

Preliminary Reflections and Assessment of the 2022 Chemical Engineering Summer School

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Abstract

The ASEE/AIChE Chemical Engineering Summer School (ChESS) is a week-long, roughly quinquennial over the past nearly 100 years, faculty development event bringing together early-career and seasoned faculty for workshops and community building [1]. The most recent ChESS took place July 25-29, 2022 at the Colorado School of Mines in Golden, CO, with around 160 participants and 80 presenters. The two core outcomes for the Summer School are 1) to build the Chemical Engineering education community and 2) to provide useful knowledge and tools for teaching, scholarship, and service for those early in their careers.

A typical day at ChESS starts with breakfast and a plenary session, followed by one to two sessions with 5-6 parallel workshops, lunch, then two more parallel workshop sessions. These are complemented by thematic networking sessions, evening poster presentation receptions and a host of social events including a scavenger hunt. One afternoon of the week, local sightseeing and similar activities are available to all participants and presenters. Most workshops are delivered by volunteer presenters from the chemical engineering education community and about 20 are offered by industry and funding agency partners. Changes in programming for the most recent offering included specific identification of pedagogical, Diversity Equity and Inclusion (DEI), and content tracks for the parallel workshop sessions. To support this structure, plenary speakers were invited to present on pedagogical practices and DEI, in addition to the long-standing Teaching Institute and industry plenary. Workshops were either 90 or 150 minutes in length and typically hosted between 20-50 participants. While the core audience is newer faculty, the more experienced faculty who attend as workshop presenters are welcome to attend other workshops, space and time permitting, and about 90% of them did so.

A survey conducted immediately after the close of ChESS 2022 showed respondents found it to be successful at meeting its two goals. 96% of respondents somewhat agreed or strongly agreed that the Summer School was conducive for meeting other Chemical Engineering faculty, while the same fraction somewhat agreed or strongly agreed that the workshops were useful. 93% of respondents strongly agreed that they would recommend the Summer School to a colleague, with a further 3% expressing some agreement.

This paper shares details on the program, funding, and overall design of the Summer School as well as some reflections and recommendations from the steering committee. It also summarizes the results of the immediate post- Summer School survey.

Introduction and Background

The Chemical Engineering Summer School (as of 2021 known as the ASEE/AIChE Summer School for Chemical Engineering Faculty or ChESS) has been held approximately every five years since 1931. The very first offering of general engineering faculty summer school in 1927 ran for one and a half to three weeks and had the goal of *“The bringing of groups of the ablest and most promising younger teachers into contact with the leaders having different points of view and different methods of presentation with adequate opportunity for free discussion promises a forward step in methods of teaching, in developing and holding the interest of the student, and in putting new life and inspiration into this department of engineering training”* (1). Building upon this foundation, subsequent ChESS’ have been primarily volunteer-led efforts from within the community to collectively welcome and mentor the newest generation of chemical engineering educators. The most recent iteration of ChESS, the 17th, took place at the Colorado School of Mines in Golden, Colorado from July 25-29, 2022. The two core goals of this event were to:

1. Help newer faculty develop their toolbox for teaching, scholarship, and service;
2. Build community nationwide (and further!) within the newest cohort of ChemE faculty and between the newer faculty members and the faculty who return to Summer School as workshop facilitators.

The aim of this paper is to capture some of the efforts that went into constructing ChESS to help refresh the memories of attendees and presenters, summarize progress on the above two goals, and also to make organizing and improving ChESS 18+ easier for future organizers. In the following sections, we discuss the programming, networking, and fundraising efforts. We conclude by sharing some preliminary post-survey results and recommendations for future work.

Demographics

The target attendee audience for ChESS is chemical engineering faculty of all types of contracts - continuing, fixed-term, and tenure-track - within their first five years of work. This also includes graduate students and post-doctoral folks who are looking forward to faculty positions. At the 2022 ChESS there were 142 attendees from 88 institutions. The 88 institutions represented were primarily from the United States, complemented by colleagues from five Canadian universities plus one other international university.

