Alumni Engagement and Mentoring Integrated in the Chemical Engineering Curriculum

Dr. Joaquin Rodriguez, University of Pittsburgh

Joaquin Rodriguez is an Assistant Professor at the Department of Chemical and Petroleum Engineering at the University of Pittsburgh since 2018. He received his bachelor degree in Chemical Engineering from Universidad Simon Bolivar (Caracas, Venezuela), MSc. and PhD in the same discipline from the University of Pittsburgh (1990-92). He developed his expertise in thermal cracking processes and advanced materials (cokes, carbon fibers) from oil residues, and became a business leader for specialty products (lube oils, asphalts, waxes, cokes) at Petroleos de Venezuela, PDVSA (1983-1998). He is a founding member of Universidad Monteavila (Caracas, Venezuela) (1998—2018) and became the Chancellor of this university (2005-2015), and the President of the Center for Higher Studies (2015-2018), including teaching in the Humanities. After rejoining the University of Pittsburgh, he has been teaching Pillar courses on Reactive Process Engineering, Process Control, Process Control Lab, Process Design, and Green Chemical Engineering and Sustainability. In addition to technical courses, his service extends over curriculum development, outreach programs, alumni network, team and leadership skills development, global awareness, sustainability, and diversity, equity and inclusion.

Alumni Engagement and Mentoring Integrated in the Chemical Engineering Curriculum

1.0 Introduction.

Alumni engagement is intensively and widely fostered by colleges and universities to attract funding and donations, prestige, and loyalty. Engaged alumni can also improve the rate of job placement and internship opportunities for current students. In addition, alumni can provide a most valuable source of mentoring for students in their curriculum and career. However, there are limited approaches to engage alumni with curricular courses. Some experiences include invited talks and some type of participation in capstone design projects, as industrial collaborators [1], sometimes as industry liaisons in real-world projects [2], or as industrial advisors to meet with students and review their reports, or industrial partners pitching projects for students' choice, attending, and grading final presentations, or invitees for special topics (i.e., safety, team building, PI&Ds) [1].

2.0 Project Description

2.1 An initiative inserted in the capstone course for chemical engineers.

Teaching the capstone course for chemical engineers (generally a process design course) is always very challenging. Students come with the expectation of wrapping up all that they were learning in college and projecting their application in the upcoming jobs. Most of them have one foot in college and one foot in industry or graduate programs. They expect the course to provide a bridge between the "two worlds", or between "the past and the future".

The capstone course at our institution has been described elsewhere [3]. Essentially, it is a five-credit-hour course, offered twice a year in the spring term (two sections) and in the summer session (one section). Spring sections normally enroll 30-50 students, and less than 20 in the summer sessions. One faculty teaches each section. Spring sessions may have one or two teaching assistants (graduate students). It focuses on a team project for the design of a commercial chemical plant, with supporting lectures on process synthesis and design, equipment sizing, and economic evaluation. It makes extensive use of software (i.e., Matlab, EXCEL) and simulators (i.e., ASPEN). The course underscores the development of teamwork skills, providing some limited additional training on team building and performance, and at least two weekly hours of in-class teamwork with the assistance of the faculty. In addition, teams develop an outreach project, most frequently a selection or combination of presentation on chemical engineering topics (curriculum, career, and job experience) and hands-on experiments, delivered to K-12 programs. The course assesses ABET Criterion 3 outcomes 2, 3, 4, 5, and 7. Recently, faculty have been advancing some initiatives to reinforce outcomes 2 and 4 [4].

In 2021, one faculty teaching the course advanced the proposal to include student-alumni networking as a resource to support the transition of senior students to jobs or academic careers. One strong motivation for the initiative came from the faculty's conviction that alumni could provide effective orientation to current students for career development, grounded on the similar

experience of sharing the same college education. One additional motivation was the faculty's vision of developing a long-lasting intergenerational chain where current students motivate younger generations for STEM careers (outreach project) while receiving somewhat analogous orientation for their own careers from department alumni. In addition, a reinforced motivation came from consulting with officers at the alumni engagement office who confirmed the interest of some alumni in keeping in contact with the department, and enthusiastic about the opportunities of networking with students. The office of alumni engagement and some members of the department advisory board showed strong interest in supporting the initiative of opening opportunities for increasing alumni involvement with the department.

The initiative was structured in the format of an open-end project, titled "Legacy project", for individual students to relate to individual alumni, fostering networking and mentoring. The syllabus included a description of the project, deliverables, schedule, and grading (detailed below). Alumni received the same information at the start of the project. The instructor was responsible for arranging for the pair matching and introducing each other. Alumni and students were then free to arrange for the communication strategy, schedule, and evolution during the semester. Students were advised to lead the initiative. The instructor recommends about three or four brief and spaced meetings with somewhat specific and different purposes each.

- One first meeting targeting to get-to-know each other.
- A second meeting to share on the experience at college, identifying common and diverse backgrounds (i.e., courses, professors, places, events).
- A third meeting (or more) to explore career orientation.

Students were invited to present initiatives to alumni for their advice, being technical (current courses, projects, etc.), professional (job opportunities, academic areas), or personal (on career development), that can resonate with alumni experience or interest. In addition, faculty suggested including a conversation on the "alumni role" considering recommendations to keep and foster the loyalty, service, and engagement with the institution. However, it was emphasized that the topics and arrangements were open to be decided by the students and alumni.

The objectives for the project were summarized as:

a) To add to the formation of senior students the guidance of experienced alumni in the areas of industry, academia, management, and personal wellness,
b) To promote the engagement of committed alumni, fostering their institutional loyalty, and providing valuable mentoring experiences and advises,
c) To provide useful information in tracking the progress of the education and professional training provided by department from the perspective of alumni.

