

PROGRAM ASSESSMENT DATA AY2018-2019

UNITED STATES MILITARY ACADEMY
DEPARTMENT OF CHEMISTRY AND LIFE SCIENCE
CHEMICAL ENGINEERING PROGRAM
June 8, 2020

<u>Student Outcome</u>	<u>Page</u>
1.....	<u>1</u>
2.....	<u>3</u>
3.....	<u>5</u>
4.....	<u>7</u>
5.....	<u>9</u>
6.....	<u>12</u>
7.....	<u>14</u>
8.....	<u>18</u>

Evaluations

Faculty.....	<u>21</u>
Advisory Board.....	<u>22</u>
Program Director	<u>23</u>

Note: This data is intended to facilitate completion of the faculty and advisory board surveys. The different groups (faculty and advisory board) review the data and then complete the survey. When complete, the results of the surveys are then summarized in the “Evaluations” section.

Level of Achievement of Student Outcome 1:

On completion of the chemical engineering program, our graduates will be able to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. Fundamentals of Engineering Examination, once/yr.
3. End-of-Semester Student Surveys, once/semester.
4. Chemical Engineering Program Exit Survey, once/yr.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

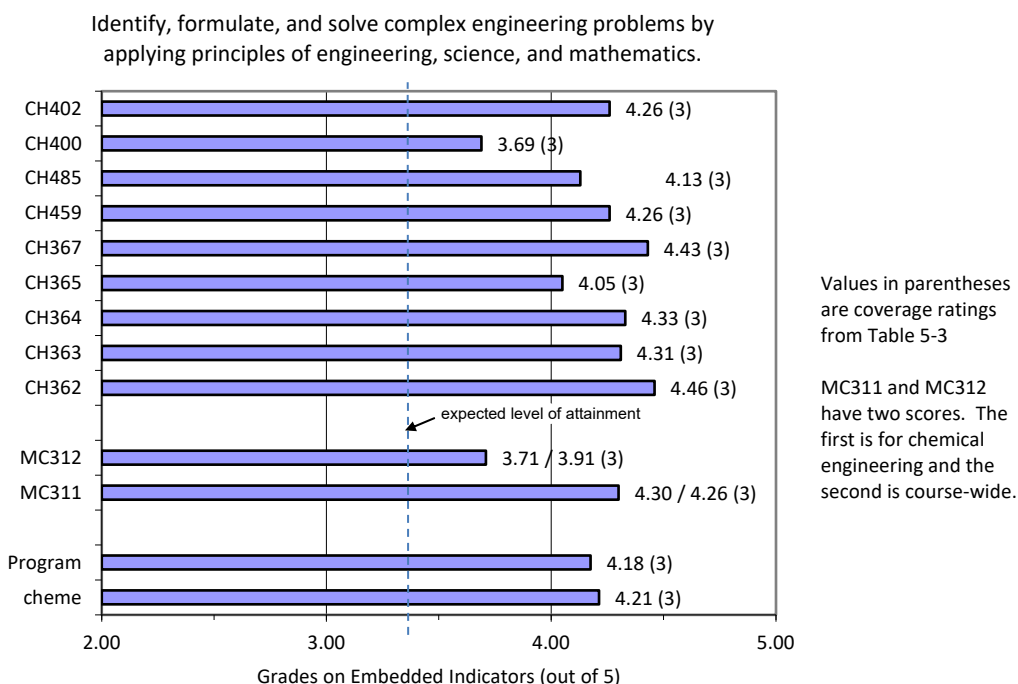


Figure 1-1. Coursework Embedded Indicator results for Student Outcome 1.

2. Fundamentals of Engineering Examination (FEE). According to the 2019 report from NCEES, 21 out of 24, or 87.5% of the students in the Class of 2019 took and passed the FE Exam. The three who failed took the exam again and passed on the second attempt (100% pass rate). The national average in 2019 was 77%, and this is our expected level of attainment. In the previous five years, the pass rates were 81% in 2018, 94% in 2017, 79% in 2016, 76% in 2015, and 92% in 2014. Our running average over those five years is $84.8\% \pm 8\%$ ($81\% \pm 5\%$ for the national).

Note: The national percentage of chemical engineering examinees passing was 86% for many years prior to 2015. However, as of that year, NCEES changed our comparator group from all takers to those first-time takers taking the exam within 12 months of graduation. Also, a new chemical engineering exam in electronic format was implemented that year. As a result of these changes, the national average dropped to 77% (74% this year). That is, we are **above** the national average, and the national average is our expected level of attainment.

3. End of Semester Student Surveys

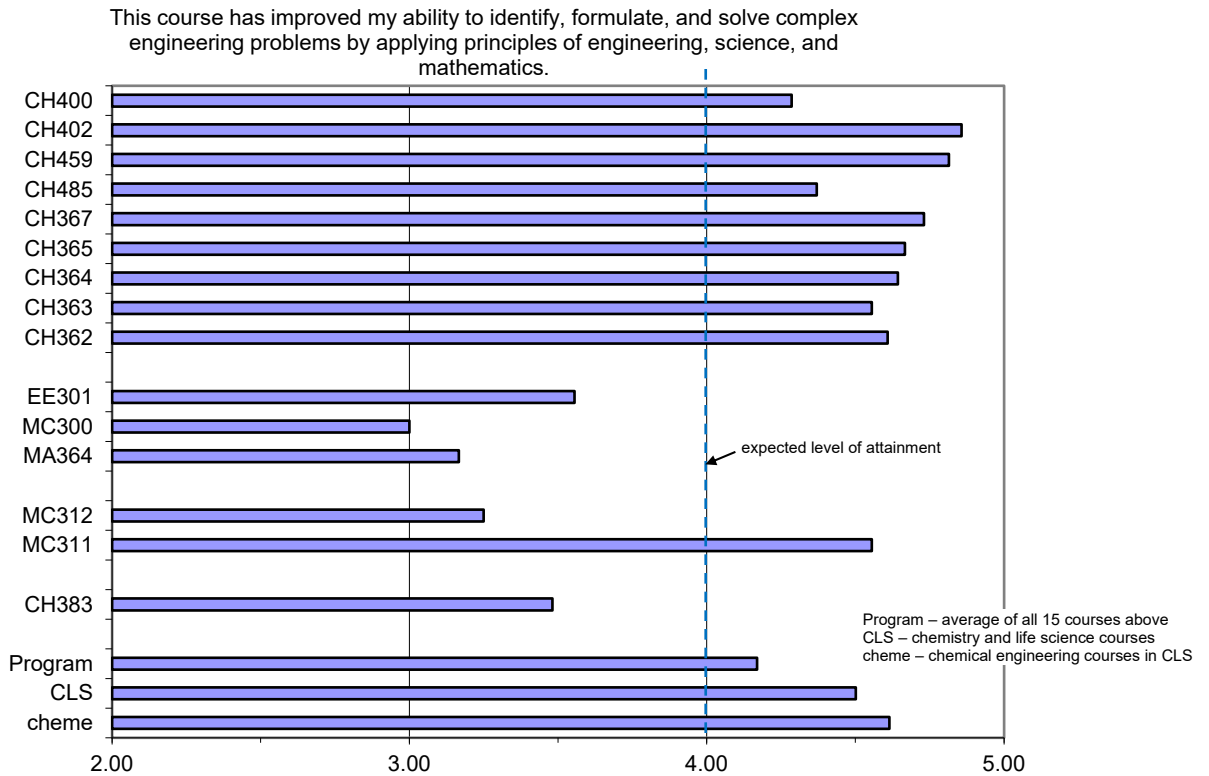


Figure 1-2. End-of-Semester Student Survey responses for Student Outcome 1.