The number of Chemical Engineering faculty who are on contracts other than tenure-track has been growing as in other sectors of higher education, and this is reflected in the attendees who were 22% professional / teaching track, 75% tenure-track, and the remainder being graduate students or post-doctoral researchers. The modal teaching load of all attendees was two

courses per year, with a range from zero to over six. Of those attendees who shared demographic information, 38% identified themselves as women, 61% as men, and 1% as non-binary or another gender. 53% described themselves as white, 34% as Asian, 10% as Black / African American, and 3% as another racial group. Nine percent of attendees reported they were of Hispanic origin.

This group was complemented by a further 65 faculty presenters with an additional four presenters who were also first-time attendees. Over 30 additional representatives from sponsors and professional societies attended for the Expo on Wednesday. The distinction between “attendee” and “presenter” is a little artificial as all presenters were invited to stay on-site and attend workshops and events for as much of the event as they could, and the majority stayed for at least one additional day and attended workshops besides their own.

One note on attendee and presenter numbers; the final values for attendees and presenters shown here are lower than the registered and expected number due to emergency late cancellations for a variety of reasons including the ongoing COVID-19 crisis. In some cases, these cancellations came too late to recover costs associated with their attendance (housing, food, etc), something we note needs to be included in budgeting for future ChESS planners.

Programming and Schedule

In contrast with previous, recent Summer Schools, the 2022 Programming Team focused on maximizing the diversity of types of workshops presented and organizing content in broad themes. Past Summer Schools had identified a smaller number of workshops and then focused on scheduling so that workshops could be offered multiple times. Early on, the Programming Team focused on recruiting workshops with two major themes: **Content** workshops, where the focus would be on sharing materials and techniques that faculty could adopt directly or on teaching them a specific skill, and **Pedagogical** workshops, where the focus would be on higher-level learning and different frameworks and ideas for teaching and learning. Content workshops would be 90- minute sessions, whereas Pedagogical workshops would be 150 minutes. As we receive proposals we added a 90 minute **DEI** session as well. The Program also included a half-day Teaching Institute, facilitated by Prof. Mike Prince from Bucknell University, as well as two morning plenary sessions, one focused on DEI Initiatives, led by then-AICHe President and Professor at North Carolina State University, Christine Grant, and another with an out-of-discipline perspective on STEM education by Prof. Mark Windschitl, a Learning Scientist from the University of Washington.

Feedback from previous Summer School participants had highlighted the value and importance of building in some time for networking, both structured and unstructured. To facilitate this, we drew from successful events from previous Summer Schools. There were informal but topically-structured networking events on Monday and Thursday, after the last regular session of the day and before dinner. There were also two poster session events for new attendees on Monday and Tuesday evenings to allow participants to share their work, current or planned, as well as interact with more senior members of the community. Finally, on Wednesday there was

an Industry Expo, which allowed participants to interact with corporate and academic partners and sponsors, followed by a variety of social events, ranging from a Colorado Rockies Game to whitewater rafting, to a guided bike tour and tours of local points of interest.

The Programming Team began work in earnest approximately one year before the Summer School. We leveraged the community's national conferences with a Call for Proposals that was announced at the 2021 ASEE Virtual Meeting. Potential workshop presenters were invited to submit their proposal to the programming team via a Google Form that was created, and the call was open through the AIChE Meeting in Boston in the fall of 2021. Following the close of the call, the Programming Team, made up of three people, divided up the workshops for review, with each proposal being reviewed by two team members. The team identified proposals that were very similar in content and in those cases typically contacted all of the proposers and suggested combining their proposal into a single workshop. Programming was divided into 5-to-6 parallel tracks. Highly-ranked proposals were slotted into the schedule and broad themes were identified so that workshops that the programming team thought would be complimentary were not counter-programmed against one another. To ensure high-quality workshops and provide professional development to workshop presenters who may not have participated in Summer School previously, a virtual "Workshop on Workshops" was delivered approximately two months before Summer School in May of 2022, facilitated by esteemed engineering education community members Rich Felder and Rebecca Brent. The organizing committee also created a shared Google Drive for all workshop presentation teams to store materials for their workshops, which was made available to the Summer School attendees during and after the event.