The project was attached to ABET Criterion 3 Student outcome 3 "Ability to communicate effectively with a range of audience", adding to students' communication with non-technical audiences (outreach project) and industrial collaborators (technical project).

The project has been executed with the courses taught in the spring 2021, spring 2022, and summer 2023. A special edition was run in the summer 2022 with the junior course on "Process Reactive Engineering" as it will be explained below. It is also in progress in the spring 2024.

2.2 The alumni network.

The alumni network started with a seed of volunteers replying to a survey by the office of alumni engagement about their potential commitment to serve in this role. A former list of 21 alumni responded positively to pioneer the initiative; however, two of them did not follow up on the invitation. Students, who had been invited to suggest alumni potentially interested in the project, proposed 26 candidates (family relatives, supervisors from co-op rotations, older friends). In addition, the instructor recruited three former colleagues and one former student to complete the roster for the 49 students enrolled in that year. Table 1 reports the source of alumni for the entire project.

Table 1. Source of alumni participating in the project.

Source	2021	2022	2022*	2023	Pending	Total	Active
Office of Alumni Engagement	21	13	-	5	-	21	17
Office of Career Center	-	5	-	1	-	5	5
Instructor	4	7	8	3	7	26	24
Colleague	3	2		1	-	4	2
Email mistake	-	1	-	-	-	1	1
Former Graduate Student		2	-	-	-	2	2
Former Undergraduate Student	1	2	8	2	7	12	19
Students	26	24	2	5	-	47	36
Unknown	1	1	-	-	-	1	1
Relative	6	3	-	-	-	9	2
Co-op/Internship	6	6	-	3	-	8	7
Friend	12	13	2	2	-	28	25
Coach	1	1	-	-	-	1	1
Total	49	49	10	14	7	99	82

In the second year (2022), 13 alumni from the former list of the office of alumni engagement participated in the project. In addition, the instructor identified the office for career center as a new source for alumni potentially interested in the project, as they were in contact with alumni working in companies frequently coming for recruitment at career fairs. The office of career center suggested a list of 17 candidates. The instructor contacted 10 of these candidates and 5 of them responded with interest and joined the project in this second year. The instructor added three new students (one former undergraduate student, and two former graduate students in the department). The account of 24 alumni proposed by students that year included 6 alumni that had already participated the previous year and were directly contacted by the instructor. In that same year (2022*), the instructor took the initiative to extend the project to the 10 junior students attending the course of Reactive Process Engineering, selecting former undergraduate students as the alumni for this edition.

The third year (2023) edition was developed with the summer session, as the instructor was not assigned to teach the spring session. The sources for alumni are reported in Table 1, also reporting several alumni (7) who have confirmed their interest in participating in the project but who have not been assigned any student yet (labeled as “pending”). In total, 99 alumni have been

listed in the project, with 82 considered active as they have not canceled their participation and have replied to emails in the last two years. As it can be noted, most of the alumni nominated as a “family relative” do not remain active after helping with their first assignment. In addition, most of the alumni nominated by students as “friend” are generally older peers, graduating one to three years before. These alumni have helped current students with the unique orientation on how to navigate getting a job and transitioning to the first job in current circumstances. These alumni have remained available to network and mentor new students other than the ones who nominated them. An increasing number of students, who participated in the project in previous years, volunteer to serve in the role of alumni after graduating.

Most of the alumni work in industry (21.21%), others in academia (17.17%), businesses (12.12%) or government agencies (9.09%). The list includes 5% of retired professionals and 4% in other professional areas (law, medicine). The distribution of alumni according to the years after graduation is presented in Figure 1. About 36% graduated more than 20 years ago, with a record of 46 years ago, and the remaining in the last 13 years. The significant number of alumni with less than 6 years after graduation participating in the project results from the interest of students on getting advice from recent graduates on how to navigate entry-level job opportunities (and academic programs). In addition, some alumni participating in this project as students (last three years) are volunteering to serve in the role of alumni after graduation, though 33% of them have not had any assignment yet. About 13% of the alumni have graduate degrees from the institution, and 12% have a degree other than the chemical engineering degree (mainly associated with students selecting them as a family relative for networking). Six alumni have mentored students three times, and 21 alumni have mentored students twice, all in the different courses.