4. Chemical Engineering Program Exit Survey. This survey is issued to the firsties at the end of their last semester. In this question, they were asked whether or not they agree with the statement “The program has prepared me to Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.” 21 out of 21 cadets completed the survey. All 21 of the cadets said that they either agreed or strongly agreed, and 18/21 replied that they strongly agreed (score = 5/5). This equates to a mean score of 4.857/5.00 for the 21 cadets. The expected level of attainment on this survey is 4.00/5.00.

Level of Achievement of Student Outcome 2:

On completion of the chemical engineering program, our graduates will be able 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.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. End of Semester Student Surveys, once/semester.
3. Course Grades in CH402 Chemical Engineering Process Design, once/yr.
4. Chemical Engineering Program Exit Survey, once/yr.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

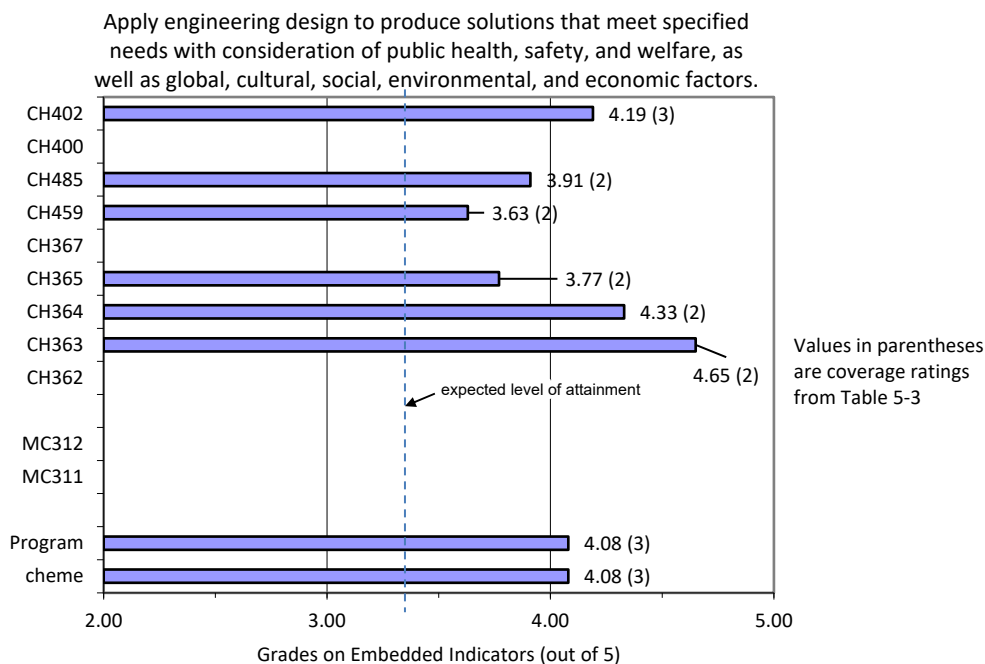


Figure 2-1. Coursework Embedded Indicator results for Student Outcome 2.

2. End of Semester Student Surveys

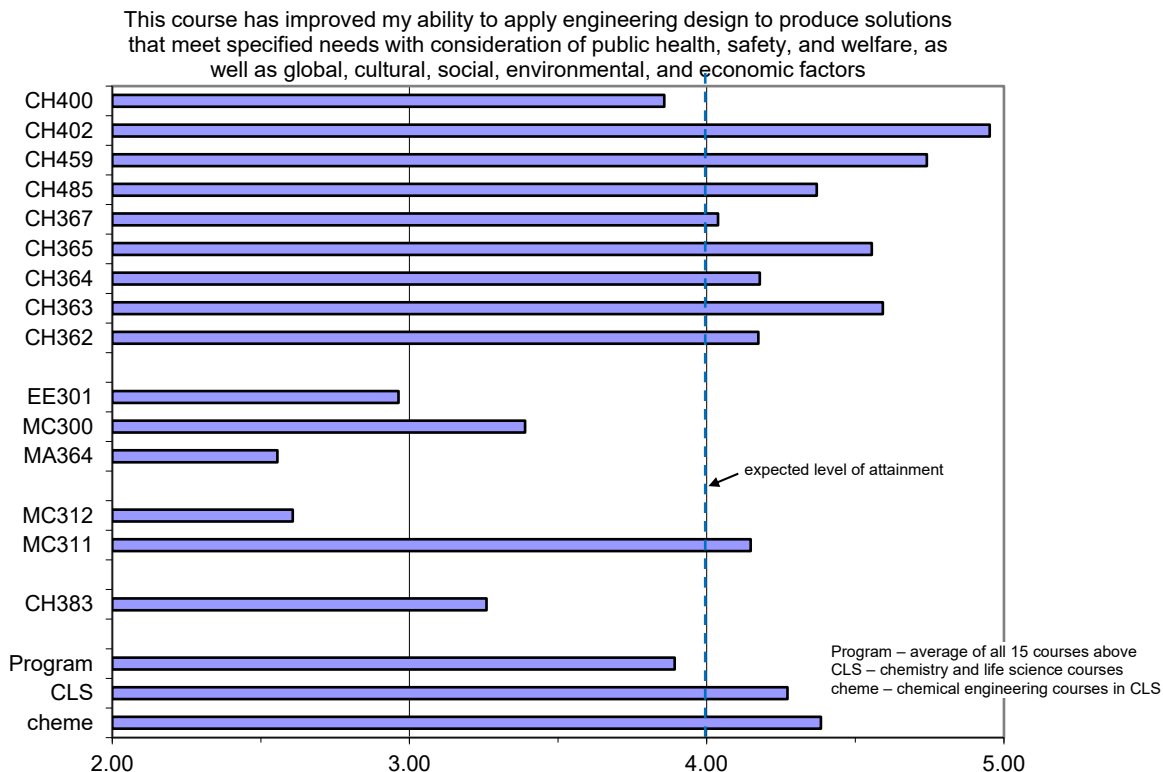


Figure 2-2. End-of-Semester Student Survey responses for Student Outcome 2.