Figure 1 shows the overall program schedule. In support of attendee work/life balance, the event was intentionally constrained to weekdays with no weekend programming besides registration. Each of the numbered sessions, 11 in total, had between five and six parallel sessions with space for up to 50 people in the largest session rooms. Overall 38 different sessions were offered, eight of which were offered twice.

	July 24	July 25	July 26	July 27	July 28	July 29
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
7:30 AM		Breakfast (starts 6:30)	Breakfast (starts 6:30)	Breakfast (starts 6:30)	Breakfast (starts 6:30)	Breakfast (starts 6:30)
8:00 AM						
8:30 AM		M1 Welcome Reception	T1 Plenary	W1 Industry Panel	H1 Plenary	
9:00 AM			Break	Break	Break	F1 Reflection
9:30 AM						
10:00 AM						
10:30 AM				Industry Panels, Workshops, and Expo		
11:00 AM		M2 Teaching Institute				
11:30 AM			T2 Session 3		H2 Session 8	F2 Session 11
12:00 PM						
12:30 PM		Lunch	Lunch	Lunch to Go	Lunch	Lunch
1:00 PM						
1:30 PM						
2:00 PM		M3 Session 1	T3 Session 4		H3 Session 9	
2:30 PM		Break	Break		Break	
3:00 PM						
3:30 PM						
4:00 PM		M4 Session 2			H4 Session 10	
4:30 PM		M5 Networking	T4 Session 5	W3 Social / Recreation Events	H5 Networking	
5:00 PM						
5:30 PM						
6:00 PM						
6:30 PM		Dinner	Dinner			
7:00 PM				Dinner		
7:30 PM					H6 Banquet	
8:00 PM	S1 Informal Gatherings and Social Activities					
8:30 PM		M6 Poster Session 1	T6 Poster Session 2			
9:00 PM						

Figure 1: Overall Program Grid

Networking and Game

Half the overall goal of ChESS is the forming of interpersonal relationships. The schedule in Figure 1 had a number of features designed to foster such connection in both formal and informal ways between attendees and between presenters and attendees. As previously mentioned, presenters were invited to remain at the Summer School and attend meals and workshops and get to know the attendees and other presenters. Formal opportunities for connection included active engagement in workshops, the attendee poster session, and the Monday and Thursday afternoon networking sessions (M5 and H5, Fig. 1). These sessions were organized around different common interests that could form a basis for future discussion and collaboration, such as research and teaching areas. Less formal, yet fully intentional,

opportunities for connecting included at the communal meals, intersession breaks, and the Wednesday afternoon recreational outings. In these outings, groups of attendees chose to attend a baseball game, visit a museum, go whitewater rafting, hiking, or biking. Everyone was also encouraged to stay in the residence halls on campus, leading to numerous opportunities to hang out together including a memorable evening singalong on the residence-hall lobby piano.

At previous Summer Schools and other professional events, a week-long networking game had been used to facilitate community-building and help connect new and established chemical engineering educators. These games involved seeking others who fulfilled specific prompts (i.e., someone who is attending their first Summer School, someone who teaches a specific class, someone from a specific region, etc.). The game served as a springboard to start conversations with new people during designated networking events or other interactions during meal times. Participants collected signatures, with the person who collected the most receiving a prize, but this could often be a challenge to track using pen and paper.

