Impact of "The Design of Coffee," A General Education Chemical Engineering Course, on Students' Decisions to Major in STEM Disciplines

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Abstract

The Design of Coffee is a popular general education course offered by the Department of Chemical Engineering at UC Davis, enrolling more than 1800 students/yr, that uses the roasting and brewing of coffee to teach chemical engineering principles to a broad audience. It was recently voted as the number one course by students in the "Best of Davis" yearly contest, placing ahead of other popular general education courses at UC Davis. Freshman design courses, like *The Design of Coffee*, are used to recruit and retain diverse students in STEM majors. These courses are intended to help students discover science and engineering majors as possible choices, especially among student populations who are unfamiliar with these majors.

Survey data have suggested that there have been students who have switched into the chemical engineering major at UC Davis because of this course. In this study, the effects of this course on first-year "non-STEM majors" were investigated. It was hypothesized that first-year non-STEM students taking *The Design of Coffee* would be more likely to change into STEM majors due to the course's experiential and approachable nature as compared to first-year non-STEM students that did not take this course but a comparable introductory food science course. To test this hypothesis, we performed a detailed statistical analysis comparing the two groups. Additionally, students who switched into chemical engineering after taking *The Design of Coffee* were identified and interviewed in order to probe particular aspects of the course that were influential in their decision to change majors.

At least 12 students were found have changed their major into chemical or biochemical engineering after taking *The Design of Coffee* since the course was piloted in 2014 and have since graduated. Those that we had the opportunity to interview spoke to the significant impact this course played in changing the trajectory of their academic journey and their career. More broadly speaking, non-STEM first-year students taking this course and had taken or were concurrently enrolled in a "core" STEM course such as introductory chemistry or biology were significantly more likely to change into and graduate in STEM majors as compared to students taking a comparable introductory food science course prior to pandemic-initiated remote instruction beginning in Spring 2020 (58.1% vs. 39.3%, $p = 0.042$). While the remote instruction period eroded this impact, it is our hope and expectation that as most classes at UC Davis have returned to in-person instruction, students taking *The Design of Coffee* will once again be motivated to change into and persist in STEM majors, adding much needed talent to the pool of perspective scientists and engineers.

Introduction and Motivation

Introductory design experiences are recommended by the National Academy of Engineering for recruiting and retaining students into STEM and engineering in particular [1]. These experiences have the potential to be particularly impactful for students underrepresented in STEM in part due to their use of relatable contexts [2-3], opportunities to apply theory to practice [4-9], and ability

to impart gains in self-efficacy, sense of satisfaction, community, and belonging [10-13]. Students who participate in project-based learning experiences such as introductory design experiences are generally motivated by the experience and have a better understanding of the complexities of professional practice [14]. In one such project-based learning experience, the investigators noted a gain in positive attitudes towards the mechanical engineering discipline [11].

Typical engineering classes, including introductory classes, require students to have prior knowledge of advanced mathematical and physical concepts. Many introductory courses are lecture-based and may be supplemented with discussion sections and presentations by guest speakers or alumni. While these activities offer students exposure to the engineering discipline, they lack the hands-on component commonly used to enhance learning [15]. Many introductory-level courses do not offer students a laboratory experience since first-year students lack the background necessary to apply engineering principles, and many activities would require extensive laboratory and calculation time [16]. Additionally, it has been shown that highly competitive introductory math and science courses that lack engagement may discourage students from earning a STEM degree [17]. For example, it has been shown that struggles in first year chemistry courses have been an important factor in students' decisions not to pursue an engineering degree [18-19]. Leveraging instructional strategies that challenge students to innovate and invent, such as engineering design and problem solving, has been shown to better engage and motivate students, helping to attract and retain students in STEM disciplines [4, 20].

At UC Davis, *The Design of Coffee* is a popular [21], large enrollment (> 1800 students/year), general education course offered by the Department of Chemical Engineering that uses the roasting and brewing of coffee to teach chemical engineering principles to a broad audience. There are no pre-requisites for this course, and students are not assumed to have any prior knowledge of physics, chemistry, or calculus beyond what they may have seen in high school in order to participate in activities and learn concepts. Course objectives include demonstrating what a chemical engineer does (and how they think), introducing students to core chemical engineering principles and skills, enabling students to clearly communicate technical data via graphs and tables, and using data to draw conclusions. The over-arching goals for the course are to cultivate student's interest in chemical engineering and broader STEM disciplines/classes and to encourage students to consider pursuing a career in STEM.