3. The average course grade in CH402 Chemical Engineering Process Design was 3.27 ± 0.92 ($n=21$) in AY19, compared to 3.37 ± 0.66 ($n=19$) in AY18, 2.73 ± 0.39 ($n=16$) in AY17, 3.43 ± 0.49 ($n=24$) in AY16, and 3.40 ± 0.75 ($n=20$) in AY15, 3.23 ± 0.71 ($n=13$) for AY14. *The 5-year running average for the previous five years is 3.23, and this is our expected level of attainment. This year's score was slightly above the 5-year running average.*
4. Chemical Engineering Program Exit Survey. As stated earlier, this survey is given to the firsties at the end of their last semester. In this question, they were asked whether or not they agree with the statement "The program has prepared me 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." 21 out of 21 cadets completed the survey. All 21 cadets said that they either agreed or strongly agreed, and 17/21 replied that they strongly agreed (score = 5/5). This equates to a mean score of 4.810/5.00 for the 21 cadets. The expected level of attainment on this survey is 4.00/5.00.

Level of Achievement of Student Outcome 3:

On completion of the chemical engineering program, our graduates will be able to communicate effectively with a range of audiences.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. End of Semester Student Surveys, once/semester.
3. Course Grades in CH459 Unit Operations Laboratory, once/yr.
4. Chemical Engineering Program Exit Survey, once/yr.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

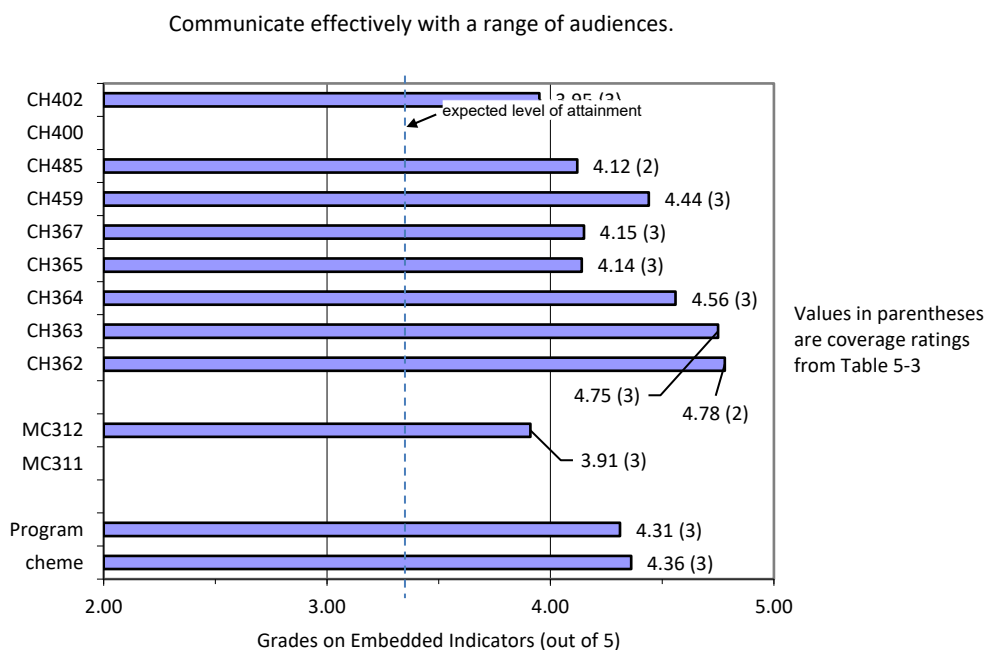


Figure 3-1. Coursework Embedded Indicator results for Student Outcome 3.

2. End of Semester Student Surveys

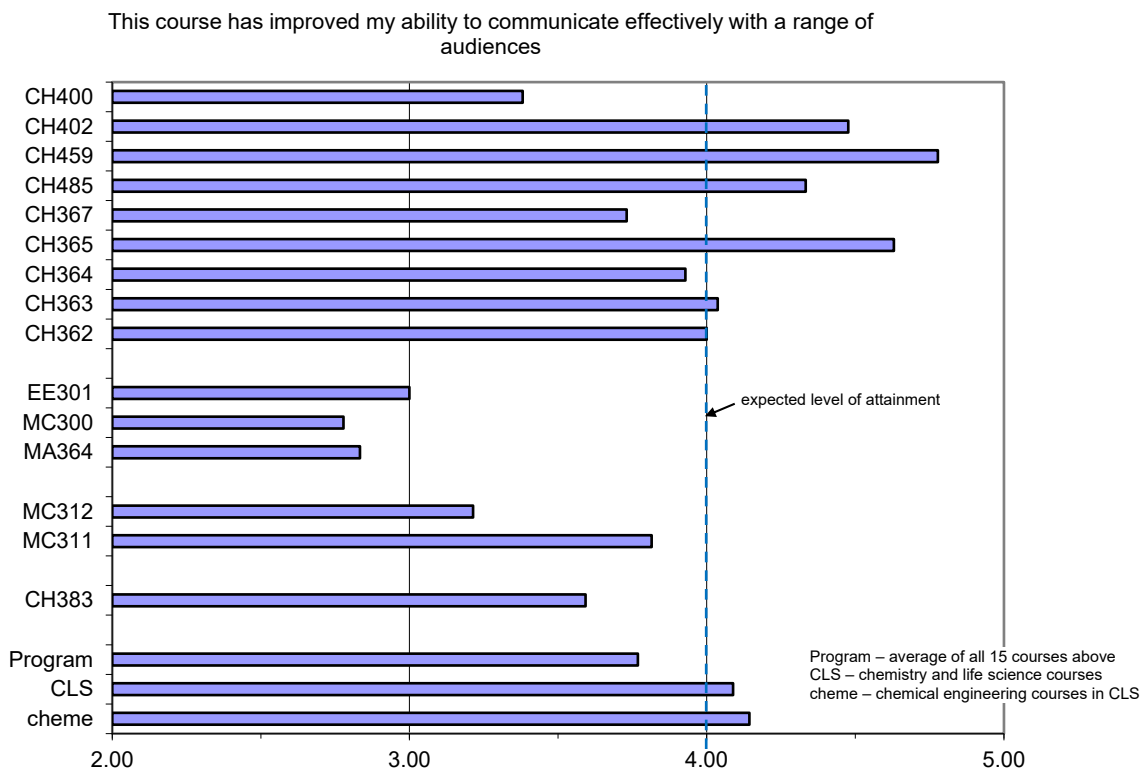


Figure 3-2. End-of-Semester Student Survey responses for Student Outcome 3.

3. The average course grade in CH459 Chemical Engineering Laboratory was 3.52 ± 0.44 ($n=21$) in AY19, compared to 3.42 ± 0.64 ($n=19$) in AY18, 3.54 ± 0.30 ($n=16$) in AY17, 3.70 ± 0.35 ($n=23$) in AY16, 3.67 ± 0.37 ($n=20$) in AY15, and 3.87 ± 0.44 ($n=13$) in AY14. *The 5-year running average is 3.6, and this is our expected level of attainment. This year's score was 0.08 points below the 5-year running average, which is low but improved over the previous year.*
4. Chemical Engineering Program Exit Survey. As stated earlier, this survey is given to the firsties at the end of their last semester. In this question, they were asked whether or not they agree with the statement "The program has prepared me to communicate effectively with a range of audiences." 21 out of 21 cadets completed the survey. All 21 cadets said that they either agreed or strongly agreed, and 15/21 replied that they strongly agreed (score = 5/5). This equates to a mean score of 4.714/5.00 for the 21 cadets. The expected level of attainment on this survey is 4.00/5.00.