To streamline the networking game this year, and to increase the diversity of networking opportunities, the game was handled in the Eventzee scavenger hunt app (<https://eventzeeapp.com/> for reference). While several other apps were considered, Eventzee was selected given the variety of activities available, including challenges related to completing quizzes, entering text, taking photos or videos, and checking in at specific locations via GPS or QR code scanning. The app also supported a leaderboard for easy final determination of the winners, a media feed where participants could view or like the posts of others', and a message board where participants could communicate via text. Administrators were able to moderate the feed and message participants directly during the game.

The full variety of Eventzee challenges were used, with the majority of them being photo challenges encouraging the player to take a selfie with someone who met some specific criteria to foster new connections between the participants. A week-long set of tasks served as a tutorial of the different challenge types, including a short quiz, several selfie challenges, a QR code scan activity, and several location check-in activities using GPS (a portion of these prompts are shown in Figure 2). The other tasks were organized into sets that were unlocked each day of ChESS. Generally, each day had a new trivia quiz, a QR code to scan at a plenary, and an encouragement to eat lunch with someone you met for the first time at ChESS. Other daily activities were themed around that day's major networking event. For instance, on the day of the research networking event, participants were tasked to take a selfie with someone who researches in their same area of expertise. On the day of the class-focused networking events, participants were asked to find someone who teaches a class they currently teach and someone else who teaches a class they hope to teach in the future. To drive engagement at the VIP Expo, each VIP table was given a unique QR code that participants could scan. Finally, some of the activities were created just for fun, including a challenge to take a photo of a wild rabbit on CSM's campus (with extra points awarded for capturing more than one rabbit in the same photo). These latter tasks were very popular and helped forge connections via the in-app message board, with several participants nominating posts that were worthy of bonus points. The app was also used to collect some optional, free-response feedback from participants.

During the poster sessions, participants were encouraged to provide input on their favorite poster and who presented it. Every night also ended with a free response prompt where participants could reflect on that day's activity and comment on what they found the most useful or interesting thing they learned.