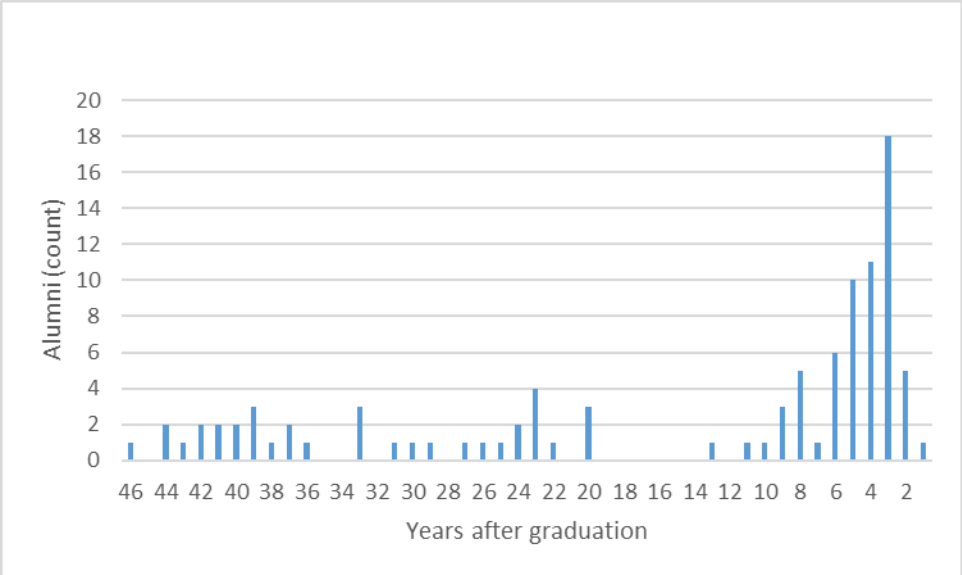

Figure 1. Distribution of alumni by years after graduation

All the alumni are contacted at least once a year, generally by Thanksgiving time, with a thank-you note of sincere gratitude for serving in the project. This also helps in detecting changes in email addresses and sensing alumni's renewed commitment form their feedback (or lack of). There are also special occasions to get in contact with all of them (i.e., survey, report on activities like presenting a paper about the project). Selected alumni are approached by email at the beginning of the courses upon identifying them as a potential good match with a student (see below). Only three alumni have asked to be removed or expressed no interest in keeping on the project, and about 14 have not replied to emails in the last two years and are considered inactive. All the communications are personalized (no mass-emails).

2.3 The matching process.

The matching process takes place at the beginning of the semester (during the first four weeks) when the instructor attempts to reconcile interests and characteristics from alumni and students to the extent possible. The instructor keeps basic records of alumni (year of graduation, degree, company/institution, job position, and email). The instructor has become increasingly acquainted with alumni by the reports of the students networking with them in the past (see below about deliverables). There have been a few opportunities for the instructor to meet with alumni in their visits to campus, or through virtual meetings. On the other hand, the instructor explores students' preferences in terms of their projected career (job, academia, manufacturing, sales, professional school, etc.) and about their interests in networking with experienced or recent alumni. Based on this limited information, the instructor explores potential matches, certainly constrained by personal biases. Attempts are made of gender, race, and ethnicity parity, in addition to the professional preferences, though there have been exceptions. The instructor offers no guarantee of matching all the preferences as constrained by alumni availability and expertise.

The matching process is simple though it takes some time (about 1 hour per student, in average). Upon identifying a potential match, the instructor emails the alumnus or alumna to check on their availability and renewed interest. Most of the replies have been positive (only two negative responses in the 3-year period) and fast, generally in a two-day period (one week at most). If there are no major concerns with student's preferences, the instructor email them both with a simple introduction message and the scope of the project, as included in the syllabus (one page). The instructor offers the availability to intervene, if necessary, but alumni and students are reminded that the project is for their free interaction. There has been only one occasion for the instructor to intervene, because one of the alumni could not commit to the project due to unexpected workload at the job.

At some point, there were considerations of establishing some virtual structure to facilitate the connections, providing information on alumni and students for autonomous matching. We explored current resources at our institution to keep in contact with alumni as a potential platform. However, we have opted for keeping the current format considering potential conflicts with the extent of personal information, protecting the time involvement of alumni, providing students with more direct guidance, and framing it into the academic scope of the course.

2.4 The open space for alumni-students networking and mentoring.
The open space for the alum-student interactions is facilitated by the instructor's introductions and guidance to both sides on the scope of the project. However, the project develops entirely on the alum-student networking. They are free to set up meetings and content. They are encouraged to go beyond the basic instructions. and make it a wonderful and fruitful experience for both.

While students are advised by the instructor to take the lead in asking questions, proposing topics, and requesting advice, they are also encouraged to share with the alum partner their experience at college, their interests, their concerns, their aspirations.

Meetings generally developed virtual platforms, with the support of emails. This makes the project highly accessible for any participation. However, there have been opportunities for some local alumni to meet personally with their student partner, or taking occasion of a visit to campus, or at the coincidence of a common meeting elsewhere. Students are advised to respect alumni's busy schedules, with the suggestion of targeting three-four meetings during the project, 15-30 min long.

2.5 Deliverables and grading.
The main goal of the project is to provide an opportunity for alumni engagement and students mentoring. The project deliverables are intended to provide some structure and orientation, but they are not proposed as substitutes for the rich personal experience that goes into this networking experience, nor are they to be considered checking boxes for grading. However, they are extremely useful to develop students' communication skills and to provide information for further improvement of the project, recommendations on updates for the curriculum, and initiatives to explore with keeping the support of alumni for the institution.

Four deliverables have been tested, with some modifications to better adapt to circumstances, as explained below.

- The "bio-sketch" assignment prompts student to elaborate a short (2-3 pages) narrative about some biographical information on the alumnus or alumna, as described in Figure 2. It is intended as an ice-breaking activity and to facilitate getting to know each other. Students are advised to explore ahead information on their alumni partners available in public sources. They are also encouraged to share their own biographical information. Students are also provided with a sample of a previous bio-sketch. The assignment is scheduled for the first month of the course, but with flexibility to adapt to circumstances such as late matching, busy schedules, etc. Students are also advised to propose a meeting schedule for the project.
- The "exchange" assignment requests from students to provide a narrative of 3-4 pages with the most relevant information exchanged in the meetings that students select for sharing.
- The "personal assessment" assignment is intended for students to provide a one-page reflection on the added value of this project and some recommendations for further improvement.

    - These last two assignments were run separately in the former editions of the project, but we took recommendations from students to reduce the number of assignments, so they have been simplified in one single assignment labeled "critical assessment" as described in Figure 3. This assignment is scheduled for the final two weeks of the course.
- The "focus group meeting" is an opportunity for socializing the experience in small groups and obtain direct assessment for the instructor and the office of alumni engagement. Students are split in small groups (about 6 students, generally the members of the team development the design project for the capstone course) to meet with the instructor and officers from the office of alumni engagement, with a dynamic of fast Q&A sessions as described in Figure 4. These meetings are scheduled in the last week of classes (before the week of finals) in one class session, where one group attends the meeting (15-20 minutes) while the other groups keep working on the final report of technical project.

