

Intrinsic Benefits of a Chemical Engineering Alumni Student Mentoring Program

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Abstract

The Ralph E. Martin Department of Chemical Engineering at the University of Arkansas (U of A) is in its third year of successfully operating an alumni mentoring program for its undergraduate and graduate students. The purpose of the program is to provide experienced alumni help to the students in their professional development and in identifying and navigating their career paths. The program was structured by annually forming 11-12 mentoring circles, each containing three mentors (most typically, one member who was a member of the Arkansas Academy of Chemical Engineers and graduated at least 20 years ago, and two other alumni who graduated 5-10 years ago) and 4-6 students that are all in the same year of school. Student participation in the program is voluntary and just under 50% of our students participate annually. Following the program kick-off soon after school starts in the Fall semester, the circles average four mentoring events during the Fall semester, followed by a final Program Review and Celebration in February. As a result of the program, the students receive valuable resume and LinkedIn feedback, tips on preparing for the Career Fair, information on the variety of careers that are available for chemical engineers, the importance of soft skills on the job, ways to stand out to employers, the differences in careers in industry and academia, and the need for developing a good work/life balance.

A number of other unexpected benefits resulted from the program, particularly with the younger alumni. Younger alumni are very anxious to "give back" to the department but are not often able to make significant financial contributions when they are only 5-10 years post-graduation. Examples of these other forms of alumni engagement include:

- A desire to continue mentoring year after year
- Presentations in classrooms, seminars and even a course offering in the department
- Greater visibility by the mentors' companies at the Fall and Spring Career Fairs
- Job offers that were made to members of their mentoring circles
- Mentor-to-mentor connections
- Financial gifts, even if they were not large

Utilizing the results from an alumni survey, this paper quantifies the intrinsic benefits and the positive effect that the alumni mentoring program is having on the department.

Introduction

As in all aspects of life, students benefit greatly from strong mentoring relationships. Successful mentors can take many forms including faculty, graduate students, undergraduates and alumni. A few of the many examples of successful mentoring are faculty-led programs that help undergraduates with technical, ethical and professional problems [1]; the creation of graduate student communities as mentoring groups [2,3]; the mentoring of new graduate student

instructors by existing graduate student instructors [4]; undergraduate student mentoring of transfer students who are new to STEM [5] and residential peer mentoring of early engineering students and at-risk students by upper-level undergraduates [6].

In 2021, the Ralph E. Martin Department of Chemical Engineering at the University of Arkansas (U of A) created an undergraduate mentoring program using departmental alumni as career path identification as well as professional development mentors [7]. The program was modeled after a similar program in the Industrial Engineering Department at the U of A [8] and other successful mentoring programs found in industry. The program was augmented in 2022 to include the mentoring of Ph.D. students [9] and the program is currently in its third year.

The alumni mentoring program was found to be very successful in helping students learn about career options for today's chemical engineers, the mechanics of the interview process for internships and full-time jobs, and the on-the-job expectations of a successful engineer [7, 9]. Undergraduates participating in the program received valuable resume feedback and tips in preparing for the university's Career Fair. They also learned about the importance of soft skills on the job, ways to stand out to employers and tips on developing a good work/life balance. The participating Ph.D. students were able to interact with successful international graduates and learned about the similarities and differences in industrial and academic research. The mentoring process served as a networking opportunity for all of the participants and also served as an opportunity for personal and professional growth.

In speaking with the alumni mentors, it became obvious that the mentoring program represented an excellent way for the mentors to give back to the university through their time and talents. Alumni participation is often measured solely in terms of financial gifts to the university, but financial gifts are not always possible for an alumnus or alumna who is relatively early in his or her career. However, other unexpected benefits also surfaced from participation in the program including a strong desire for the mentors to continue mentoring year after year, an interest in participating in the academic mission of the department through seminars and classroom visitations, and a strong desire to make sure that the mentors' companies were represented on campus and made job offers to U of A students.

The purpose of this paper is to quantify these intrinsic benefits and the positive effect they are having on the department. Following a brief description of the mentoring program, the results from a survey of the alumni on intrinsic benefits will be presented and discussed.