Level of Achievement of Student Outcome 4:

On completion of the chemical engineering program, our graduates will be able 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.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. Fundamentals of Engineering Examination Performance Index, once/yr.
3. End of Semester Student Surveys, once/semester.
4. Chemical Engineering Program Exit Survey, once/yr.
5. Completion of Cadet Character Education Program, once/yr.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

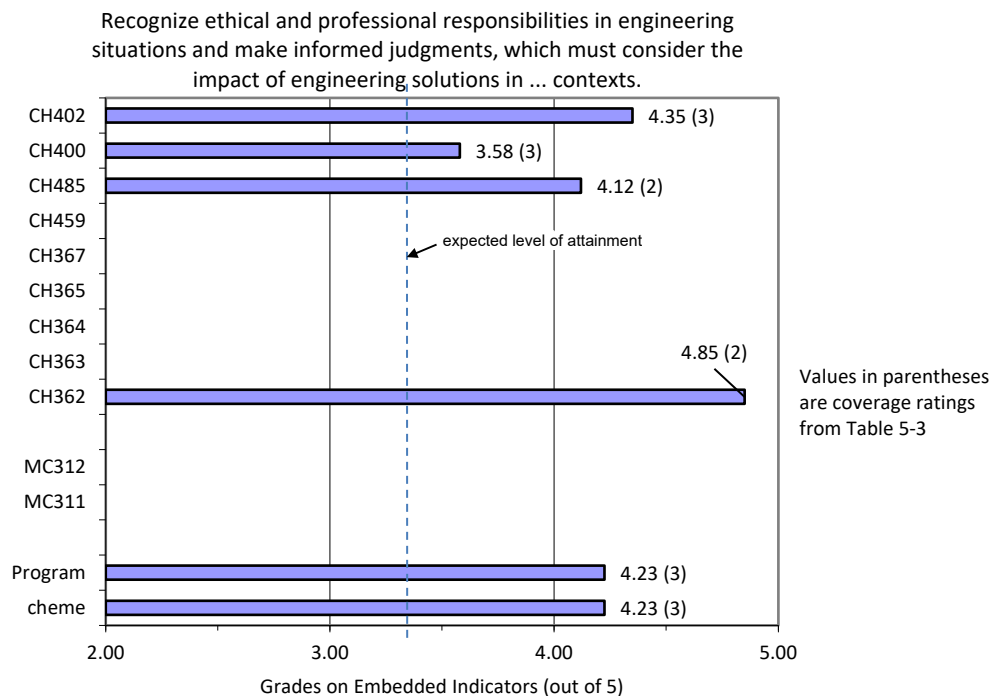


Figure 4-1. Coursework Embedded Indicator results for Student Outcome 4.

2. Fundamentals of Engineering Examination Performance, Self-Study Table 4-2.

Subject	Outcome	Questions	USMA	National (expected level of attainment)
Ethics and Professional Practice	6	2	13.7	11.8
Process Design and Economics	8	8	10.6	9.7

The national average performance index was 11.8 ± 5 in ethics and professional practice and 9.7 ± 2.6 in process design and economics, and these are our expected levels of attainment, where the uncertainties are standard deviations.

3. End of Semester Student Surveys

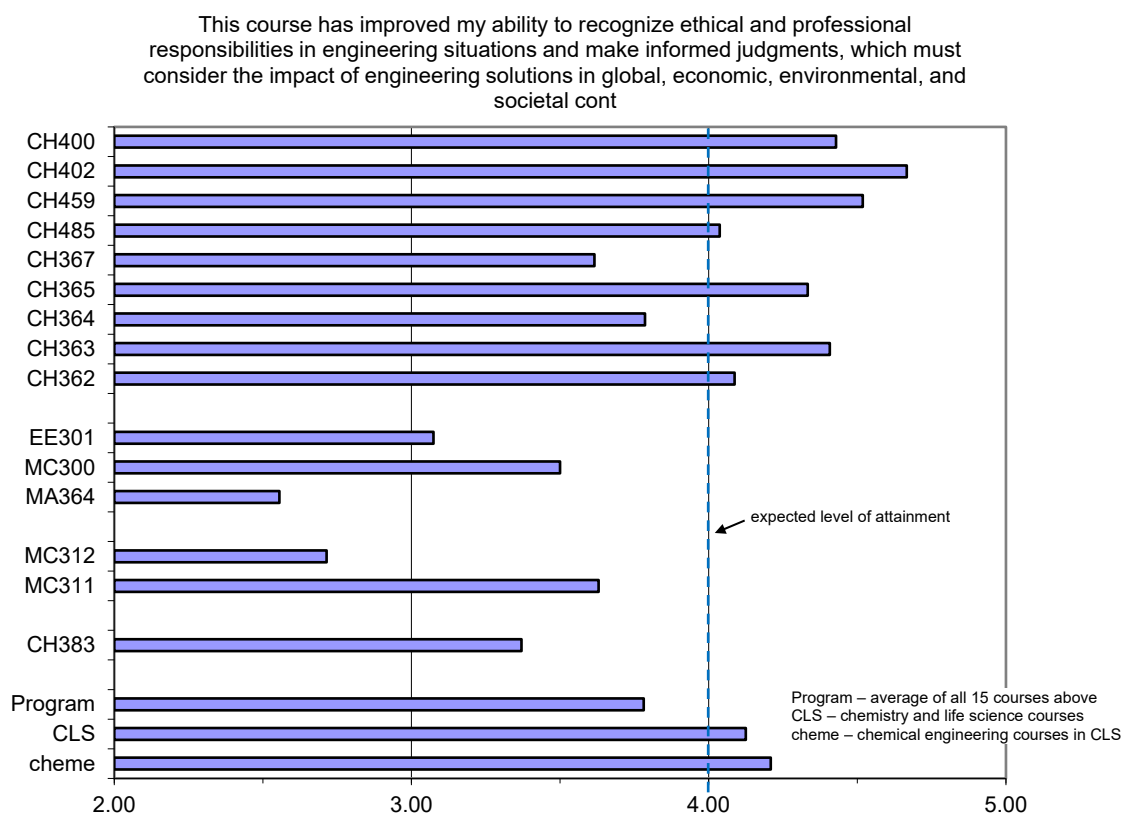


Figure 4-2. End-of-Semester Student Survey responses for Student Outcome 4.

4. Chemical Engineering Program Exit Survey. This survey is given to the firsties at the end of their last semester. In this question, they were asked whether or not they agree with the statement “The program has prepared me 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.” 21 out of 21 cadets completed the survey, all 21 said they either agreed or strongly agreed, and 12/21 replied that they strongly agreed (score = 5/5). This equates to a mean score of 4.571/5.00 for the 21 cadets. The expected level of attainment on this survey is 4.00/5.00.
5. Training in honor and ethics takes place as part of the Cadet Character Education Program (CCEP) during the academic year and during summer military instruction. The program is overseen by the Commandant of Cadets through the Simon Center for the Professional Military Ethic. CCEP tailors instruction to each of the four year-groups of cadets, who interact with faculty volunteers who share their perspectives and experience in the Armed Forces, with industry, and at other civilian institutions. All 21 chemical engineering cadets successfully completed the 4-year Professional Military Ethics Education program.