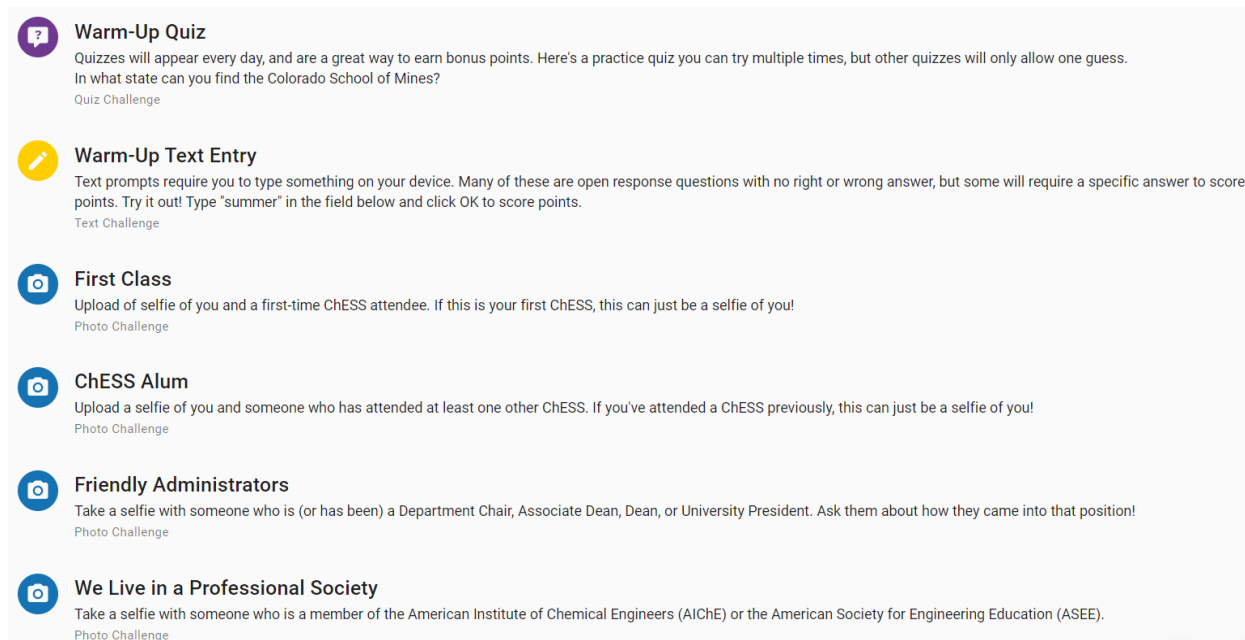


Figure 2: Sample challenge prompts for the week-long tutorial portion of the networking game

Approximately 90 (44%) of the eligible ChESS 2022 attendees and presenters signed up for the networking game, with 68 (33%) of those individuals completing some amount of activities. Prizes, including textbooks and banquet vouchers, were awarded to the top 10 on the leaderboard at the ChESS closing banquet, with these top 10 participants being a mix of new and returning Summer School attendees. Informal feedback of the experience was largely positive. Some attendees commented that the tasks were a fun way to engage with their fellow chemical engineering educators in a new context, while other attendees who were less active using the app suggested that greater diversity of activities would encourage the participation of those who did not wish to take selfies.

Funding and Administration

The Chemical Engineering Summer School was generously funded with grants from the National Science Foundation (NSF) and the American Institute of Chemical Engineers (AIChE) Foundation Doing a World of Good campaign. NSF program directors also provided two workshops discussing funding opportunities available to early-career faculty. In addition, program directors scheduled and met individually with faculty members to discuss specific research opportunities and coaching on what makes for a successful grant application.

In addition, corporate sponsorship was also provided by Chevron, 3M, Dow, Kern Entrepreneurial Engineering Network (KEEN), AbbVie, Amgen, Bristol-Myers Squibb, and Eli Lilly. Collaboration between the Summer School organizing committee (volunteers) with the AIChE Foundation staff was instrumental in attracting many of the sponsors. Corporate supporters of the Summer School sent representatives to both participate as conference presenters and to network with the new faculty. During the Industry Day plenary session, the Gold Sponsors shared their views on chemical engineering education and the key skill sets they perceive to be needed in both current and future chemical engineering undergraduate and graduate students. They also discussed the keys to successful faculty/industry research collaborations. An open forum, question-and-answer period followed their remarks. Another session included a Pharmaceutical Industry Panel with AbbVie, Amgen, Bristol Myers Squibb, and Eli Lilly; Leadership of the AIChE's Pharmaceutical Discovery, Development and Manufacturing Forum (PD2M) helped with both sponsorships and the panel's organization.

A vendor fair and workshops were also part of Industry Day. The vendors included ABET, Chemstations, Elsevier, Mathworks, Pearson, Petroskills, and Wiley/zyBooks. Chemical Engineering-related professional societies were also represented, including the EdDiv from AIChE, ChED from ASEE, and CACHE. In addition, four of the vendors sponsored product-specific workshops. Specifically, Mathworks covered MATLAB and Simulink, Chemstations talked about CHEMCAD simulations, Petroskills promoted the ChemE Sports competition, and Elsevier discussed their Engineering products including Knovel.

The generous grant and corporate funding provided the opportunity for each chemical engineering department in the United States to send one faculty early-career member to attend the Summer School with all local expenses paid (including registration, housing in dorms, all meals, a social outing, and transportation to/from airport). Each department only needed to provide airfare/transportation to and from the event, which is a very low cost for a weeklong professional development event. Additional faculty attendees from each department were asked to provide the registration fee of \$1,000 to partially cover their costs of attendance.