The first three editions of the project were included as a regular (mandatory) component of the course. However, more recently, the Department has been reviewing the curricular load for students, in response to some criticism of potential excessive demand for students' independent work associated with the fundamental courses of the career. Faculty have been suggested to revisit their course programs to comply with School regulation (i.e., 2 hours of independent study work per hour of lecture) and to better align with students' expectations, including the impact of Covid-19 pandemic on student mental health and attitudes. As a response, the instructor took the initiative, starting in 2023, to offer this project as optional. In that opportunity, all the students enrolled in the course decided to take the project. However, for students who could choose to opt out of this project, the corresponding weight percentage of the assignments were to be added to the technical project, a major component of these courses.

Description. A short (2 pp, Times New Roman 12, single space, left justification) biographical note on partner alumnus/a. Provide a fluid narrative to describe your partner's profile, collecting data from available sources and from direct conversation. Provide personal and family notes before coming to Pitt (place of birth, childhood, K-12 schools, sports, hobbies). Include degrees/dates at Pitt and some distinctive anecdotes. Describe important milestones in the professional career (jobs, honors, publications, achievements) and personal life. Describe current job. Include hobbies, favorite things, and places, etc. Add comments that impacted you during the first conversation. Review the Appendix below "On preparing for the first meeting".
Use the style of a newspaper article or a friendly introduction for an honors convocation. Review the sample.

Appendix. On preparing for the first meeting
It is important to find out a gentle and respectful way to manage these topics, not a dry Q&A exchange. Remember that the project asks for an exchange. You should try to share the same information about you as the one you are asking from your partner (as it makes sense).
Please, do research on your partner. Collect as much information as possible to document your bio sketch and to orient your conversation. It is okay if you do not find any. Some alumni may not have public exposure.
What is your heritage?
Where were you born?
What was the family business when you were born?
Where did you spend your childhood?
What schools did you attend?
What were your favorite games and passions at that age?
Which professors made a significant impact on your career choice?
Any anecdote?
What degrees did you get at college? (We will talk about your college experience in a future meeting)
What jobs did you get in? What position did you reach?
What does a typical day look like for you (morning rituals to get the day started etc.)?
Please, do not share the bio-sketch with anybody before getting your partner's approval!

Grading: 2 points, by Instructor/office of alumni engagement
Rubric

Items	Range	Points
Important dates and places before coming to Pitt (birth, childhood, K-12)	0-4	
Relevant information on Pitt connection (majors, degrees, sports, activities) and memories (professors, places)	0-4	
Description of current job and activities	0-4	
Important information on career and life achievements	0-4	
Impacting comments from the first meeting	0-4	
Total	0-20	
Divide by 10. Report one decimal figure	2.0	

Figure 2. Description of the bio-sketch assignment

Description. A 3-5 pages essay on topics discussed with alum. Topics for communication are wide open including alumni experience at Pitt and after graduation, comparisons with current college experience at Pitt provided by the student, advises from alumni on graduating students after graduation, analysis, and recommendations on improving aspects of Pitt's performance on education. Students are invited to present initiatives to alumni for their advice, being technical (current courses, projects, etc.), professional (job opportunities, academic areas), or personal (on career development) that can resonate with alumni experience or interest. Assessment of the experience with this project, significant takeaways, and suggestions to improve it.

Please structure your essay in four main parts.

1. The exchange of experiences at Pitt, academic and social. Compare both perspectives and come out with suggestions about what is great at Pitt, what has changed, what can be done better.
2. Advice on professional development and a successful career, with a good work-life balance. You should be asking about all things that are relevant for you to discern your options and opportunities.
3. Exchange on how you both see your roles as Pitt alumni, what information you would like to receive, what help you would like to give back, what proposals you may have for the Alumni Association.
4. Assessment of your experience, including major takeaways, value for your formation, suggestions for improvement of the project, etc. Please elaborate on your strategy to develop this project. Please, comment on how the project helped you to visualize and commit to your role as Pitt alum.

This essay does not have to address all the issues but to provide an illustrative narrative of the most relevant and impactful content. Use the style of a newspaper article. Please complete the following survey.

Have you met your alumni partner before this project? (Y/N)	
How much information did you get about your alum partner before the first meeting? (Scale 0-5, 0-None, 5-Very much)	
How long did take you to get the first connection with your partner after you send the invitation to meet (# days)	
How friendly was your first experience connecting with your partner for this project? (Scale 0-5, 0-Not so friendly, 5-Very friendly)	
How many in-person meetings did you share with your partner?	
How many virtual meetings (phone, zoom, other) did you share with your partner?	
How many emails did you exchange with your partner?	
How much time did you spend exchanging with your partner (hours)	
How much time did you spend in the entire project (hours)?	
How valuable was this project for your formation? (Scale 0-5, 0-Not much, 5-Very much)	
How much do you support keeping this project in the curriculum? (Scale 0-5, 0-Not much, 5-Very much)	
What is your self-grade for this project (1-5, 5 is best)? You may use up to one decimal	

Grading: 3 points. Alum (50%), Instructor (25%), Self (25%)
Rubric for Instructor

Items	Range	Points
Narrative on alumnus/a-student experience at Pitt during college time What suggestions you both have to improve our curriculum and formation at Pitt?	0-4	
Narrative on advice for professional career development How have your partner's advice influenced your career goals?	0-4	
Narrative on the role of Pitt alumni (commitments, information, the Association, activities), including student projection. Recommendations.	0-3	
Narrative on the assessment for this project, including major takeaways and suggestions for improvement	0-4	
Total	0-15	
Divide by 20. Report one decimal figure	0.75	

Figure 3. Description of the "critical assessment" assignment

Thank you so much for attending this meeting and thank you very much for participating all through this semester in this pioneering project.
This meeting focusses on how to improve this project. You can elaborate on other aspects of the project in your critical assessment.
We have seven questions. After you hear your name, please provide your comments. You can follow up briefly on any other comments, following courtesy rules and due respect. Time constraints make this meeting a fast exchange.