Brief Description of the Mentoring Program

The alumni mentoring program began in the Summer of 2021 with the formation of a Steering Committee (two faculty and four distinguished alumni—the authors of this paper) and the development of a Mentoring Program Handbook to serve as a guide for the mentoring activities. The selection of mentors occurred each July from a pool of volunteers consisting of members of the Arkansas Academy of Chemical Engineers (distinguished alumni that had graduated more than 20 years ago) and alumni that had graduated 5-15 years ago. The recruitment process was very simple and consisted of sending e-mail invitations to alumni that had maintained at least some contact with the faculty in the department after graduation—most of the alumni that were invited chose to participate in the program. Table 1 shows mentor participation in each of the three years of the program. Some mentors have participated for three consecutive years and some mentors have participated one or two years. Student selection began each August, just after the Fall semester started, and Table 2 shows student participation by class. Student participation was encouraged by the department but was completely voluntary and no students were turned away. The program was initiated in 2021 as an undergraduate mentoring program only, but Ph.D. students were also invited to participate in 2022 and 2023.

Year	Number of Alumni Mentors Participating				
	Academy Members Younger Alumni Total				
2021	10	26	36		
2022	7	31	38		
2023	9	24	33		

Table 1. Alumni Mentors, 2021-2023

Year	Number of Students Participating					
	Sophomores	Juniors	Seniors	Ph.D. students	Total	
2021	15	29	11	0	55	
2022	32	11	17	20	80	
2023	26	16	10	10	62	

Mentoring teams were formed with three mentors (ideally one Academy member plus two younger alumni) and 4-6 students from the same class per team (see Table 3). The lone exception to this model was in 2022 when a larger than expected number of Ph.D. students participated in the program, leading to two Ph.D. teams with ten students and four mentors per team (in hindsight, a bad idea because the teams were too large). The Steering Committee considered forming teams according to student interest (petrochemicals, pharmaceuticals, etc.) but, after discussion, decided to instead group mentors and students with diverse interests on each team.

Year	Number of Mentoring Teams					
	Sophomores	Juniors	Seniors	Ph.D. students	Total	
2021	4	6	2	0	12	
2022	5	2	3	2	12	
2023	4	3	2	2	11	

In 2022, efforts were made to separate returning students from students who were new to mentoring because the steering committee thought that these groups of students may have different mentoring needs. This arrangement was found to be unnecessary because both new and

returning students interacted well and had very similar questions for the mentors. This practice was abandoned in 2023 in favor of just separating students by class. Graduates in the 2023/2024 academic year were the first students to have access to the alumni mentoring program every year in the department. Of those who graduated in that academic year, 56.8% had participated for at least one year in the mentoring program.

Mentoring began each fall with an in-person September kick-off event where the students and mentors met for the first time, discussed what the students expected from a mentoring program and made plans for upcoming mentoring sessions throughout the Fall semester. Prior to this meeting, the mentors participated in a mentor training program and were provided with mentoring resources to help guide the mentoring process. Most mentoring groups met four times (in-person, virtually or a combination) throughout the Fall semester, but some groups decided to continue to meet into the Spring semester.

A typical mentoring session lasted about an hour and primarily covered professional development topics such as co-ops and internships, searching for a job, performing on the job and work/life balance. The best discussions originated from student questions or concerns. The students realized that virtual meetings were going to be an integral part of the mentoring process because a majority of the mentors lived a significant distance from campus. Everyone would have preferred an in-person mentoring program but this was not a feasible option. The program was evaluated each January by the students and mentors using a survey questionnaire. Mentoring activities ended each year in February with a program review and celebration.

Student attendance at the mentoring sessions surfaced as a problem during 2022 (see Table 4). As a result, student commitment was emphasized during the enrollment period prior to sign-up in 2023. Survey responses showed that both the students and mentors felt like the number of mentoring sessions was about right for a successful mentoring program and were happy that they had participated in the program. Communication with the students (not answering mentor emails in a timely fashion and not communicating to the mentors about upcoming student absences) was found to be a problem that was identified from the mentor surveys and accompanying comments in 2021 (see Table 5). This issue was addressed prior to program initiation in 2022. A few of the students would have preferred an earlier starting date for the workshops to better prepare for the Career Fair and were interested in possibly pairing mentors and students by interest. Both of these suggestions were discussed by the Steering Committee but were not implemented. An earlier start time is not possible because the students do not return to the university for fall classes until the end of August. Although pairing students and mentors by interest is a viable alternative and might be implemented in some way in the future, the Steering Committee felt that a majority of the students have not firmly decided on a career path and should be exposed to a variety of options.

Several students noted in both 2021 and 2022 that they were not likely to participate in the program again, but most of these students were in their final year of undergraduate work, so they would not be eligible to participate again. More importantly, they reported that they had no problems with the mentoring program.