In this course, students attend a weekly lecture, complete short pre-lab quizzes, participate in a weekly laboratory session following steps outlined in the lab manual specially written for this course [22], and work in groups to complete lab reports. The relationship between chemical engineering and post-harvesting coffee is discussed in lecture while the pre-lab quizzes briefly go over essential lab information that students must complete prior to lab participation. Labs are divided into two distinct parts: analysis and design. In the analysis labs, students focus on performing "engineering analysis" on one core chemical engineering concept. These concepts include process flow diagrams, mass conservation, the effects of chemical reactions, conservation of energy, flux, mass transfer, fluid mechanics, colloids, and viscosity.

After students have a grasp of chemical engineering analysis, the remaining lab sessions focus on different aspects of design through open-ended design trials. The design labs cover optimization

of brew parameters, scaling up from a cup to a liter of coffee, and economics of roasting and brewing coffee. Once each of the previously mentioned labs are completed, students submit lab reports that contain graphs and tables of their numerical data and brief paragraphs discussing their interpretations. Everything culminates in the last lab where students compete in the engineering design challenge: to make the best tasting cup of coffee with the least amount of energy. The benefit of this challenge is to expose students to open-ended design problems that have multiple solutions.

Anecdotal reports and preliminary survey data suggested that *The Design of Coffee* (*TDOC*) has a positive impact on recruitment of students into STEM majors. Accordingly, we sought to rigorously test the hypothesis that freshmen who were not originally enrolled in a STEM major would indeed ultimately transfer into a STEM major at a higher rate after taking *TDOC* compared to a control group who did not. To test this hypothesis, we needed to identify a well-defined control group, ideally of students who had taken a general education class on a similar topic without a hands-on laboratory component. At UC Davis, there is such a course, titled *Food Science, Folklore and Health (FSFH)*, which is an introductory, no-prerequisite course with the same number of units and comparable enrollment numbers, offered by the Department of Food Science and Technology. The goals of *FSFH* are to provide students with a good understanding of modern-day foods and their properties, as well as to examine ancient and modern food folklore using modern science related to health and well-being. In this course, students attend two lectures each week that are taught from PowerPoint slides, and they complete several quizzes, two midterms, and a final exam. The topics covered in this course include (i) the societal development of conventional, natural, and organics foods, (ii) the social science perspective of what food represents, (iii) animal & plant fats, oils, proteins, and enzymes, (iv) food groups such as fruits, vegetables, and dairy, (v) toxicants, poisons, and nutrients in food and food safety, (vi) beverages & stimulants, and (vii) historical and current uses of medicinal plants.

Many students in non-STEM majors take *TDOC* or *FSFH* to fulfill in part their science and engineering general education requirement. Figure 1 shows a breakdown of students' major category at the time that they actually took the respective course. From 2014 to Fall 2023, a total of 12,194 students took *TDOC*, while 13,510 took *FSFH*. The distribution of majors was also comparable, with economics and biology in the top two. Here, the College of Agricultural and Environmental Sciences (AE&S) includes animal science, food science, plant sciences, nutrition, and environmental science & management, all of which are classified as STEM majors. Majors classified as non-STEM include economics, social sciences, humanities, communication, and art & design, which make up approximately 45% of all students that took *TDOC* (Figure 1a) and approximately 34% of all students that took *FSFH* (Figure 1b).