Level of Achievement of Student Outcome 5:

On completion of the chemical engineering program, our graduates will be able to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. End of Semester Student Surveys, once/semester.
3. Chemical Engineering Program Exit Survey, once/yr.
4. Multidisciplinary Skills Rubric, once/yr.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

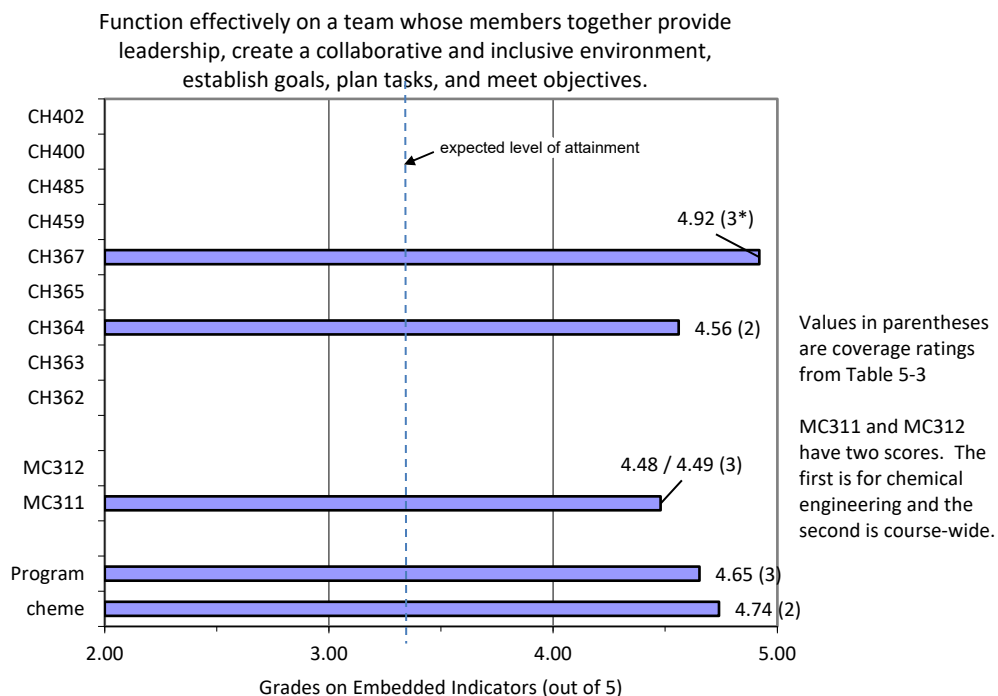


Figure 5-1. Coursework Embedded Indicator results for Student Outcome 5.

2. End of Semester Student Surveys

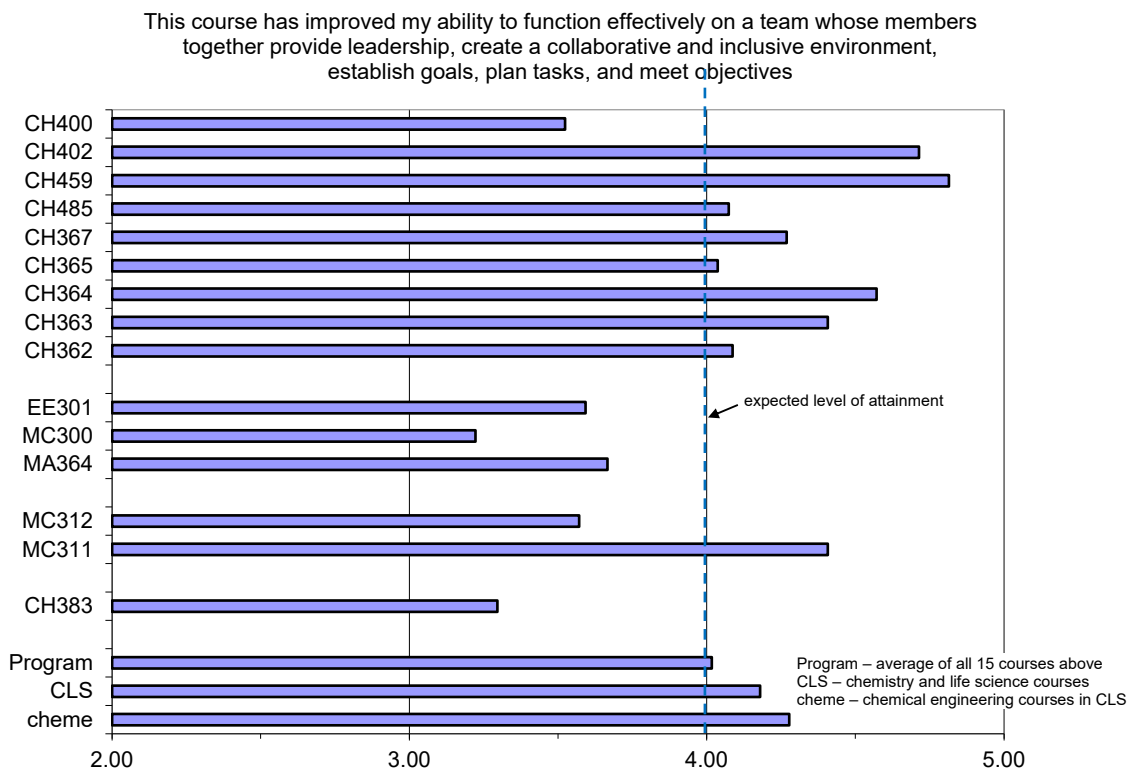


Figure 5-2. End-of-Semester Student Survey responses for Student Outcome 5.

3. Chemical Engineering Program Exit Survey. As stated earlier, this survey is given to the firsties at the end of their last semester. In this question, they were asked whether or not they agree with the statement “The program has prepared me to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.” 21 out of 21 cadets completed the survey. All 21 cadets said that they either agreed or strongly agreed, and 15/21 replied that they strongly agreed (score = 5/5). This equates to a mean score of 4.714/5.00 for the 21 cadets. The expected level of attainment on this survey is 4.00/5.00.
4. Teamwork Skills Rubric. The rubric is designed to assess performance in four skills associated with the ability to function on multidisciplinary teams, namely technical competence, communication, organization, and teamwork. The rubrics are completed by the cadets after each laboratory exercise in CH459. The results are then averaged over the entire semester and reported in the rubric below. Results designated with a superscript “a” next to the numeric average are for group leader self-assessments (Group Leader Self-Assessment or GLSA). The team leader also uses the rubric to assess his or her team mates (Group Leader Assessment of Team, GLAT), indicated with a superscript “b.” The colors in the rubric indicate the expected level of attainment, where green indicates that expectations are exceeded,

yellow indicates that expectations are minimally met, and red indicates that improvement is needed. The expected level of attainment is 4.0. The results shown here indicate that the cadets are meeting or exceeding expectations in all cases.