Year	% Attendance				
	Not attending	Virtual	In-person	Virtual/in-person	
Mentor Attendance					
2021	11	72	17	89	
2022	13	68	18	86	
2023	12	75	13	88	
Student Attendance					
2021	27	48	25	73	
2022	39	40	21	61	
2023	29	45	26	71	

Table 4. Mentor and Student Attendance at Fall Mentoring Events

Table 5. Summary of Mentor and Student Evaluations from 2021 and 2022

Question	Evaluation Score				
	Mentors St		Stuc	udents	
	2021	2022	2021	2022	
How satisfied were you with the overall Mentoring Program?	4.5	4.3	4.3	4.2	
How well did your students (mentors) communicate?	3.3	4.0	4.4	4.4	
How helpful were the topics that were discussed?	4.6	4.5	4.4	4.5	
How likely are you to recommend the program to another	4.9	4.8	4.4	4.7	
student (alumnus)?					
How likely are you to participate again in the program?	4.6	4.6	3.7	3.4	

5—very satisfied; very well; very helpful; very likely 4—somewhat satisfied . . .

3—neutral . . .

4—somewhat satisfied . . . 2—somewhat dissatisfied . . .

1—very dissatisfied . . .

Intrinsic Benefits of the Mentoring Program

Beginning with the advent of the mentoring program in 2021, it became common to notice alumni around the department. While much of this activity was directly related to student mentoring, alumni were also seen giving seminars in classes and at AIChE meetings. It was apparent that the mentoring program led to additional opportunities for our alumni to be involved in the department.

In an effort to quantify these intrinsic benefits of the mentoring program, all 59 alumni who are or have participated in the mentoring program were sent a brief questionnaire on their participation in other activities within the department. Thirteen of the 59 alumni were Academy members and the balance were younger alumni. Table 6 shows a breakdown of the alumni that were invited to participate in the survey and those that did participate. As is noted in the table, some alumni only served as mentors for one year (2021, 2022 or 2023), some participated for two years (2021/22 or 2022/23) and some participated in all three years of the program (2021-23). Forty-six of the 59 mentors (78%) participated in the survey. Excellent survey participation (100%) was evident from those that mentored students for all three years of the program (2021-23) but mentors who participated for one or two years were also well represented. The questions used in the survey and a summary of the brief answers to the questions without comments are appended.

	Number of alumni participating by year						
	2021	2022	2023	2021/22	2022/23	2021-23	Total
Invited	13	4	8	9	11	14	59
Participated	9	3	8	5	7	14	46

Table 6. Alumni Mentor Survey Invitation and Participation

A Connection to the Department

The survey began by asking the mentors about their connections to the department and the students that they mentored. Thirty of the 46 mentors that responded (65%) felt that they now have a stronger connection to the U of A Chemical Engineering Department through their participation in the Alumni Mentoring Program. Sixteen mentors (35%) felt that their connection was "somewhat stronger" and none felt that the connection was "definitely not stronger." Thirteen of the 46 mentors (28%) noted that their connection with the students they mentored extended beyond the one-semester duration of the mentoring program and 17 of the 46 mentors (37%) said that U of A chemical engineering students had contacted them outside of the mentoring program. Most of these interactions were career-oriented (additional resume and LinkedIn help, supplying job references and referrals, and offering jobs to their students) but some were just informal conversations between the mentors and the students.

Employment Opportunities for Students

Several mentors have helped to secure job opportunities with their companies for the students. While only nine of the 46 mentors (20%) said that their company participated in the STEM Career Fair at the U of A during the last three years, five others noted that they were now actively pursuing STEM Fair participation for the upcoming year. A few mentors noted that STEM Fair participation was not possible for them and their companies because they were now retired and no longer actively connected with their companies or that their companies only hired regionally. Eighteen of the 46 mentors (39%) said that they informed the Chemical Engineering Department or students about job openings at their company. In addition, three mentors noted that they are currently building an internship program which will be launched in the near future and will include U of A chemical engineering students.

Fourteen of the 46 mentors (30%) noted that their companies recently hired a U of A full-time, co-op or intern chemical engineer and seven of the 46 mentors (15%) noted that the mentoring program impacted the hires. One mentor noted that "one full-time offer was made as a direct result of the program; however, the student took a different offer." Another said that "the mentoring impacted the hire because I guided the application through the process," and still another said that "we hired an intern that was in the program, and she had an excellent experience that summer."

Participating in the Educational Mission

Several of the alumni helped to support the educational mission of the department through AIChE presentations, classroom presentations and seminars, and related activities. Thirteen of the 46 mentors (28%) made at least one presentation or performed a related activity in the past three years and several mentors made multiple presentations. One mentor co-taught a one-hour graduate class to help prepare Ph.D. students for careers in industry. Table 7 summarizes the mentor activities by the type of activity, the area of expertise and the mentor involvement. It is also notable that two of the mentors that were not yet participating in these activities expressed a desire to participate in the future.