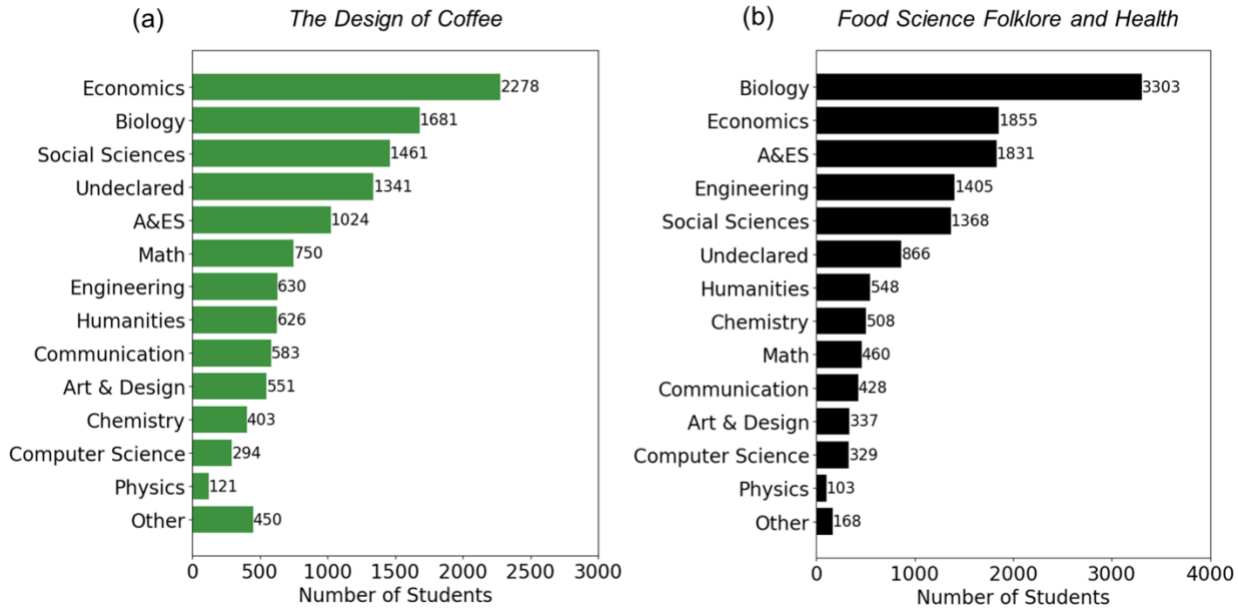

Figure 1. The major category for students who took (a) *The Design of Coffee* (n = 12,194) or (b) *Food Science Folklore and Health* (n = 13,510), both over the time period from 2014 to Fall Quarter 2023. A&ES is an abbreviation for Agricultural and Environmental Sciences.

In this study, we sought to quantify the impact of *The Design of Coffee* on recruiting students into STEM disciplines, as well as more specifically into chemical engineering. It was hypothesized that first-year students originally enrolled in non-STEM majors who took *TDOC* would be more likely to change their major into a STEM major, due to the experiential and approachable nature of the course, when compared to non-STEM students who did not take *TDOC* but instead took *Food Science Folklore and Health*. To test this hypothesis, we performed a detailed statistical analysis comparing the two groups. Furthermore, we also identified students who had graduated with a degree in chemical or biochemical engineering, or were currently in our program, after taking the *TDOC* and performed qualitative interviews to identify aspects of *The Design of Coffee* that were particularly impactful.

Methods

In order to evaluate the impact of *The Design of Coffee* on students not enrolled in STEM majors, data was collected from the transcripts of students (i) who matriculated to UC Davis in Fall 2013 or later (so that they would have had a chance to take *TDOC*), (ii) have since graduated from UC Davis, (iii) were not enrolled in a STEM degree program upon admission to UC Davis, and (iv) who took *The Design of Coffee* or *Food Science Folklore and Health* during their first year. The Center for Educational Effectiveness at UC Davis had produced a list of STEM degree programs, aligned with the NSF definition for such programs [23], that was used for this study. The purpose of restricting this study to students who took *TDOC* during their first year (many sophomore, junior, and senior students also take the course) was to focus on students who had the most time to change their choice of major if motivated to do so. Transcripts from individuals who did not meet the above criteria were excluded from the study.

Students whose transcripts met the above criteria were separated into two groups: A) students who took a "core" STEM course during their first year before or while taking *TDOC* or *FSFH*, named "STEM leaning" and B) students who did not take any "core" STEM courses during their first year, named "STEM avoiding". "Core" STEM courses were defined as courses in the general chemistry and general biology series at UC Davis. The purpose of defining these groups was to differentiate between students who may have had thoughts about entering a STEM program from students whose first-year coursework indicated that they had little to no interest in pursuing a STEM degree. The impact of a large enrollment introductory science course on both groups was assessed. Table 1 summarizes these student groups under investigation.

