UNIT REPORT

Chemical Engineering BS - Institutional Effectiveness Final Annual Report 2019

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Definition of Unit

Mission and Vision for the CHE-BS Program and Connections to the TTU Mission

Reporting Year: 2018-2019

Providing Department: Chemical Engineering BS

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Mission/Vision/Goal Statement:

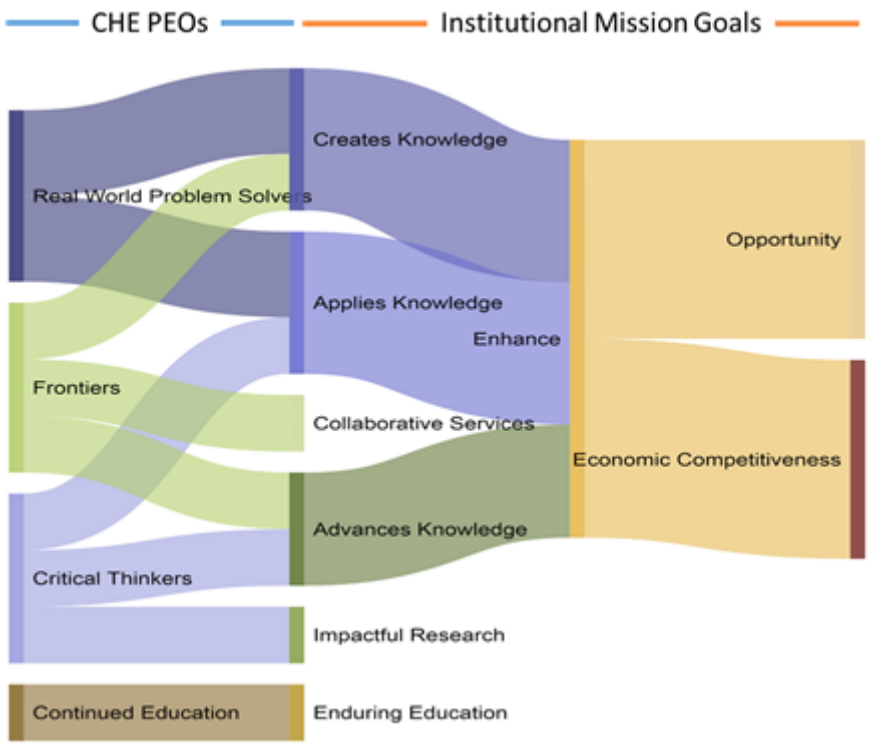
The Department of Chemical Engineering at Tennessee Technological University strives to develop the 21st Century Renaissance Engineer through development and implementation of novel learning environments anchored by the award-winning Renaissance Foundry Model. The foundation of this platform is rooted in the guidelines provided by the National Academy of Engineering's Vision for the Engineer of 2020. Educational protocols within the department are consistent with the mission and vision statements given below:

The **Mission** of the Department of Chemical Engineering is to prepare relevant and adaptive chemical engineers in state-of-the-art areas by emphasizing real-world problem solving and critical thinking skills. The **Vision** of the Department of Chemical Engineering is to be a recognized leader in chemical engineering education through excellence in teaching, research, and service.

The current Program Educational Objectives (PEOs) stipulate that within roughly five years that our graduates will collectively exhibit the following traits:

- Be real-world problem solvers (RWPS): the graduates of our program will obtain positions such as plant process engineer, design engineer, group leader, production engineering, sales engineer.
- Be critical thinkers (CT): the graduates of our program will demonstrate that they consistently make informed decisions through a process wherein they utilize critical thinking skills.
- Have continued their formal education (CFE): our graduates will demonstrate that they have continued their education beyond the BS through some form of professional development (not necessarily leading to another degree) or will have graduated from a professional school with an MS, PhD, MD, JD or similar degree.
- Be working at the frontiers in ChE (FChE): graduates from our program will utilize and apply technologies such as biomaterials, nano- and micro-systems, multi-scale analysis, informatics, group dynamics, and multi-media.