Please, remember NOT to identify your alumni partner.

1. Did this experience add value to your education? Personally, professionally, networking, other?
2. What was the best moment of this project?
3. What did impress you the most about your partner?
4. In a scale 0-10 (10 being the best), and overall, how do you rate this project?
5. Would you recommend keeping this project for the CHE0613 course?
6. What major improvement would you suggest?
7. How do you envision your engagement as Pitt alumni?

Thank you so very much!

Grade, 2 points, by officers form the office of alumni engagement and instructor.

Item	Range	Points
Participation. Answers all the questions	0-1	
Contribution. Provides meaningful analysis and valuable suggestions	0-1	
Total	0-2	
Report total with 1 decimal figure	2.0	

Figure 4. "Focus group meeting" script.

The grading structure for the assignments and project is summarized in Table 2. The two initial editions of the project earned students 8% of the final grade for the course. The trial edition with junior students in the Reactive Process Engineering course was significantly simplified, with only one short assignment (personal assessment) and the focus group meeting. There was no good opportunity to schedule the focus group meetings during the summer session of 2023, and the grading for the project reduced to 7%.

Table 2. Grading of assignments for the Legacy project. Percents over the final grade for the course

Year	2021	2022	2022*	2023
Bio-sketch assignment	2	2	-	2
Exchange assignment	2	2	1	5
Personal assessment	2	2	-	
Focus group meeting	2	2	1	-
Total legacy project	8	8	2	7

We took the opportunity to survey students attending the summer session of 2023 regarding their time investment in the project. These surveys were conducted on a weekly basis. Overall results are presented in Figures 5 and 6. The average for the total time investment of the students in the project averaged 10 hours (heavily influenced by the extended dedication of two students in this sample), with a mode and median of 8 hours. The actual time invested by students in meeting with their alumni partners averaged 2.57, with a mode and median of 2.00. Certainly, the open-ended nature of the project and the personal environment for its execution allows for significant variations on the involvement of students and alumni (i.e., some students went out for lunch with alum for meetings).

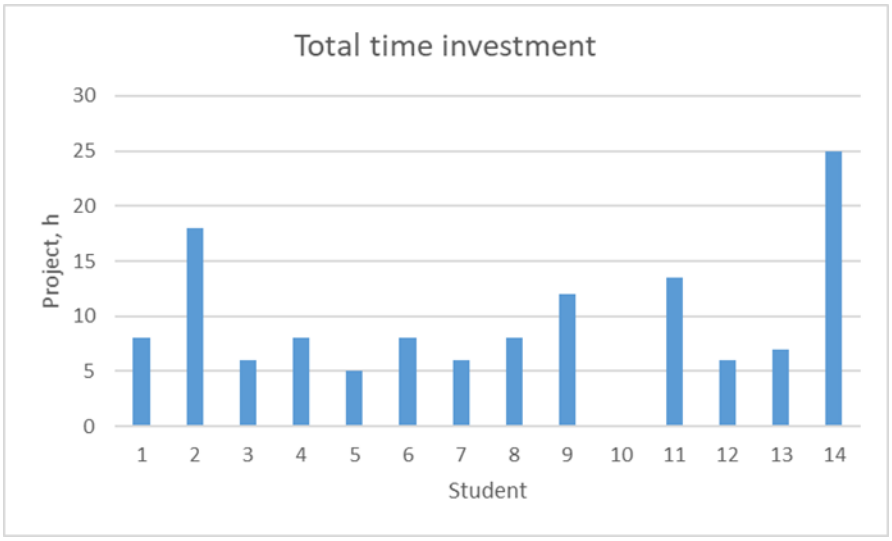

Figure 5. Students' total time investment in the Legacy project, totaling weekly dedication surveyed on weekly basis.

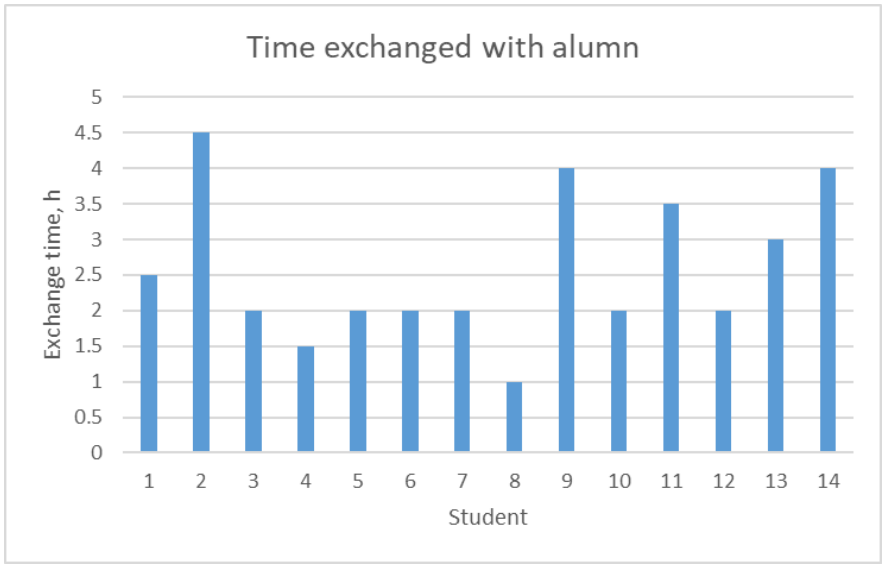

Figure 6. Students' total time exchanged with alumni in the Legacy project, from weekly surveys.