Table 1: Student groups under investigation.

Characteristic	**STEM leaning (n = 230)**	**STEM avoiding (n = 1,483)**
First-year student at UC Davis during the 2013-14 academic year or later:	YES	YES
Graduated from UC Davis:	YES	YES
Were enrolled in a STEM major during their first year:	NO	NO
Took *The Design of Coffee* or *Food Science Folklore and Health* during their first year:	YES	YES
Took a "core" STEM course during their first year **before or while** taking a non-core STEM course:	YES	NO

For both groups, data was obtained for students graduating before pandemic-related remote instruction began (students graduating Fall 2019 and earlier) and for students that would have been impacted by remote instruction. Due to the constraints on the population studied of (i) being in their first year when they took *TDOC* or *FSFH* and (ii) having since graduated from UC Davis, all students would have taken either of the non-core STEM courses before remote instruction began in Spring 2020. However, any impacts of remote instruction on the students' choices to complete degree programs in STEM majors were evaluated. The statistical significance of the variation in type of bachelor's degree earned across the cohorts was determined using chi-squared tests of independence on 2x2 contingency tables with $\alpha = 0.05$ (see Appendix B).

A secondary objective of this study was to evaluate the influence of *The Design of Coffee* on students who had not previously considered chemical engineering in particular as a possible choice of major. Therefore, all the students who graduated with a chemical or biochemical engineering degree and took the general education version of *TDOC* course prior to switching into the major were identified and contacted with a request to be interviewed for this study. Twelve individuals met these criteria and seven agreed to be interviewed and share their experiences. Students were encouraged to participate in an in-person or online interview but were also given the option to complete a survey. One interview was conducted in-person, five were conducted online, and one survey was requested and returned via email. The 10–20-minute interview was conducted by one or two investigators and the questions are shown in Appendix A.

Results/Discussion

Impact of *The Design of Coffee* on First-Year Non-STEM Majors

Figure 2 shows the results for both student groups under investigation in which the percentage of students who graduated with a STEM degree vs a non-STEM degree was tabulated.

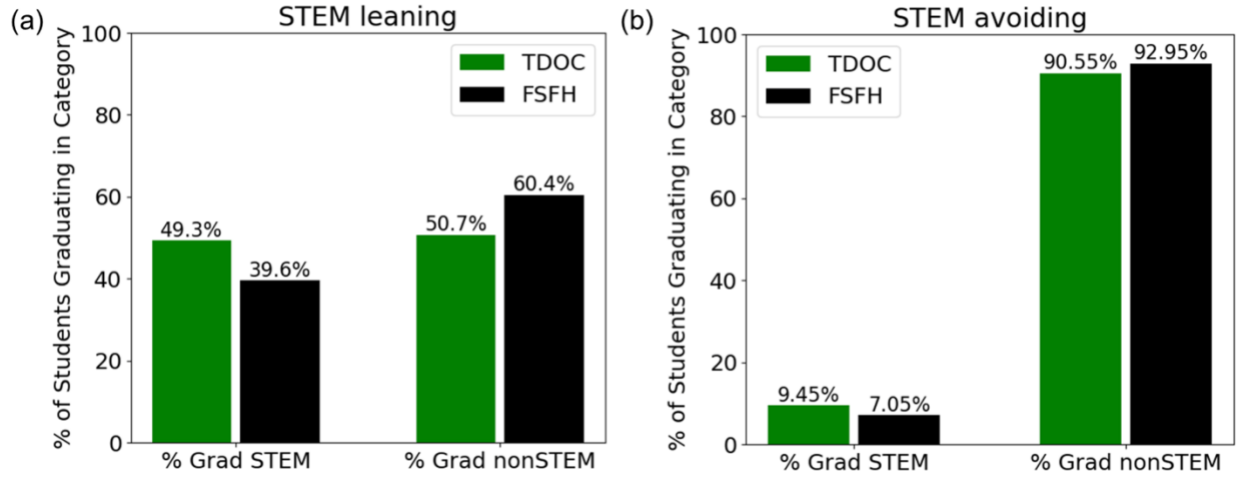

Figure 2. STEM vs. Non-STEM major graduation results for students under investigation. The percentage of students graduating with bachelor's degrees in STEM fields vs. non-STEM fields is shown for students who took *The Design of Coffee* (green) vs. students who did not take *The Design of Coffee* (black) for (a) STEM leaning and (b) STEM avoiding groups.