These objectives (considered herein to be synonymous with "Program Goals") are consistent with the TTU mission and vision. The figure below illustrates a clear association between the Program Goals and the institutional mission statement. Program Goal 1, real-world problem solvers, is mapped to two institutional mission goals: creates knowledge and applies knowledge. Program Goal 2, critical thinkers, is mapped to: applies knowledge / advances knowledge and impactful research (since critical thinking is clearly associated with an ability to apply, advance, and have impact). Continuing education, Program Goal 3, is most directly linked to the institutional mission to provide an enduring education. Finally, Program Goal 4, working at the frontiers in CHE, is linked to creating and advancing knowledge and working collaboratively since the frontiers are almost always at the interface between multiple disciplines.



Mapping for Institutional Mission Goals and CHE Departmental Program Goals

Goal/Objective/Outcome

Program Goal 1: Graduates Recognized as Real World Problem Solvers

Define Goal:

Program Goal 1: Be recognized as real-world problem solvers (RWPS): the graduates of our program will obtain positions such as plant process engineer, design engineer, group leader, production engineering, and sales engineer. RWPS – Real world problem solving as it relates to both design and experimentation has been addressed in the curriculum. Changes to our curriculum including the distributed lab integration have addressed both design and experimentation nicely. A "problem solving formalism" sequence was introduced early in the curriculum with an assessment strategy to establish a baseline from which we can assess progress later in the curriculum.

Intended Outcomes / Objectives:

The TTU Chemical Engineering BS curriculum is specifically designed to prepare students for either a professional career in the Southeastern US regional chemical process industries and/or simultaneously to prepare students who will choose to pursue graduate studies in engineering or other professional studies, e.g., medicine, law, business, pharmacy. Our overall Program Goals were redesigned throughout academic year 2007-2008. The redesign process involved use of faculty consensus management techniques, and multiple faculty meetings and retreats dedicated to discussion of the undergraduate curriculum. The feedback of our BOA and other constituencies was incorporated into this redesign process. The Program Goals are designed to guide curriculum development, to be measurable statements of purpose, and to advertise our curriculum intent to our constituency. Ultimately the intended outcome is that within roughly five to seven years after graduation, our graduates will satisfy four Program Goals (the first of which is listed above with the others provided in subsequent sections of this report) and seven student learning outcomes (1-7). These seven student learning outcomes represent a reduction from 11 as indicated in previous reports since ABET has changed its definition of such outcomes.

Program Goal 2: Graduates Recognized as Critical Thinkers

Define Goal:

Program Goal 2: Be recognized as critical thinkers: the graduates of our program will demonstrate that they consistently make informed decisions through a process wherein they utilize critical thinking skills.

Intended Outcomes / Objectives:

Program Goal 3: Graduates Continuing Formal Education

Define Goal:

Program Goal 3: Continue their formal education: the graduates of our program will demonstrate that they have continued their education beyond the BS through some form of professional development (not necessarily leading to another degree) or will have graduated from a professional school with an MS, PhD, MD, JD or similar degree.

Intended Outcomes / Objectives:

Program Goal 4: Graduates Working at the Frontiers of Chemical Engineering

Define Goal:

Program Goal 4: Work at the frontiers in ChE: the graduates of our program will utilize and apply technologies such as bio materials, nano- and micro-systems, multi-scale analysis, informatics, group dynamics, and multi-media.

Intended Outcomes / Objectives:

Student Learning Outcome 1

Define Goal:

An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

Intended Outcomes / Objectives:

The department's articulation matrix for ABET (which is in the process of being updated with a completion date in time for the 2019-2020 reporting period as mandated by ABET) is followed to help ensure student learning outcomes are assessed throughout the curriculum. This applies for each of the program's seven student learning outcomes.

Student Learning Outcome 2

Define Goal:

An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

Intended Outcomes / Objectives:

Student Learning Outcome 3

Define Goal:

An ability to communicate effectively with a range of audiences

Intended Outcomes / Objectives:

Student Learning Outcome 4

Define Goal:

An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

Intended Outcomes / Objectives:

Student Learning Outcome 5

Define Goal:

An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

Intended Outcomes / Objectives:

Student Learning Outcome 6

Define Goal:

An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

Intended Outcomes / Objectives:

Student Learning Outcome 7

Define Goal:

An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Intended Outcomes / Objectives:

Assessment Tools

Assessment Mapping to Program Goals and Student Learning Outcomes

Goal/ Outcome/ Objective: Program Goals 1-4 and Student Learning Outcomes 1-7

Type of Tool: Other

Frequency of Assessment: N/A

Rationale:

Attached is the mapping of the assessments used to the CHE BS Program Goals and Student Learning Outcomes. The rationale for this mapping is discussed in each "assessment item" section.