3.0 Analysis of the experience.

The project has provided a unique opportunity for alumni to keep or renew their engagement with the institution. To assess some way the rich interaction of this initiative, a survey explored major takeaways from alumni. The survey was responded to by 21 alumni. Most (15/21) of the alumni reported that his project is the only one that keeps them connected with the institution, two ranked it one of the top two connections they keep with the institution, other two ranked it in the top five, and one reported that it is ranked very high. The alumni time investment also varies significantly (0.5-10 hours) with an estimated average of 3-4 hours. Some major takeaways from alumni are reported in Table 3.

Table 3. Selected major takeaways reported by alumni.

"An opportunity to share my knowledge with a [ ] student and hopefully enhance their ability to succeed in their studies and work and life. An opportunity to see what is on the mind of students today i.e., stay in touch with current [ ] students."
"It's very encouraging to share experiences with the students. They are smart, motivated and are willing to listen."
"I do believe that new/ young engineers can benefit from conversation/ insight from seasoned and experienced engineers. Conversely, I believe that I have learned what these young people are feeling and facing as they traverse the educational process with the goal of an opportunity to start their careers in a productive role."
"It was very interesting to discuss the career pathways of the engineering students. My main experience is in medicine, so I enjoyed discussing future pathways with the engineering students. My husband is an engineer."
"Love the connection with the students and learning about their college experiences. Rewarding for me to share my experiences"
"Some students are highly receptive to advice from old guys, others appear to feel that have a solid grasp on the world (much as I did when I was in my early 20's, only to figure out that I was a bit brash)"
"There is a curiosity for the students on what they can do with their ChemE degree, beyond the obvious heavy-industry chemical plant design or academic route like their professors"
"I really learn a lot about the University, the Chemical Engineering department, and how things have changed since I graduated in 2004. It is great to stay in touch with the University and current students. I get to re-live the wonderful memories I made as a student whenever I talk with them! To the extent I can pass any of my work experiences that can help students (especially those interested in non-traditional career paths, like in law or data analytics), I am happy to help. But I think I'm learning even more from them—seeing a student's perspective on the world really helps me too! I am always so impressed with how mature, wise, and prepared your students are."
"It was great being able to interact with a current student and reflect on my time at [ ] and how it has helped me get to where I have in my career!"
"It is humbling to be able to give back my professional experience to upcoming engineers. I enjoy learning about what pre-career individuals want to do with their lives and even have experiences thus far (internships, research, etc.). I think it helps me in my own role because I have been involved in mentoring and advising younger engineers and interns. I also have a passion for college recruiting and would like to get [ ] as a potential partner school for [ ] one day. The more I can build this connection, the more likely it is for this to happen"
"It is important to have an alumni contact or two as an undergrad to help you understand the next steps after graduation. It also helps in making the transition out of undergrad in graduation, industry, or whatever other path one decides to take."
"It incentivizes students to attain industrial insight in an achievable and applicable way. (And I think that's awesome!)"
"My biggest takeaway is that the [ ] Chemical Engineering department is dedicated to continuous improvement and ensuring that the curriculum stays in line with current technology and practices in the field."
"My major takeaways from now being on the alumni side would have to be nothing but positive. As I am a very young alumni, I was able to relate to some of the questions/concerns my partner had with classes and was able to provide some advice and input in that regard. I personally enjoyed getting to connect with current students and hearing about their journey and sharing mine as well. I left the project feeling inspired and connected with the school."

Their statements reflect a very positive appreciation of the scope of the project and their experience networking with current students. They also addressed valuable suggestions for improvement, as reported in Table 4.

Table 4. Alumni suggestions for improvement

"I like the structure - the student comes to the discussion with clear goals which makes it easy to start each session and develop a relationship. The only add might be the student bringing the mentor some piece of work for the mentor's input."
"Perhaps the use of Zoom with a recording for the initial session then a meetup to discuss the write-up. That way the student can focus on the interview and not have to worry about taking notes."
"I think the structure is good. May consider engaging students earlier in their college career (i.e., junior year?), to provide mentorship as they move thru their job searching and interviewing process."
"This is a tremendous work. Keep the strength of its "mission". It can become a pattern soon. Keep and develop the "sense of purpose". Provide for advocacy. Open for industry trends to set the goals for academia. Let industry pull out academia. Realize the faster pace of technology development in industry. Increase partnership with industry. Keep the dominant role of research. Open for higher education transformation in "modalities". Include more industry knowledge (internship, "case studies")."
"I would like to see the final work product of the program. I believe it is a presentation if memory serves. I think it would be nice for the alumni involved to have a chance to see the presentation virtually."
"a Webex kickoff for all attendees could help broaden the network for all involved and cross-pollinate teams and ideas for mutual benefits."
"I think it's already great because it helps to improve students' oral and written communication, and interpersonal skills, which are so important in the workforce, but not always formally taught in the classroom. If students know what they want to do, or where they want to work, when they graduate, it may be helpful to try to match them up with alumni in that same field or company if possible."
"One potential area of improvement is if there was more of a technical piece. For example, University of Delaware partners with outside engineering professionals to get volunteers to mentor the senior capstone project. I would love to get involved more thoroughly with the design project and perhaps provide guidance from my own experience taking the course and, in the industry"
"One thing that could improve the project might be to expand its reach. This could already be happening, but if the alumni outreach program was started in the second year (first year within the department) then the students could get access to alumni mentioning earlier on."
"My only thought for improvement is to stay in contact at the end of the project and get feedback from students on what they learned from the project itself and also how we can do better as alumni."
"Having a schedule of the deliverables would be helpful from an alumni standpoint. When I assisted last year, I didn't know the schedule and it was difficult to make time to meet with the student."
"The project seemed to do a great deal of collecting feedback from alumni like me, but if any alterations or updates were made to the curriculum because of the feedback of all participants, that wasn't immediately evident. If discussions are happening around our feedback, or ideas are being generated, then releasing a summary or update on status/progress of those discussions/ideas would communicate to alumni like me that our feedback is being translated into tangible results for the student body as a whole. If the main goal is just to share our feedback with undergrads to allow them access to our perspectives, then a summary of how recent graduates have changed career paths in line with some of our feedback would achieve the same"
"I think maybe, if possible, you could have alumni even come into the classroom or incorporate them in such a way that if they are local and can come connect with the school and students in person that could be beneficial to the students and to further the connection between the alumni and school. I really think people are lacking that personal connection, just as we talked about when I saw you last!"
"I think maybe a nice idea would be that in addition to a student connecting with a single alumnus and going through the exercises of the project - maybe (with permission from the alumni participating) share the other alumni that are participating contact info to the whole class along with their job title and company and give the opportunity to connect with them outside of the project."