In the STEM leaning group (n = 230), the number of students who took *TDOC* (n = 134) and received a bachelor's degree in a STEM field was 10% higher than students who did not take *TDOC* (n = 96) but took *FSFH*. This would suggest that students may have been influenced by the coffee course to switch into a STEM program. However, this result was not found to be statistically significant (p = 0.146). In the STEM avoiding group (n = 1483), the number of students who took *TDOC* (n=1100) and received a bachelor's degree in STEM was 2% higher than students who did not take the course (n = 383), however, this result was also not statistically significant (p = 0.153).

If students took a core STEM course during their first year (STEM leaning), taking *TDOC* was found to have a larger positive impact on students' decision to switch into STEM majors compared to students that did not take a core STEM course during their first year (STEM avoiding). This result could suggest that taking the course strengthened STEM leaning students to continue their path towards a STEM degree program. The percentage of students graduating in STEM majors for the STEM avoiding group is significantly lower than that of the STEM leaning group which may imply that students in the STEM avoiding group had little to no interest in pursuing a career in STEM based on their first-year coursework, however, some students may have been motivated by *The Design of Coffee* to take STEM courses later in their academic tenure or switch into a STEM major.

To assess the effect of the pandemic-induced switch to remote learning, data for both groups were divided into pre-pandemic (graduated before Fall 2019 - solely experienced in-person instruction), and mid-pandemic (impacted by remote instruction). Importantly, in all cases, courses taken by this population during their first year, including STEM courses, were not impacted by the pandemic and were taught in-person. However, courses taken after the first year may have switched to remote instruction. The results of the pandemic's effect on the percentage of students in this study graduating in STEM fields are shown in Figure 3.

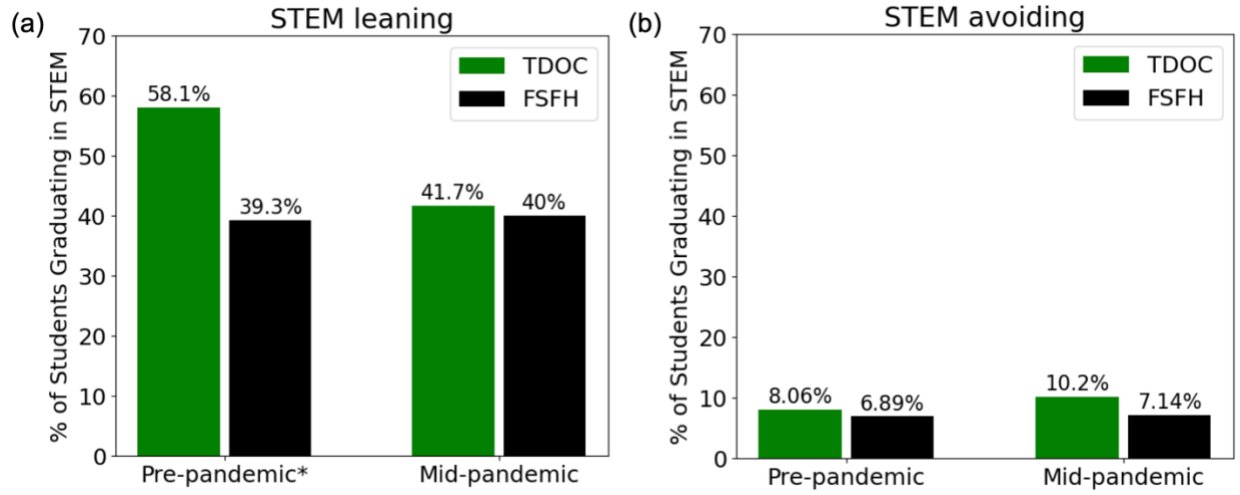

Figure 3. STEM major graduation results for students before and during the pandemic. The percentage of students graduating with bachelor's degrees in STEM fields pre-pandemic vs mid-pandemic is shown for students who took *The Design of Coffee* (green) vs. students who did not take *The Design of Coffee* (black) for (a) STEM leaning and (b) STEM avoiding groups. Note that the result for the STEM leaning group is statistically significant ($p = 0.042$).