Attached Files

Mapping of Assessments to Goals and Outcomes BS Program 2019 and Later.pdf

Assessment: Alumni Survey

Goal/ Outcome/ Objective: Program Goals 1-4

Type of Tool: Survey

Frequency of Assessment: Once every three years

Rationale:

Alumni Surveys: A new strategy of survey collection has been decided upon which leverages the CHE Board of Advisors (BOA) which includes program alumni and employers. The new survey will contain questions directly related to the attainment of Program Educational Goals. Written comments will also be collected. The results will be shared with the Department Chair and Undergraduate Program Coordinator for potential improvement actions.

Assessment: Capstone Design Outcomes and External Project -- CHE 4410 and CHE 4420

Goal/ Outcome/ Objective: Student Learning Outcomes 1-7

Type of Tool: Capstone Project

Frequency of Assessment: Annually

Rationale:

External Review of Senior (Capstone) Design Projects: (Senior Year, Spring Semester) Student Learning Outcomes 1-7. The capstone process design sequence includes two, three-credit hour courses taken during the senior year. The first semester course focuses on equipment sizing, and the second semester course leverages student knowledge as teams of students work on a project of interest that is led by various faculty in the department. External evaluators are used for assessing the quality of the Senior Design Projects and providing feedback on the capstone design course, and by extension of the ChE Program at large. The evaluators ask questions of the team members and provide feedback on the technical quality of the projects and oral/poster presentations using an established ABET-criteria based rubric. The external evaluations are provided to the instructor who summarizes the feedback to the faculty for implementation of improvement as necessary.

Assessment: Capstone Lab Outcomes and External Project --CHE 4240

Goal/ Outcome/ Objective: Student Learning Outcomes 1-7

Type of Tool: Capstone Project

Frequency of Assessment: Annually

Rationale:

Capstone Lab and External Project Assessments: (Annually) - ChE 4240. Student Learning Outcomes 1-7. Each year, the Capstone Lab student team projects are assessed by both the instructor and (periodically) by invited judges that provide an overall assessment of the relevance and practicality of the different projects.

Assessment: ChE External Advisory Board (BOA)

Goal/ Outcome/ Objective: Program Goals 1-4

Type of Tool: Advisory Board

Frequency of Assessment: Annually

Rationale:

ChE External Advisory Board (BOA): (Annually) The ChE External Advisory Board (BOA) consists of approximately 8-10 members, selected primarily from employers of our students and other related industries as well as program graduates. The main purpose of this board is an advisory one. It is not intended as a fund-raising mechanism, however, recent conversations have involved increased efforts for the BOA to also serve in a fund-raising capacity. The board provides input and feedback on

various curricular and accreditation matters (ABET, SACS, THEC Graduate Program Review). Some BOA members also regularly serve as External Evaluators for the Senior Design Projects. Key selected items identified by the BOA are then discussed among faculty including the Undergraduate Program Coordinator for potential actions for improvement.

Assessment: Co-Op Performance Assessment

Goal/ Outcome/ Objective: Student Learning Outcomes 1, 3-5, and 7

Type of Tool: Checklist

Survey

Frequency of Assessment: Typically once at the end of each semester

Rationale:

Co-Op Report Assessment: (Semi-annually or annually). The Department uses the evaluation summaries that are directly provided by the student supervisor at the co-op site to learn about important student competencies. Reports are reviewed by the Chair and or the Designee Faculty to extract valuable feedback.

Assessment: Course-Level Assessments of Selected Courses

Goal/ Outcome/ Objective: Student Learning Outcomes 1-7

Type of Tool: Annual Unit Report

Other

Frequency of Assessment: Annually (dependent on course offering schedule)

Rationale:

Course Level Assessments: (Annually, dependent on course offering schedule). The Department uses selected courses (nine in total) to learn about student performance at the different levels of the curriculum through the completion of what are referred to as "Course Level Assessment and Improvement Reports" (or CLACIR's for short). CLACIR's are completed for every term that the course is taught, and an overview summary is completed for the course every third year. Those summaries are used to continuously improve the courses and the curriculum as a whole and are discussed with the faculty and appropriate corrective action taken. These courses along with their mapping to the Student Learning Outcomes are listed in the attached table. The "M" and "m" designations refer to what are considered "Major" and "minor" assessment criteria.