Type of Activity	Area	Mentor Involvement	
		No. Presentations	No. Mentors
Classroom presentations	Intro to ChE	2	3
	Sustainability	5	3
	Bioreactors	1	1
	Safety by Design	1	1
Judging presentations	Design	1	1
AIChE presentations	Multiple	6	4
Teaching a Class	Ph.D. prep for industry	8	1

Table 7.	Mentor Partici	pation in De	partmental Eq	ducation Activities
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Similarly, many of the mentors were involved in other interactions within the department and the College of Engineering. Twenty-one of the 46 mentors (46%) are participating or have participated in these types of activities and, once again, some mentors participated in multiple activities. Table 8 summarizes these activities, noting that the table includes important activities that are helping to shape the future of the College of Engineering and the Department of Chemical Engineering.

Table 8. Mentor Involvement in Additional Departmental, College or University Activities

Activity	Level	No. Mentors
Arkansas Academy of Chemical Engineers	Department	11
Chem-E Car	Department	1
Scholarship programs	Department	2
Discussion of climate solutions	Department	1
Arrange presentations at companies	Department	1
High school student visits to department	Department	1
Other alumni interactions	Department	1
Engineering advisory	College	2
Engineering development activities	College	1
Early Career Advisory Council	College	3

Financial Contributions

The mentors were asked if they had made financial contributions to the U of A Chemical Engineering Department in the last three years. A summary of the responses to this question, shown in Table 9, verified that most of the younger alumni are not yet in a position to make financial contributions to the department but instead are eager to make non-financial contributions, including serving as a mentor. By contrast, a majority of the Academy member mentors were making financial contributions.

Response	Number Responding		
	Academy Members	Younger Alumni	
Yes, the mentoring program impacted my giving more	9	3	
Yes, the mentoring program impacted my giving less	1	0	
No, I am not considering it at this time	1	11	
No, but I am considering it in the future	0	18	
No response	0	1	

Table 9. Summary of Mentors' Desire to Make Financial Contributions to the Department

Mentors Mentoring Other Mentors

Mentoring is not just for students and mentoring of course continues throughout our professional lives. The mentors were asked if they had served as a mentor, formally or informally, to any of the other alumni from our department. Seventeen of the 46 mentors (37%) indicated that they had indeed served as a mentor. Examples of the mentoring included formal and informal mentoring of employees (and our alumni) at their companies and providing advice on making a job change. Nearly all of the respondents indicated that they had formally or informally mentored employees at their companies. Many of our younger alumni can benefit greatly from mentoring because they have not yet firmly settled into their careers or are still considering major career moves.

Concluding Remarks by the Mentors

The alumni mentors were highly complementary of the mentoring program and are excited about their participation. When asked if they would like to continue to participate in the mentoring program in the future, 28 of the 46 mentors (61%) said "definitely yes" and 18 (39%) said "possibly." None said "definitely no." Thirty-three of the 46 mentors (72%) said that they have encouraged other alumni to participate in the program and nearly half of the mentors shared positive overall comments about the program. A few of the comments are shown below.

This is a great way to stay connected with the university and provide students with experience and connections!

I love the engagement with the students. Mentors are invaluable throughout your career and it's rewarding to contribute back in that way.

Engaged alumni, engaged faculty, and engaged students creates a great program.

The mentoring program has improved my connections to past classmates, new colleagues, and the students. I get significant fulfillment in helping mentor students as they transition from school into the workplace.

I enjoy helping young people starting their careers.

It is a great program that gives our students an edge in their professional careers.

The expanded connection to the Department as many alumni are scattered all over the country is valuable to alumni connections.

It was a great experience to mentor the next generation of engineers and the networking opportunity was also great!

I have very much enjoyed this program and would love to continue to be a part of it. I work for a great company and would love to help a mentee get an internship or job after college or even continue the mentorship outside of the program.

Benefits to the Department

Many of the benefits of the alumni mentoring program are obvious, but are also very important:

- Career mentoring gives our students a clear advantage as they navigate the job market and compete for jobs against students from other universities.
- Some of the mentoring relationships will last for years.
- The mentoring program gets alumni connected to the department and has made the alumni feel that they are appreciated and have a significant role in developing chemical engineers for the future.
- The department can advertise the mentoring program as a special feature to incoming students, both at the graduate and undergraduate levels, and note that they will have the opportunity to participate in career development activities that may not be available to students at other universities.