Prior to the pandemic, the number of students that graduated in STEM majors and took *The Design of Coffee* course was approximately 20% larger than students that did not take the course for the STEM leaning group (Figure 3a). The 20% increase in STEM graduates was statistically significant ($p = 0.042$). This suggests that *TDOC* had a positive impact on students choosing and graduating in STEM majors prior to (and including) Fall 2019. However, during the pandemic, participating in the course (or not) showed no significant difference on the number of students that graduated in STEM ($p = 0.864$). The percentage of STEM graduates before and during the pandemic remained relatively the same for students that did not take *TDOC*, but a 16.4% drop occurred in the number of STEM graduates that did take the course between pre-pandemic and mid-pandemic years. This decrease, although not statistically significant ($p = 0.068$), may have indicated potentially negative impacts of transitioning to remote instruction on students graduating in STEM.

Recent studies have shown that the pandemic has had adverse effects on undergraduate students in STEM. Students reported difficulty maintaining commitment and engagement in their courses after the transition to remote instruction [24]. Pronounced levels of depression and generalized anxiety, as well as math anxiety, were also reported for STEM students during online learning which may have led to delaying or suspending future STEM coursework and ultimately deterring

students from obtaining a bachelor's degree in STEM [25-27]. Additionally, the pandemic has contributed to an increasingly competitive STEM job market adding financial and health insurance concerns to academic anxieties [28]. Despite students' participation in *The Design of Coffee* before the pandemic, the results for the STEM leaning group show that the detrimental effects of the pandemic in students later academic years overshadowed any potentially positive impact of the course. It is our hope that the significant impact of *TDOC* on students' changing into STEM majors will once again be realized as most instruction returns to fully in-person at UC Davis.

For the STEM avoiding group, no statistically significant difference was observed in the number of students graduating in STEM between students that did or did not take *The Design of Coffee* before the pandemic ($p = 0.655$) (Figure 3b). The same result holds true for students graduating in STEM during the pandemic ($p = 0.166$), although a 2% increase in STEM graduates was observed for students that took the course. This observed increase could be attributed to students' tendencies to gravitate towards higher-paying majors during adverse economic conditions [29]. However, results for the STEM avoiding group suggest that the pandemic and subsequent shift to remote instruction had little to no effect on students transitioning to STEM.

Interviews with Current and Former Chemical/Biochemical Engineering Students Who Changed into the Major After Taking *The Design of Coffee*

Five major themes were identified from the interviews with current and former chemical or biochemical engineering students who switched into the major after taking *The Design of Coffee*, and they are discussed below.

1. *Diverse applications of chemical engineering presented during opening lecture*
   One of the main aspects of the course that impacted students' decision to transition to chemical or biochemical engineering was the opening lecture. Most of the interviewees mentioned that they "had no idea" what chemical engineering was and that it has a variety of career paths such as food, cosmetics, and pharmaceuticals. One of the students mentioned she was interested in skin care and was not aware that this industry was related to chemical engineering. She pointed out that she was fascinated when the instructor had referred to a chemical engineer friend working at Neutrogena. Another student mentioned that the course was the reason why she changed her major to chemical engineering, since she always wanted to work with food, and it was only during the class and the opening lecture that she learned about the connection between engineering and the food industry. This shows the importance and potential impact of exposing a bigger and more diverse audience to what chemical engineering is, whether it be in a course like *The Design of Coffee* or in another setting.

2. *Application of engineering to daily life activities*
   For most of the students, *TDOC* influenced their decision to switch majors (see Appendix C). Besides the opening lecture, another aspect of the course that impacted their decision was the application of engineering to daily life activities such as brewing coffee. One of the students mentioned enjoying the process of conducting a material balance for coffee,

from green coffee beans to brew, and understanding how applying different brewing and roasting methods altered the material balance and taste. The application of material balances to any process was not previously considered by the student, and this exercise was particularly influential in drawing him into biochemical engineering. In addition to *TDOC*, the chemical engineering department at UC Davis offers additional classes related to food applications. One of the students mentioned that she also participated in a pilot class for *The Design of Cocktails* (an upper division chemical engineering course at UC Davis), and she enjoyed the fact that chemical engineering concepts were so broadly applicable.