There have been 124 students enrolled in this project for the last three years. A total of 112 were senior students taking the capstone course on process design. All of them completed the assignments, though one student was limited in the scope as her alumna partner was not able to continue with the mentoring. There was a trial experience (2022*) with 12 junior students attending the reaction engineering course in a summer session. Ten of those students completed a reduced version of the assignments, and three students abandoned the project and the course at a late stage in the semester. Table 5 reports on student overall evaluation of the project. Results show a very high rate of approval (an average over 8.5/10) with most students (90%) recommending keeping the project in the curriculum, with some (8.5%) students suggesting some modifications (mainly to reduce the assignments) and only two students suggesting removing it (mainly arguing overload work).

Table 5. Overall evaluation of the project by students

Year	Overall evaluation of the project (1-10, 10 being the best)						Recommendation		
	<7	7	8	9	10	Average	Keep	Modify	Remove
2021	2	2	19	15	9	8.51	42	5	1
2022	2	2	20	15	9	8.52	44	3	1
2022*	1	-	2	2	3	8.75	8	-	-
2023	3	-	2	-	9	8.86	12	2	-

Senior students confirm their high appreciation for the project with impacts including choices in career orientation and job offers, and particularly their interest in becoming the alum at the other end of the line for new students, which offers the most attractive guarantee for the persistence of the project. Table 6 provides some illustrations with selected statements. The narratives on the biographical sketches that students wrote on their alumni partner (abundant in anecdotical notes), and their summary reports on their conversations (whether referring to the college experience or orientation after college), including their self-assessments of the project extend over several hundreds of pages very rich in personal and professional insights. Junior students also showed a very positive appreciation after a simplified version of the project as illustrated in Table 7 presenting notes from the focus-group meetings.

Table 6. Students' appreciation of the learning experience with the Legacy project.

"I had a very positive experience with the legacy project. I think at the beginning of the semester I thought of it as just one more thing to check off my to-do list for the semester. However, once we got into the project, I saw it was much bigger than that. I think I have had a rough time finding where I fit within the chemical engineering major because I always feel like I am missing that real world experience. Chemical engineering is such a broad range of careers and ventures. It is hard getting a good understanding of it. This is why I really enjoyed this project. My alumna shared so much detail with me about what she has done during college as well as after. She has experienced many different fronts of chemical engineering experience. I learned a lot from her a better understanding of what it means to be a chemical engineer."
"I want to become a doctor and have always considered the traditional medical career paths (such as surgery, primary care, private practice, academic medicine, etc.). But my partner introduced me to the career of a chief medical officer (and more generally to different roles a doctor can have in industry), who are usually doctors that lead the transition of many new medical treatments/technologies from clinical trials to the market. He exposed me to the various ways doctors can be involved in biotech through entrepreneurship and science, a topic I am really interested in. To do so, he highly recommended pursuing an MD-PhD program. This was also something that I knew about but never really considered, and it is something I am considering now."
"Overall, I think the legacy project is a well-intentioned idea for the curriculum. Establishing a connection with an alumnus is a valuable method for networking. Further, learning from the experiences of past Pitt associates is a good way to understand how the school's education and processes have changed. I think that if a student can maintain their connection with the alumnus they met, it could have lasting impacts on their careers. This project is also a good way to encourage current students to maintain contact with the university after graduation for roles like mentoring."
"For me, I know that I had a very positive experience with the legacy project. I attribute a lot of the success to my partner being very kind and insightful into her job. She was so pleasant to talk to and gave a lot of "quotable" advice that I will remember after this point, especially in terms of what I should be aware of when looking for a job. Even though I'm sure she had other obligations, she was always willing to make time to meet with me, and I appreciate that she took me and the project seriously. It was also cool to see how the engineering experience at [ ] has changed over the years."
"Overall, I enjoyed the legacy project as a whole, but I believe some adjustments could have been made. My partner made the whole experience friendly and shared insights into life after college. We also had the opportunity to bond over teachers, experiences, and life as a whole. My partner gave me another option to a future career path. After all of that, this was a valuable learning experience for me. It taught me things about myself, about my future, eliminated some stress associated with post-graduation plans, helped me make a networking connection/friend, and let me reflect on my college experience and what I liked and dislike."
"The Legacy Project was a nice change of pace for a course that is otherwise very number, figure, and concept intensive (that's not bad by the way). It provided an outlet to get to know another person that I previously had no knowledge of, but now feel I can use as a resource in future career endeavors."
"My personal feeling with this legacy project is that it is a good way for the students to get to know a little bit more about what life is like after graduation as well as a good way for alumni to stay involved with the program. I enjoyed getting to know the alumnus that I was in communication with and it appeared that he enjoyed our meetings as well. One of my biggest personal takeaways from this project is how much it opened my eyes to the ability that a chemical engineering degree gives you to work in a variety of different fields. The alumnus that I worked with went on to be a patent lawyer after getting his initial degree in chemical engineering. Before talking to him I wouldn't have even considered that as a possibility at all. Furthermore, I felt that this project helped me learn how to network with more experienced individuals, beyond those in academia. Even if this project only had me talking to one person it gave me experience in how to talk to more experienced adults."