Your Name: Armstrong, LTC, Instructor				Person Assessed: Cadets in CH459					
Your Position: CH459 CD				Major of Person Assessed: Chemical Engineering					
	1 – Needs Improvement	1	2	3 – Meets Expectations	3	4	5 – Exceeds Expectations	5	N/A
Technical Competence	Some misunderstandings of the technical content.			Demonstrated knowledge of the technical content.		4.4 ^a ±.2 ^c	Exceptional knowledge of technical content.	4.7 ^b ±.3 ^c	
Communication	Lacked sensitivity and/or did not provide specific suggestions for improvement.			Effectively communicated important points.			Exceptional ability to explain important points. Very effectively communicated ideas for improvement.	4.7 ^a ±.3 ^c 4.7 ^b ±.4 ^c	
Organization	Was not prepared or did not give sufficient time to prepare.			Demonstrated effective organization during class.		4.5 ^a ±1.0 ^c	Was exceptionally efficient, timely and responsive throughout the entire process.	4.8 ^b ±.3 ^c	
Teamwork	Demonstrated limited ability to see other perspectives or find common ground.			Worked collaboratively with team members to reach consensus.			Exceptional ability to help group find common ground or resolve conflict in order to ultimately reach consensus.	4.7 ^a ±.5 ^c 4.8 ^b ±.4 ^c	
Are the cadets capable of functioning on multidisciplinary teams? Yes	Comments: Each cadet was group leader twice. Footnote “a” designates the average of all Group Leader Self-Assessment (GLSA) scores, while “b” designates average of all Group Leader Assessment (GLAT) scores. Footnote “c” designates standard deviations.						Assignment used for assessment: AY19, Round Robin 1		

Your Name: Armstrong, LTC, Instructor				Person Assessed: Cadets in CH459					
Your Position: CH459 CD				Major of Person Assessed: Chemical Engineering					
	1 – Needs Improvement	1	2	3 – Meets Expectations	3	4	5 – Exceeds Expectations	5	N/A
Technical Competence	Some misunderstandings of the technical content.			Demonstrated knowledge of the technical content.			Exceptional knowledge of technical content.	4.7 ^a ±.7 ^c 4.8 ^b ±.3 ^c	
Communication	Lacked sensitivity and/or did not provide specific suggestions for improvement.			Effectively communicated important points.			Exceptional ability to explain important points. Very effectively communicated ideas for improvement.	4.8 ^a ±.0 ^c 4.8 ^b ±.3 ^c	
Organization	Was not prepared or did not give sufficient time to prepare.			Demonstrated effective organization during class.			Was exceptionally efficient, timely and responsive throughout the entire process.	4.8 ^a ±.8 ^c 4.8 ^b ±.3 ^c	
Teamwork	Demonstrated limited ability to see other perspectives or find common ground.			Worked collaboratively with team members to reach consensus.			Exceptional ability to help group find common ground or resolve conflict in order to ultimately reach consensus.	4.8 ^a ±.0 ^c 4.8 ^b ±.3 ^c	
Are the cadets capable of functioning on multidisciplinary teams? Yes	Comments: Each cadet was group leader twice. Footnote “a” designates the average of all Group Leader Self-Assessment (GLSA) scores, while “b” designates average of all Group Leader Assessment (GLAT) scores. Footnote “c” designates standard deviations.						Assignment used for assessment: AY19, Round Robin 2		

Level of Achievement of Student Outcome 6:

On completion of the chemical engineering program, our graduates will be able to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. End-of-Semester Student Surveys, once/semester.
3. Chemical Engineering Program Exit Survey, once/yr.
4. Course Grades in CH459 Unit Operations Laboratory, once/yr.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

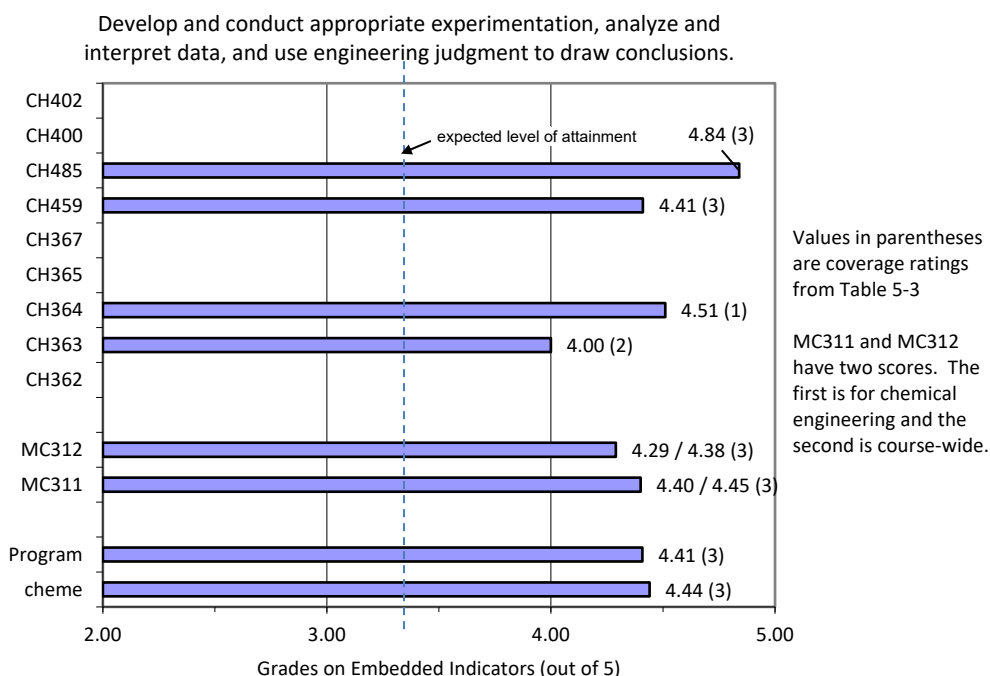


Figure 6-1. Coursework Embedded Indicator results for Student Outcome 6.