3. *Hands-on Activities and Design Project*
   Another aspect of the course that influenced students' decisions to switch majors was the laboratory component and the final design project. One student mentioned the social aspect of the class since she had to work with senior students. Another student stated the appeal of the coffee laboratory sessions was the illustration of the engineering thought process and emphasis on improving products and designs.

   The student for which *The Design of Coffee* course did not influence the decision to switch majors (see Appendix C) stated that even though the class was enjoyable, she felt that "…it is a misrepresentation of how in-depth chemical engineering is - mass balance is relatable but there's so much more to that". It is important to emphasize that *TDOC* has a version for chemical engineering majors, which covers more in-depth concepts compared to the general education version.

4. *Previous exposure to science/engineering*
   Two students reported not being exposed to science or engineering during high school. One attended a performing arts magnet high school. She mentioned that she was enrolled in the Honors section of *The Design of Coffee*, which has the laboratory component led by the professors instead of teaching assistants. She found these professors more approachable and "not scary". The interaction with professors in a low-stress environment provided her the opportunity to learn more about the major, which was one of the reasons for her decision to pursue a degree in chemical engineering.

   Another student who transferred from community college with an associate's degree in math and chemistry and was pursuing a degree in chemistry while taking *TDOC*, reported that before enrolling at UC Davis she did not know what engineering was. She was always "scared" of engineering and thought she "could not do it". She enrolled in *TDOC* because she wanted to work in the pharmaceutical industry and one of the advisors at UC Davis mentioned that chemical engineering was one of the options to work in this industry. The counselor advised her to enroll in *TDOC* in order to gain experience in an engineering discipline. While the opening lecture corroborated the counselor's statements about the pharmaceutical industry, the class also provided her with more perspectives on chemical engineering.

For the interviewees who had previously been exposed to science and engineering in high school, they had not previously considered engineering because (i) they were interested in other topics at the time they applied for college, (ii) did not know what engineering led to, or (iii) had family who earned degrees in other engineering majors and had jobs that seemed "boring".

5. *Satisfaction with major*
   All interviewees were satisfied with their decision to switch their major into chemical or biochemical engineering (see Appendix C). For most of the students the program was "hard", but it helped them to acquire skills and the engineering mindset required for their jobs. Core engineering disciplines helped them to develop their ability to work hard, think critically, and "figure anything out".

   Although all interviewees were initially enrolled in a STEM major, this qualitative result revealed significant reasons for students to change their degree to chemical and biochemical engineering. Among the reasons for students to consider majoring in chemical engineering are the acquired understanding on the range of industrial applications that a chemical engineering degree offers and the connection between engineering and daily life activities. These two aspects seem to be crucial to individuals choosing chemical engineering as a possible career path.

Conclusions

In conclusion, *The Design of Coffee* is a unique large-enrollment general education chemical engineering course that has exposed a large number of students to basic (chemical) engineering principles since its inception. At least 12 students have changed their major into chemical or biochemical engineering after taking this course and have since graduated. Those that we had the opportunity to interview spoke to the significant impact this course played in changing the trajectory of their academic journey and their career despite initial fears of engineering rigor. More broadly speaking, non-STEM first-year students taking this course were significantly more likely to change into and graduate in STEM majors as compared to students taking a comparable introductory food science course prior to pandemic-initiated remote instruction beginning in Spring 2020. While the impact of remote instruction has eroded this impact, it is our hope and expectation that as most classes at UC Davis have returned to in-person instruction, students taking this course will again be motivated to change into and persist in STEM majors, adding much needed talent to the pool of perspective scientists and engineers.

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Appendix A – Interview questions

1. Do you recall what year (freshman, sophomore, etc) and quarter you took ECH 1? If so when?

2. What was your major while taking ECH 1?

3. (If answer to question 2 is not an engineering major). Why did you not consider majoring in engineering before this point in your plan of study?