However, some of the less obvious benefits that were discussed in this paper are just as important:

- Mentoring participants truly feel a stronger connection to the department. Wellconnected mentors who believe in the benefits of the mentoring program will also participate in other important alumni activities in the department including seminars and presentations in classrooms and with AIChE, service on advisory councils which helps to set the future direction of the college and department, and the development of scholarship programs.
- Younger alumni are looking for ways to help the department but are often not able to make financial commitments at this time in their careers. A mentoring program can serve as a conduit for engaging multiple young alumni which could also lead to future financial gifts.

• Mentoring leads to more mentoring, and mentoring leads to a community. Many of our program mentors also mentor other alumni inside their companies and alumni seeking career changes. Many of our students have now experienced mentoring as they progressed through the chemical engineering program and will very likely expect to be asked to serve as a U of A mentor once they have settled into a career.

Conclusions and Future Initiatives

An alumni mentoring program has been developed for undergraduate and Ph.D. students at the University of Arkansas and has been successfully operated for the past three years. The program pairs students and alumni in mentoring circles that consist of three mentors and 4-6 students that are at the same academic level. Circles meet virtually, in-person or a combination most typically four times during the Fall semester. The program is very successful in helping students learn about career options for today's chemical engineers, the mechanics of the interview process for internships and full-time jobs, and the on-the-job expectations of a successful engineer.

In addition to these obvious benefits of alumni mentoring for the students, the program also generates significant intrinsic benefits including a stronger mentor connection to the department and university; job offers for our students from the mentors' companies; significant participation by the mentors in the education mission of the department through the presentation of seminars, classroom activities and extracurricular activities; financial contributions by the mentors and a willingness for mentors to mentor other mentors. The alumni mentoring program and resulting intrinsic benefits in turn lead to a community atmosphere within the department. As a final thought, one more quote from an alumni mentor: "We should have done this years ago."

Future initiatives include the development of an option for mentoring in specific areas of chemical engineering, getting even more alumni mentors involved in the program and perhaps even extending the program to future chemical engineers that are participating in the First-year Engineering Program (FEP). Mentoring in specific chemical engineering areas was suggested by students participating in the program and might be accomplished by offering subject-directed mentoring in addition to the standard mentoring program. Many of our mentors have participated in the program for all three years of the program's existence, which limits the opportunities for the addition of new mentors. A year or two off from mentoring after participating for 2-3 years might bring more mentors to the program while also giving active mentors a brief break from mentoring. Finally, the addition of FEP students to the program might attract more students to chemical engineering.

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Mentoring Program Impact Survey, Including Survey Results Without Comments January 2024

1. Do you feel that you have a stronger connection to the University of Arkansas (U of A) Chemical Engineering Department through your participation in the Alumni Mentoring Program?

> Definitely yes—30 Somewhat—16 Definitely not—0

2. Has your interaction with your student mentees extended beyond the mentoring program? If yes, explain.

Yes—13 No—33

- 3. Has your company participated in the U of A STEM Career Fair at any point in the last three years? Please comment.
 - Yes—9 No—37
- 4. Have you informed the U of A Chemical Engineering Department or students about job openings at your company? If yes, please explain.
 - Yes—18 No—28
- 5. Has your company recently hired a U of A full-time, co-op or intern chemical engineer? Please include any comments on the hire or how the mentoring program impacted the hire.

Yes, but the mentoring program did not impact the hire in any way—7 Yes, and the mentoring program impacted the hire—7 No—29 No response—3

- 6. Have you presented a seminar or made a classroom presentation in the last three years at the U of A? If yes, please describe.
 - Yes—13 No—33
- 7. Have any of the U of A chemical engineering students contacted you outside of the mentoring program? If yes, please comment.
 - Yes—17 No—29
- 8. Have you had any other interactions with the department, college or university? If yes, please elaborate.
 - Yes—21 No—25

9. Have you made financial contributions in the last three years to the U of A Chemical Engineering Department?

Yes, the mentoring program impacted my giving more—13 Yes, the mentoring program impacted my giving less—1 No, I am not considering it at this time—13 No, but I am considering it in the future—18 No response—1

- 10. Would you like to participate in the mentoring program in the future? Definitely yes—28 Possibly—18 Definitely no—0
- 11. Have you encouraged others to participate as a mentor in the Alumni Mentoring Program?
 - Yes—33 No—13
- 12. Have you served as a mentor, formally or informally, to any of the other alumni from our department? If yes, please describe.
 - Yes—17 No—29
- 13. Any other comments on the impact of your involvement in the Alumni Mentoring Program?