Table 7. Notes from the focus-group meetings with junior students on the Legacy project

Did this experience add value to your education? Personally, professionally, networking, other?
Yes. Enriched my network, provided me with projection for my career.
Yes. Provided me with tips to move along with the degree and career, study habits, and how are real jobs in industry.
Yes. Both personally and professionally. Help me to plan my next moves, and how to face uncertainties.
Yes. Provided me with insights on realistic expectations.
Yes. Provided me with insights after graduation.
Yes. Mainly with professional orientation
Yes. Good professional orientation, sharing similar tracks. I asked questions that I have not asked anybody else. Gave confidence on my career development.
Yes. Guidance on steps after graduation, despite different tracks (academia/industry). Helped me to reduce anxiety
What was the best moment of this project?
Talking about Boston
Fluid conversation
Nice relation
Sharing her experience with STEM outreach projects
Friendly conversation
Nice relation
Sharing anecdotes from her job
Face to face meeting. Talking about New York. Her experience on changing jobs
What did impress you the most about your partner?
Managing a non-technical job
Moving from industry to academia
Amount of work she manages.
Professional plan
Combining work and study
Versatility in managing a job with many non-technical components.
Working out LinkedIn to get a job
In a scale 0-10 (10 being the best), and overall, how do you rate this project?
6, 8, 8, 9, 9, 10, 10, 10, average 8.75/10
Would you recommend keeping this project for the course?
Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
What major improvement would you suggest?
Enforcing more commitment
More commitment. Plan more time to meet.
Approach more than one alumnus/a
Adjust pairing by previous surveying of interests.
Pair with similar interests (industry or academia)
Establish at least one mandatory zoom meeting.
Pairing with similar co-op experiences
Alumni with more experience. Include alumni in academia. Pair based on surveys
How do you envision your engagement as [ ] alumni?
Come back for meetings.
Moving out of state. Not much follow up.
Not coming back. Attending [ ] events.
Come back as much as possible.
No plan
Come back for football games. Participate in projects like this one.
Participate in mentoring like this project.
Mentoring projects like this one

4.0 Conclusions.

A new initiative of networking alumni with students at the Department of Chemical Engineering has been explored for the last three years, integrating 99 alumni, 112 senior students, and 12 junior students. Results evidenced an extremely positive appreciation by alumni ranking it at the top of their connection with the institution. Students also gave high grades (0ver 8.5/10) for the project and showed a very high support for integrating the project in their college education.

The networking and mentoring project has been integrated with the capstone course on process design and tested with a junior course. It develops upon conveniently arranged meetings (mainly virtual meetings) between one student and one alumni partner, matched by the instructor. A set of three assignments provide some basic structure and orientation for academic purposes.

The project offers a unique opportunity for alumni to provide most valuable mentoring to current students, to suggest improvements to the curriculum, and to obtain institutional updates directly from the personal perspective of students.

The project is a relatively low time-investment activity providing students with insightful mentoring on career development and professional networking and developing valuable communication skills.

The project is a source of inspiration and personal enrichment for alumni and students, that can be easily implemented by committed faculty, and extended throughout engineering education.

References.

[1] L. P. Ford, J. Cole, K. D. Dahm, B. K. Vaughen, M. V. Jamieson, L. J. Landherr, D. L. Silverstein, T. J. Voegel, C. W. West, and S. W. Tiel. "*How We Teach: Capstone Design*". ASEE 2023 Annual Conference & Exposition, Baltimore, MD, June 25-28, 2023. [Online] Available: https://nemo.asee.org/public/conferences/327/papers/37520/view

[2] J. Raab, "*Senior capstone design course marks 25 years of real-world problem solving with industry partners*" Chemical and Biological Engineering, University of Colorado Boulder, 28 February 2022. [Online]. Available: https://www.colorado.edu/chbe/2022/02/28/seniorcapstone-design-course-marks-25-years-real-world-problem-solving-industry-partners . [Accessed 2024].

[3] Rodriguez, J., & Enick, R. (2023, March), "*Chemical Engineering Capstone Course Improved for Broader Impacts"* Paper presented at 2023 ASEE North Central Section Conference, Morgantown, West Virginia. 10.18260/1-2—44905 [Online] Available: https://peer.asee.org/44905

[4] Bayles, T. M., & Rodriguez, J., & Enick, R. (2023, June), "*Board 30: Incorporating the Impact of Engineering Solutions in Global, Economic, Environmental, and Social Contexts into our Core Curriculum"* Paper presented at 2023 ASEE Annual Conference & Exposition, Baltimore, Maryland. 10.18260/1-2—42829 [Online] Available: https://peer.asee.org/42829