4. Were you exposed to science/engineering principles in high school? If so to what extent?

5. Did ECH 1 impact your decision to switch majors?

6. **(If the answer is yes)**, Which aspects/topics of the course were influential in your decision to switch into chemical/biochemical engineering?
   (If the answer is no). Were there particular aspects of ECH 1 you feel helped confirm your decision or push you towards chemical/biochemical engineering?

7. Are you satisfied with your decision of switching majors into chemical or biochemical engineering?

8. When did you graduate?

9. Can you describe your current position (if applicable).

Appendix B – Contingency Tables

Table B1: Contingency Table for STEM leaning group

Observed Values			
	STEM	NON-STEM	Total
ECH 1 TRUE	66	68	134
ECH 1 FALSE	38	58	96
Total	104	126	230
Expected Values			
	STEM	NON-STEM	Total
ECH 1 TRUE	60.59	73.41	134
ECH 1 FALSE	43.41	52.59	96
Total	104	126	230

Table B2: Contingency Table for STEM avoiding group

Observed Values			
	STEM	NON-STEM	Total
ECH 1 TRUE	104	996	1100
ECH 1 FALSE	27	356	383
Total	131	1352	1483
Expected Values			
	STEM	NON-STEM	Total
ECH 1 TRUE	97.17	1002.83	1100
ECH 1 FALSE	33.83	349.17	383
Total	131	1351	1483

Table B3: Contingency Table for STEM leaning group prior to the pandemic (solely experienced in-person instruction)

Observed Values			
	STEM	NON-STEM	Total
ECH 1 TRUE	36	26	62
ECH 1 FALSE	22	34	56
Total	58	60	118
Expected Values			
	STEM	NON-STEM	Total
ECH 1 TRUE	30.47	31.53	62
ECH 1 FALSE	27.53	28.47	56
Total	58	60	118

Table B4: Contingency Table for STEM avoiding group prior to the pandemic (solely experienced in-person instruction)

Observed Values			
	STEM	NON-STEM	Total
ECH 1 TRUE	30	342	372
ECH 1 FALSE	10	135	145
Total	40	477	517
Expected Values			
	STEM	NON-STEM	Total
ECH 1 TRUE	28.78	343.22	372
ECH 1 FALSE	11.22	133.78	145
Total	40	477	517

Table B5: Contingency Table for STEM leaning group during the pandemic (impacted by remote instruction)

Observed Values			
	STEM	NON-STEM	Total
ECH 1 TRUE	30	42	72
ECH 1 FALSE	16	24	40
Total	46	66	112
Expected Values			
	STEM	NON-STEM	Total
ECH 1 TRUE	29.57	42.43	72
ECH 1 FALSE	16.43	23.57	40
Total	46	66	112

Table B6: Contingency Table for STEM avoiding group during the pandemic (impacted by remote instruction)

Observed Values			
	STEM	NON-STEM	Total
ECH 1 TRUE	74	654	728
ECH 1 FALSE	17	221	238
Total	91	875	996
Expected Values			
	STEM	NON-STEM	Total
ECH 1 TRUE	68.58	659.42	728
ECH 1 FALSE	22.42	215.58	238
Total	91	875	996

Appendix C - Summary of interviewee's responses

Student	Previous major	Quarter when took *Design of Coffee* course	Year when took *Design of Coffee* course	Graduation year	*Design of Coffee* course influenced switch of majors?	Satisfaction with major	Major
1	Biochemistry	Fall	First year	-[b]	Influenced	Yes	Chemical Eng.
2	Undeclared, Agriculture.	Winter	First year	2018	Influenced	Yes	Chemical Eng.
3	Chemistry	Winter	First year	2021	Influenced	Yes	Chemical Eng.
4	Undeclared, Physical Sciences	Winter	First year	2019	Influenced	Yes	Chemical Eng.
5	Microbiology	Winter	First year	2020	Maybe[c]	Yes[d]	Biochemical Eng.
6	Chemistry	Winter	First year[a]	2018	Influenced	Yes	Chemical Eng.
7	Wildlife fish conservation biology	Spring	First year	2019	Did not influence	Yes	Biochemical Eng.

[a] First year at UC Davis (transfer student)
[b] Currently a sophomore student
[c] Not entirely sure, but think that the course had some influence
[d] Satisfied with courses, however, feel that the program did not prepare for jobs in industry