable to those of the university, albeit with more scatter due to the smaller sample sizes. However, the graduation rates are much better for the department than for the university as a whole. Note that some figures are quoted as "greater than" since the requisite time period has not yet expired; those numbers reflect graduates thus far.

The most recent freshman/sophomore retention figures in the table are a disappointment, as that reflects the first class to take the new "Introduction to Chemical Engineering" course, However, it was also the smallest entering class in memory with only 10 students. The numbers for the current freshman class are expected to be much higher, as none have changed to another major as of this writing.

The six-year graduation rate is a generally recognized measure of how effectively a university educates its students. The numbers can vary widely among different universities dependent upon the student population. For instance, at NJIT the rates are relatively low since the vast majority of its students work while pursuing their studies. This is usually an economic necessity as the typical NJIT student comes from a lower middle class background and cannot rely on economic support from parents to fund their education. Achieving substantially higher graduation rates than the rest

of the university is the area where the advising practices discussed earlier have had the clearest effect.

The chemical engineering graduation rate (within 3.5 years of passing the first course in chemical engineering) is an indication of how effective the process is once the students begin interacting primarily with department courses and faculty. As the first chemical engineering course is in the first semester of the sophomore year, the 3.5 years represent the pro-rated portion of the six years used by the university. However, aspects of retention are included, as only chemical engineering degrees are counted. These numbers clearly show that once students start on the chemical engineering program, there is a high likelihood of successfully completing it.

Data on student satisfaction, both overall and with the advising process, have also been examined. The university-wide averages, taken from public reports of the university, are 3.32/4.0 overall and 3.39/4.0 for the advising process. The department numbers, based on surveys of graduating students are similar, with a slightly higher average but much scatter, over the years studied.

The significantly higher graduation rates lead us to conclude that the changes instituted have had a beneficial effect. However, they have not led to better retention of students within chemical engineering. This probably indicates that other factors are more important to retention within a particular major than only the quality of advisement. Such factors may include public perception of the field, the current job market, and others.

Recommendations

All of the changes instituted have generally been well received by the students. They also appear to have improved student and department performance and morale. Thus, it is recommended that all departments consider implementing similar changes.

However, a caution must be appended. The role of advisor is critical to the whole process. Both of the individuals to date that have filled the role of advisor in the chemical engineering department have been willing to allow student advisement and student-related matters to be the primary focus of their careers, at least for a several-year period. This activity must be supported by their colleagues, by their chair, by the college and by the university, or it becomes an unreasonable demand on these individuals. The success that results from adopting the approach should make obtaining such support easier.

Biographical Information

DANA E. KNOX earned his B.S., M.E. and Ph.D. degrees in chemical engineering from Rensselaer Polytechnic Institute. He joined the chemical engineering faculty at New Jersey Institute of Technology in 1982, and is currently the associate chair of that department. He and his wife Petra make their residence in Edison, NJ.