Attached Files

articulationmatrix (2018-19M).doc

Assessment: Critical thinking Assessment Test (CAT) and Course Rubrics

Goal/ Outcome/ Objective: Program Goal 2 and Student Learning Outcomes 1, 2, and 6

Type of Tool: Other

Frequency of Assessment:

As needed to demonstrate effectiveness of new courses and course changes (only done occasionally)

Rationale:

Critical thinking Assessment Test (CAT) and Course Rubrics: Critical thinking skills are assessed directly or indirectly using a variety of rubrics developed by the faculty for use in evaluating student projects in multiple courses within the program, particularly the transfer science courses (heat transfer, fluid mechanics, and mass transfer) as well as process design. In addition, the faculty is engaged in educational research in these and other courses under IRB approval in which the Critical thinking Assessment Test (CAT) is utilized in a pre-post fashion (i.e., beginning of a semester and end of a semester).

Assessment: Employer Survey

Goal/ Outcome/ Objective: Program Goals 1-4

Type of Tool: Survey

Frequency of Assessment: Once every three years

Rationale:

Employer Surveys: A new strategy of survey collection has been decided upon that leverages the CHE Board of Advisors (BOA) which includes program alumni and employers. The new survey will contain questions directly related to the attainment of Program Educational Goals. Written comments will also be collected. The results will be shared with the Department for potential improvement actions.

Assessment: FE Exam Results

Goal/ Outcome/ Objective: Student Learning Outcomes 1-7

Type of Tool: Certification Exam

Frequency of Assessment: Annually

Rationale:

FE Exam: (Annually) While not a complete assessment tool in itself, the Fundamentals of Engineering (FE) exam provides an objective, nationally- normalized testing of certain engineering, math, and science topics, as well as the ability to analyze, formulate, and solve engineering problems. Consequently, the FE exam can be a useful measure of Student Learning Outcomes of the program. Results are analyzed and feedback is provided to the faculty for improvement actions.

Assessment: Student Senior Survey/Chair Debriefing of Students

Goal/ Outcome/ Objective: Student Learning Outcomes 1-7

Type of Tool: Survey

Other

Frequency of Assessment: Annually

Rationale:

Student Senior Survey and Chair Debriefing: (Annually) These items provide the opportunity for student feedback (anonymously) or directly to the Chair on the different aspects of the program, including ChE curriculum, and the students' experiences while at TTU. In addition, a number of (survey or direct) questions are directly related to specific Program Goals and Student Learning Outcomes. Items identified for action are discussed with faculty.

Results

Results (for Critical Thinking)

Goal/Objective/Outcome Number: Program Goal 2 and Student Learning Outcomes 1, 2, and 6

Results:

Critical Thinking: Students taking CHE 3111 (Heat Transfer) and CHE 3121 (Fluid Mechanics) during the 2018-19 academic year were assessed for critical thinking skills via the Critical thinking Assessment Test (CAT) which is an NSF-supported instrument developed at TTU and based on four broad aspects of critical thinking: evaluation/interpretation of information, problem solving, creative thinking, and effective communication. The test, designed to be interesting and engaging for students, has questions derived from real world situations. Most of the questions require short-answer essay responses, and a detailed scoring guide as well as grader training, and multiple graders help insure good scoring reliability. While various assessment designs are possible, a pre- and post- exam strategy was used for these two courses. Specifically, given that the heat transfer course is taken in the first semester of the junior year and the fluid mechanics course is taken during the second semester of the junior year, all students in the heat transfer course took the CAT at the beginning of the fall semester. Then, roughly half of these students took the test at the end of the fall semester (thus providing an indicator of improvements in critical thinking during this semester) while the other half of students took the test again at the end of the fluid mechanics course. Students in the heat transfer course who took the test pre and post that semester (n=25) showed an average, statistically significant increase in their "CAT Total Score" which increased from 16.80 to 18.64. Students who had taken both the heat transfer and the fluid mechanics courses and took the pre test at the beginning of the fall semester and the post test at the end of the spring semester (n=24) showed an even higher gain in the CAT Total Score which increased from 18.60 to 21.15. In addition to the CAT, students were evaluated in these and other courses using rubrics that were developed to assess creative inquiry, including critical thinking skills with positive results.