Faculty workshop presenters and organizers were provided travel costs, as well as the on-site costs. A portion of the AIChE Foundation grant helped to provide AIChE staff support to register the Summer School participants and workshop presenters, assistance in writing contracts for services provided by the host institution and payments/reimbursement for the Summer School. In order to fund future Chemical Engineering Summer Schools, an AIChE Endowment campaign was launched to sustainably offer Summer Schools for the next 100 years. The aspiration is to endow the Summer School in celebration of its centennial anniversary in 2031 with a goal of \$1,000,000.

Administrative support for the Summer School was contracted through both AIChE and Conference Services at Colorado School of Mines. AIChE was involved with registration of attendees and presenters, collecting abstracts for the poster session, and administration of finances. Colorado School of Mines Conference Services, Housing, and Dining provided support for onsite food, lodging, event space, transportation, and social events.

Survey Results and Reflections

On the last day of the Summer School, attendees and presenters were sent an online survey for their immediate reactions to their experiences at ChESS. This survey was held open for several weeks to gather responses from as many participants as possible. In the end, 114 responses were collected. Questions centered on the achievement of the two core goals of the Summer School as articulated in the introduction - forming connections, and learning valuable tools. As can be seen in Table 1, responses were overwhelmingly positive.

Table 1: Immediate-post survey responses.

Question ChESS '22 was....	% Strongly Agree/Agree	% Neutral	% Disagree / Strongly Disagree
Good for forming connections with newer faculty (Goal 1, attendees, n=78)	95	3	3
Good for forming connections with more experienced faculty (Goal 1, attendees, n=78)	96	1	3
Good for forming connections with other ChemE faculty (Goal 1, everyone, n=114)	96	3	1
Good for forming connections with industry / prof. Societies (Goal 1, everyone, n=113)	73	20	7
Presenters were knowledgeable (Goal 2, everyone, n=113)	99	0	1
Workshops were interesting (Goal 2, everyone, n=113)	96	3	1
Workshops were useful (Goal 2, everyone, n=113)	96	3	1
I would recommend ChESS to a colleague (n=113)	96	3	1

In the short-answer section, respondents were asked for their top three takeaways from their time at ChESS. The most common idea cited was that active learning is effective and related ideas on how to use active learning. Also frequently mentioned was how positive it was to meet and connect with other faculty in similar areas / experiencing similar situations.

Respondents were also asked if they would like to provide a summative quote on their experience, a few of which are shared below:

“The single most effective educational opportunity for new ChE faculty”

“Summer School is the best place to meet other ChE faculty in a friendly environment”
“You are not alone....there are many other educators having similar challenges and accomplishments, just like you!”

Recommendations and Conclusions

While a lot went right at ChESS 2022, the organizers have some thoughts on future improvements. It is difficult to reach everyone who is the audience for this event or who would be a good presenter for this event. Even the listserv of department heads/chairs does not reach everyone, so persistent and individual outreach was needed. Along those lines, there were some potential presenters who did not see the call. We encourage future organizers to identify some areas, such as PhD student advising and postdoc mentoring, where they invite presenters who might otherwise miss the open call because they are not ASEE ChED or AIChE EdDiv members. To help support attendees, if at all possible, it would be good to offer onsite support for those faculty who have a caregiving role while they attend workshops; while the organizers found and shared information about local daycare and elder care centers, none of the local centers were offering drop-in hours due to decreased staffing. A potential solution for this challenge would be to offer caregiver scholarships that attendees could spend themselves on local care, care back home, or even bringing along someone to help. This is not easy to remedy but would be of tremendous help to some members of the community. Finally, the organizers are aware of significant interest among mid-career faculty to be able to attend ChESS itself or something similar. Currently, this is possible as a presenter, but that pathway is not available to everyone.

The ASEE/AIChE Summer School for Chemical Engineering Faculty is a special event that helps Chemical Engineering faculty be and become a community. It works with ASEE and AIChE conferences, yet isn't the same thing as either due to its focus on community building along with the sharing of valuable experience and information. As we approach the centennial ChESS, the organizers of ChESS 2022 are happy to have contributed positively to this collective effort.

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