2. End of Semester Student Surveys

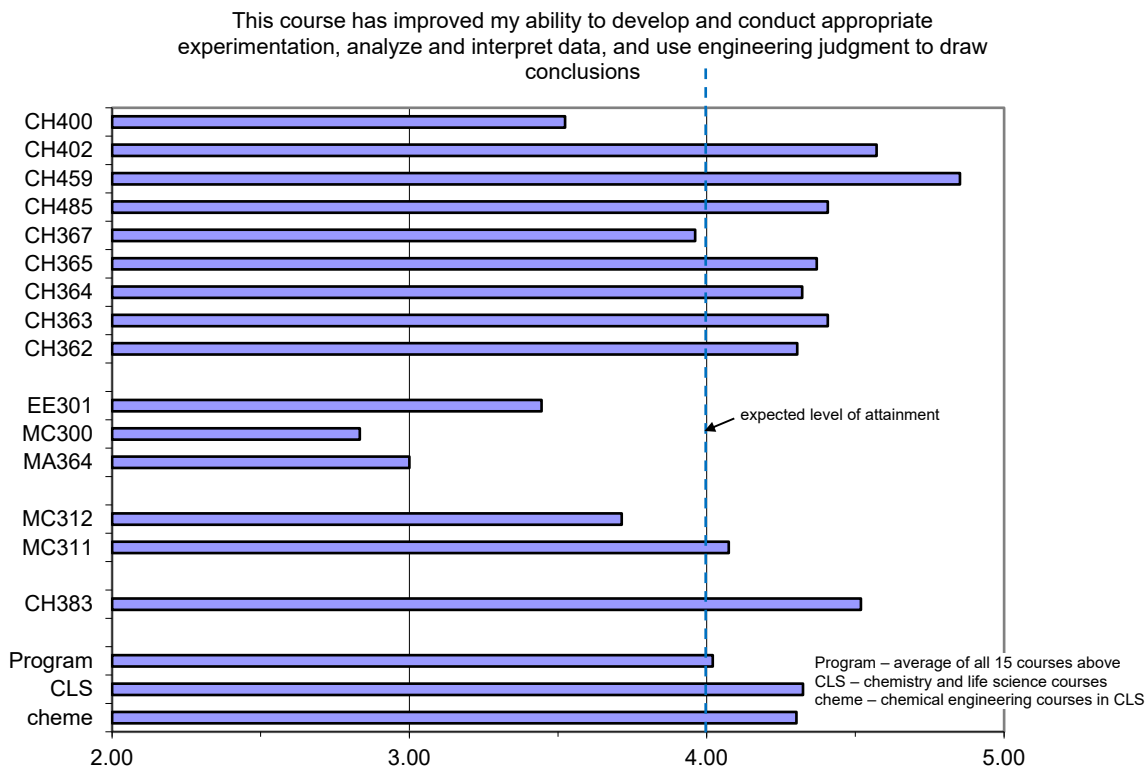


Figure 6-2. End-of-Semester Student Survey responses for Student Outcome 6.

3. Chemical Engineering Program Exit Survey. As stated earlier, this survey is given to the firsties at the end of their last semester. In this question, they were asked whether or not they agree with the statement “The program has prepared me to Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.” 21 out of 21 cadets completed the survey. All 21 cadets said that they either agreed or strongly agreed, and 16/21 replied that they strongly agreed (score = 5/5). This equates to a mean score of 4.762/5.00 for the 21 cadets. The expected level of attainment on this survey is 4.00/5.00.

4. The average course grade in CH459 Chemical Engineering Laboratory was 3.52 ± 0.44 (n=21) in AY19, compared to 3.42 ± 0.64 (n=19) in AY18, 3.54 ± 0.30 (n=16) in AY17, 3.70 ± 0.35 (n=23) in AY16, 3.67 ± 0.37 (n=20) in AY15, and 3.87 ± 0.44 (n=13) in AY14. *The 5-year running average is 3.6, and this is our expected level of attainment. This year’s score was 0.08 points below the 5-year running average, which is low but improved over the previous year.*

Level of Achievement of Student Outcome 7:

On completion of the chemical engineering program, our graduates will be able to acquire and apply new knowledge as needed, using appropriate learning strategies.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. Percent of eligible students taking the Fundamentals of Engineering Examination (FEE), once/yr.
3. End of Semester Student Surveys, once/semester.
4. Chemical Engineering Program Exit Survey, once/yr.
5. Lifelong Learning Skills Rubric, twice per year.
6. Contemporary Issues Rubric, multiple times per year.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

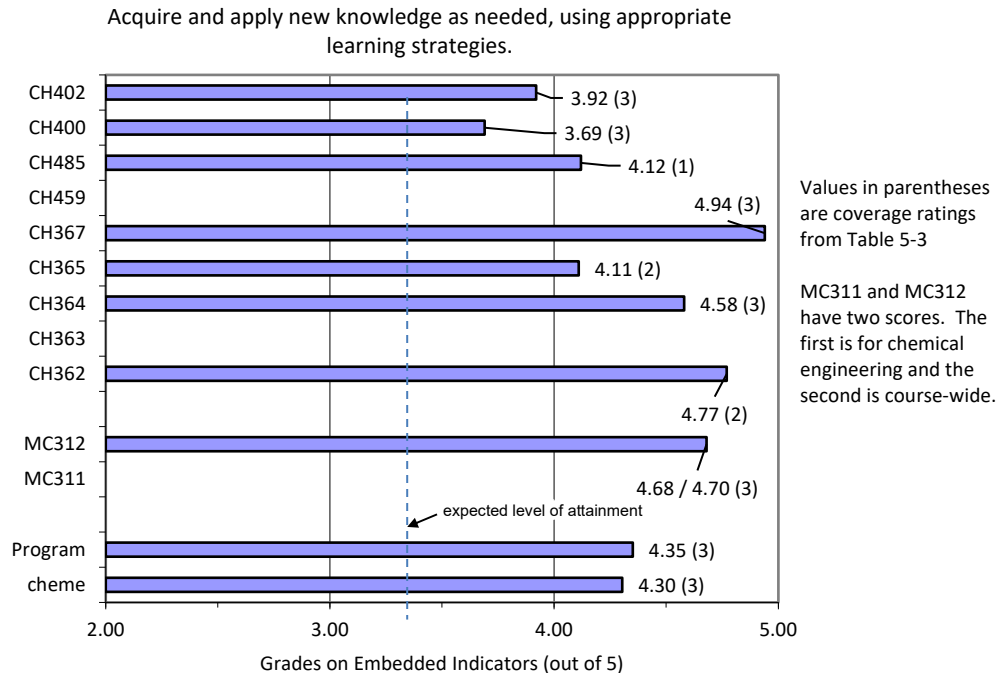


Figure 7-1. Coursework Embedded Indicator results for Student Outcome 7.

2. Percent of Eligible Cadets taking the Fundamentals of Engineering Examination (FEE). For the Class of 2019, 24 chemical engineering cadets (100% of eligible cadets) prepared for and took the FEE. This compares to 100% in 2018, 100% in 2017, 100% in 2016, 100% in 2015, and 100% in 2014. Since all of our cadets prepare for the exam in CH400, our expected level of attainment is 100%. Additionally, on average, approximately 25% of the graduating chemical engineers nationwide and 93% of the graduating engineers from all disciplines at the USMA take the FEE.