Attachments:

Results (from Alumni and Employer Surveys)

Goal/Objective/Outcome Number: Program Goals 1-4

Results:

Alumni and Employer Surveys: A new strategy of survey collection has been decided upon that leverages the CHE Board of Advisors (BOA) which includes program alumni and employers. The new survey will contain questions directly related to the attainment of Program Goals. Written comments will also be collected. The surveys have not yet been administered.

Attachments:

Results (from Board of Advisors' Meetings)

Goal/Objective/Outcome Number: Program Goals 1-4

Results:

CHE Board of Advisors (BOA) Feedback: The BOA meetings are held annually. The BOA generally documents its findings in the form of an Executive Summary. Their findings regarding student success and satisfaction are reported there. Recommendations are used specifically as feedback into the program's curricular change process; however, such are rarely made by the BOA. Broader programmatic issues are typically identified by the BOA and are used to influence elements, including but not limited to faculty numbers and institutional support.

In the November 2018 meeting with the BOA, faculty reported to the Board the following regarding the undergraduate curriculum:

- CHE is traveling a trajectory towards innovation with impact: Efforts include but are not limited to engineering at the borders of nursing and CHE, a focus on entrepreneurship, and an increase of students involved in undergraduate research.
- The department implements the Renaissance Foundry Model across the curriculum: As a result, the department displays a collaborative-centered and team-based approach to student learning with closely-integrated facilitator-based discussions and guidance.
- Commendations for the department: The recent Eagle Works Competition was won by CHE students, the undergraduate students have led us to another title as the Best Darn Major, and faculty mentoring has led to increased involvement in undergraduate research making CHE the leader of such efforts within the College of Engineering.
- Curriculum grants are allowing development of updated experiential learning opportunities for students: Creative inquiry through immersion experiences intended to enhance problem-identification strategies and prototype development to address specific learning challenges became the focus across three courses within the undergraduate curriculum after approximately $20,000 in funding was awarded via the TTU Enhanced Discovery through Guided Exploration (EDGE) Creative Inquiry Curriculum Grant Program. Such experiences offered students a more systematic approach to problem-solving strategies, ultimately enhancing their understanding of course material in an integrated fashion across the curriculum.

Following discussions, the Board provided the following feedback to the faculty regarding the undergraduate curriculum:

- The Board is excited by the leadership demonstrated by our students in the winning of the Best Darn Major award for five (four consecutive) years.
- Increased efforts with respect to faculty relationships with local industry are recommended to increase the number of companies recruiting CHE students at the career fairs as well as increase the number of alumni involved in classroom activities.
- A more systematic blending of programming is necessary across the curriculum.

Attachments:

Results (from Co-Op Performance Assessments)

Goal/Objective/Outcome Number: Program Goal 1 and Student Learning Outcomes 1, 3-5, and 7

Results:

Co-Op Performance Assessments: The Co-Op survey includes 12 questions which per the new ABET Student Learning Outcomes map to Outcomes 1, 3-5, and 7 (Note: Data collected for the 2017-18 and the 2018-19 reporting periods are currently being examined). The results of these surveys which consist of responses from employers for co-op student internships from spring 2008 to spring 2017 (refer to the 2016-17 report) are largely unremarkable. Survey questions are ranked on a 1 (lowest) to 5 (highest) scale. Our rubric is that no student receives a score lower than 3. On average (as shown in the attached file), scores are between 4 and 5 for most students with an occasional lower score. We conclude that co-op employers are satisfied with our students' performance across the board. Similarly, co-op final reports are 100% approved by the co-op supervisors. At this time, the survey that is used is a College-developed co-op survey that does not include questions related to knowledge (a), experimentation (b), design (c) and tools (k). Since most co-op students are sophomores and juniors, it seems that omitting questions related to experimentation and design might be logical. For a detailed mapping of the survey skills assessed to the Student Learning Outcomes 1, 3-5, and 7, please see the table below:

Items Assessed on Co-Op Employer Survey

Survey Item	Skills Assessed
a	Efficiently manage their assigned duties and responsibilities
b	Demonstrate the ability to work independently
c	Demonstrate a commitment to professional development
d	Participate in activities that serve the profession and/or public
1	Work effectively with other employees
2	Identify, formulate and solve engineering problems
3	Understand professional and ethical responsibilities
4	Produce effective written communications
5	Deliver effective oral presentations
6	Understand the global/societal impact of engineering
7	Recognize the need for and engaging in life-long learning
8	Understanding contemporary engineering issues
RO	Relationship with Others
AL	Ability to Learn
OP	Overall Performance

Attachments:

Results (from Design and Capstone Experiences and Other Example Course Level Assessments)

Goal/Objective/Outcome Number: Student Learning Outcome 1-7

Results:

Results from Course Level Assessment and Curriculum Improvement Reports (CLACIRs):

CHE 2020 (Intro to Chemical and Biological Engineering Analysis II)

Target rubric value: 70%

Overall Class Average Performance: 77% (This percentage indicates that the class average performance was above target rubric.)

No concerns were noted by the course instructor for the most recent iteration of the course. As there were no noted concerns, there were no recommendations by the course instructor for the most recent iteration of the course.

CHE 3010 (Thermodynamics of Chemical Processes)

Target rubric value: 80%

Overall Class Average Performance: 80% (This percentage indicates that the class average performance was at target rubric.)

The course instructor noted some conceptual deficiencies within project applications during the term. To address the deficiencies noted in the course project, the course instructor recommends providing periodic feedback to students during the project development instead of allowing students to work independently during the project development to avoid implementing course misconceptions.

CHE 3111 (Transfer Science I: Conduction, Radiation, Diffusion)

Target rubric value: 70%

Overall Class Average Performance: 79% (This percentage indicates that the class average performance was above target rubric.)

No concerns were noted by the course instructor in the most recent iteration of the course. As there were no noted concerns by the course instructor in the most recent iteration of the course, no remediation was proposed.

CHE 3121 (Transfer Science II: Fluid Mechanics)

Target rubric value: 70%

Overall Class Average Performance: N/A

Spring 2019: Not yet available at this time

CHE 4210 (Chemical Reaction Engineering)

Target rubric value: 70%

Overall Class Average Performance: 77% (This percentage indicates that the class average performance was above target rubric.)

The course instructor noted student deficiencies with respect to designing, executing and reporting on laboratory experiments as well as with student ability to execute a literature review. In order to address the noted concerns, the course instructor indicated a need for an improved integration of the laboratory and related resources to allow students to draw a more tangible connection to course concepts.

CHE 4240 (Chemical Engineering Capstone Laboratory)

Target rubric value: 70%
Overall Class Average Performance: 93% (This percentage indicates that the class average performance was above target rubric.)

The course instructor identified students to be weak in the project identification with respect to the identified topics' connection to global issues. The course instructor recommends improvements in student knowledge of global concepts for the upcoming terms. Suggestions for implementing the student awareness of such global concepts include strengthening communication of expected learning expectations and project outcomes as well as development of assignments and discussions that connect global issues to individual team projects.

CHE 4410 (Chemical Engineering Process Design I)

Target rubric value: 70%
Overall Class Average Performance: 84% (This percentage indicates that the class average performance was above target rubric.)

While many of the most recent iterations of this course have indicated efforts to strengthen student performance related to material balance concepts and written quality of work, the most recent cohort of students did not reflect the same trend. Ultimately, the cohort performed well with respect to the team reports and presentations, but individual performance did not demonstrate the same level of student competency. No recommendations by the course instructor were provided at this time as the variance seen in the most recent iteration of the course could possibly be attributed simply to the cohort of current students. More data will be collected over the coming terms and then the course instructor will reassess.

CHE 4420 (Chemical Engineering Process Design II)

Target rubric value: 70%
Overall Class Average Performance: N/A

Spring 2019: Not yet available at this time

CHE 1020 (Products, Process and Ethics)

Target rubric value: 70%
Overall Class Average Performance on Selected Program Outcomes: N/A

Spring 2019: Not yet available at this time

Attachments:

Results (from FE Exam)

Goal/Objective/Outcome Number: Student Learning Outcomes 1-7

Results:

FE Exam: Because Professional Engineering (PE) is not emphasized by the chemical engineering community at large, neither academic (research) nor industrial, only a small number of CHE students self-select to take the FE exam. Further, licensure as a PE is seldom required by employers in CHE-related industries. FE Exam statistics for the 2018/2019 reporting period are not currently available. Given the small number of students self-selecting to take this exam, it is difficult to place statistical significance on the use of these data as a basis for improvements in the CHE department's student learning outcomes. It is proposed that the use of the FE Exam as an assessment tool be reconsidered. This item has been undergoing discussions during the current reporting period by the Faculty in the CHE department.

Attachments:

Results (from Student Survey and Chair Debriefing)

Goal/Objective/Outcome Number: Student Learning Outcomes 1-7

Results:

Student Surveys and Chair Debriefings: Student surveys were administered on the typical 3-year cycle during the previous reporting period. Thus, no new results are presented for that item here. Regarding feedback during Chair debriefings (and following input from the BOA), the feedback of the BOA indicated that the experiences in laboratories are going in the right path for correction and satisfaction of the students. The Department is still monitoring this situation very closely with the help of the Capstone Lab Coordinator. The Department continues monitoring and receiving feedback from the students for courses that were indicated as a concern. The mentoring activities that have been implemented in the recent past were further extended to include the sitting-in of a faculty in the class of a more senior faculty with active engagement.

Attachments:

Modifications and Continuing Improvement to Goals/Objectives/Outcomes

Faculty Studies and Pedagogical Strategies of New and More Effective Learning Approaches

Goal/Objective/Outcome Number: Student Learning Outcomes 1-7

Program Changes and Actions due to Results:

The process of transitioning the process analysis course sequence and the ethics course as reported on in the previous reports was completed. Also in this reporting period, changes to the CHE 3730 (CHE Operations) course were discussed, and the CHE 4240 (CHE Capstone Lab) course was redesigned based on feedback from the BOA and from the Chair Debriefings.

Link to Assessment:

These changes were initiated per findings related to course level assessments of student learning outcomes within the curriculum.

Link to 'Tech Tomorrow' Strategic Plan: Efficiency and Effectiveness
Programs, Certificates, and Training

Monitoring of Retention and Diversity

Goal/Objective/Outcome Number: N/A

Program Changes and Actions due to Results:

Monitoring of Retention and Diversity: Statistics regarding such items as student retention and demographics are monitored. These statistics are also considered to be key indicators of the department's ABET-driven continuous improvement efforts but are not used as metrics to guide change.

The ChE department (effective Fall 2018) has ten full-time faculty including the Chair. Five of these faculty are female. This diverse faculty team energetically and enthusiastically works with a diverse student group. Per results from the TTU Office of Institutional Research, the CHE-BS enrollment over the last five years has been ~30% female (see table below) and includes students from multiple locations throughout TN and beyond including from other countries.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Female	23	24	23	27	41	41	47	61	68	84	104	103	102	90	87
Total	95	95	103	118	150	170	186	218	268	315	357	380	359	304	264
% Female	24.2	25.3	22.3	22.9	27.3	24.1	25.3	28.0	25.4	26.7	29.1	27.1	28.4	29.6	33.0

Source: "Women in STEM Disciplines" [Office of Institutional Research, March 25, 2019]

For first-time freshmen students majoring in CHE starting in the Fall 2017, the "first fall" to "first spring" retention rate was 92.1% (58 students retained in the program out of 63 total students entering the program) while the "first fall" to "second fall" retention rate was 84.1%. Source: "Retention Rates for First-Time Freshmen by Program: Fall 2017 Cohort" [Office of Institutional Research, October 29, 2018]

Link to Assessment:

N/A

Link to 'Tech Tomorrow' Strategic Plan: Diverse Faculty and Staff
Diversity
Efficiency and Effectiveness
Programs, Certificates, and Training

Improvement to Assessment Plan

New Improvement to Assessment Plan Item

Improvements to Assessment Plan:

The program has completed a preliminary remapping of the student learning outcomes from those designated as "a" through "k" which has historically been the nomenclature used by ABET to now reflect new student learning outcomes "1" through "7" as mandated by ABET to be effective for the 2019-20 reporting period. This remapped matrix is included earlier in this report. The program now plans to leverage its BOA to help with administration of the Alumni and Employer Surveys.