3. End of Semester Student Surveys

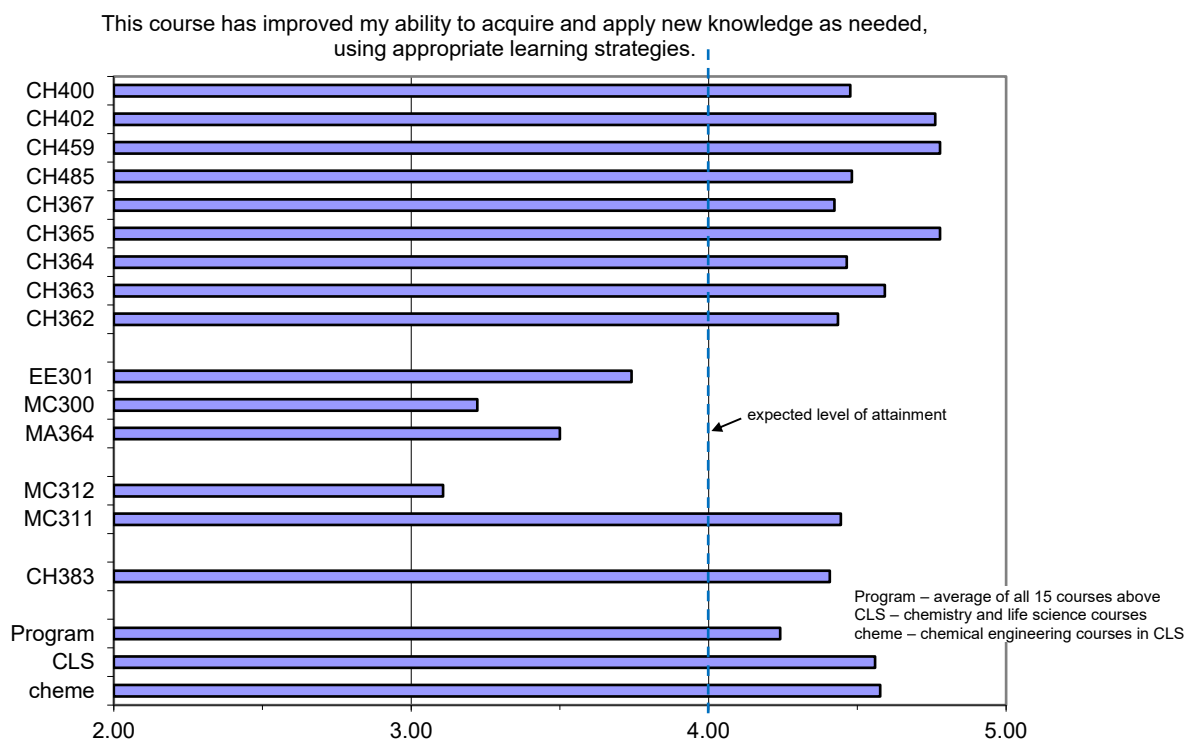


Figure 7-2. End-of-Semester Student Survey responses for Student Outcome 7.

4. Chemical Engineering Program Exit Survey. As stated earlier, this survey is given to the firsties at the end of their last semester. In this question, they were asked whether or not they agree with the statement “The program has prepared me to Acquire and apply new knowledge as needed, using appropriate learning strategies.” 21 out of 21 cadets completed the survey. All 21 cadets said that they either agreed or strongly agreed, and 19/21 replied that they strongly agreed (score = 5/5). This equates to a mean score of 4.905/5.00 for the 21 cadets. The expected level of attainment is 4.00/5.00.
5. Lifelong Learning Skills Rubric. The lifelong learning skills rubric was originally designed to assess performance in old ABET student outcome i (recognizing the need and developing the skills required for life-long learning). However, this rubric is also relevant for new ABET student outcome 7 (acquiring new knowledge). It assesses: (1) engagement of the cadet in pre-professional activities, (2) recognition of the development of professional skills, (3) demonstration of intellectual growth, and (4) the ability to communicate these features to other professionals. The rubrics shown here were used writing assignments 1 and 2 in CH365 (resume). The resume was written at the beginning of the semester, then revised at the end. The average scores are shown in the rubric. The expected levels of attainment are color-coded, with red indicating a need for improvement, yellow indicating acceptable

performance, and green indicating that expectations are met or exceeded. Instructor comments are also shown in the rubrics.

Your Name: Professor Biaglow				Cadet Assessed: Program-level (all cadets in CH365)					
Your Position: Instructor, CH365				Major of Cadet Assessed: Chemical Engineering					
	1 – Needs Improvement	1	2	3 – Meets Expectations	3	4	5 – Exceeds Expectations	5	N/A
Engagement	No evidence of pre-professional activities.			References pre-professional activities are lacking or connections to chemical engineering are weak or implied.		4.1 ±.8	Uses examples of pre-professional chemical engineering activities.		
Recognition	Skills learned in chemical engineering courses taken in previous semesters are not listed.			Skills are listed, but the skills are vaguely described, or connection to chemical engineering concepts is not clear.			Identifies specific skills learned in chemical engineering courses.	4.6 ±.6	
Intellectual Growth	Unable to identify new concepts learned this semester.			Changes are apparent in document, but connections to recent activities in chemical engineering are weak or implied.	3.8 ±1.1		Addition of multiple skills acquired this semester.		
Communication	Resume lacks organization or cohesion. Numerous grammatical errors that may interfere with meaning. Target audience unclear.			Occasional grammar errors that do not impede meaning. Demonstrates ability to write a basic resume, but document is uninteresting and flat.	3.9 ±1.0		Demonstrates an ability to effectively communicate in the resume format. Clear, concise content. Resume is interesting.		
Has the program satisfied this outcome? (Y/N)	Comments: The cadets appear to satisfy the outcome based on the rubric scores. However, many cadets, particularly those with publications, were unable to site themselves correctly. Many cadets were not able to independently demonstrate that they recognized skills they learned in the courses, and repeating back items listed during brainstorming sessions in class. Final Grade: 4.1/5						Assignment used for assessment: CH365 Writing Assignment – Resume Draft 1		

Your Name: Professor Biaglow				Cadet Assessed: Program-level (all cadets in CH365)					
Your Position: Instructor, CH365				Major of Cadet Assessed: Chemical Engineering					
	1 – Needs Improvement	1	2	3 – Meets Expectations	3	4	5 – Exceeds Expectations	5	N/A
Engagement	No evidence of pre-professional activities.			References pre-professional activities are lacking or connections to chemical engineering are weak or implied.			Uses examples of pre-professional chemical engineering activities.	4.6 ±.5	
Recognition	Skills learned in chemical engineering courses taken in previous semesters are not listed.			Skills are listed, but the skills are vaguely described, or connection to chemical engineering concepts is not clear.			Identifies specific skills learned in chemical engineering courses.	4.8 ±.4	
Intellectual Growth	Unable to identify new concepts learned this semester.			Changes are apparent in document, but connections to recent activities in chemical engineering are weak or implied.		4.3 ±1.1	Addition of multiple skills acquired this semester.		
Communication	Resume lacks organization or cohesion. Numerous grammatical errors that may interfere with meaning. Target audience unclear.			Occasional grammar errors that do not impede meaning. Demonstrates ability to write a basic resume, but document is uninteresting and flat.		4.3 ±.7	Demonstrates an ability to effectively communicate in the resume format. Clear, concise content. Resume is interesting.		
Has the program satisfied this outcome? (Y/N)	Comments: The purpose of the second draft was for cadets to update their personal skills inventory with new skills and attributes acquired this semester. The performance on the second draft was significantly better, and cadets seemed to take suggestions for improvement seriously. Some cadets still struggled with identifying new <u>skills</u>, but got the idea with faculty feedback. Final Grade: 4.5/5						Assignment used for assessment: CH365 Writing Assignment – Resume Draft 2		

6. Contemporary Issues Rubric.

Your Name: LTC April Miller				Cadet Assessed: CH485 Cadets					
Your Position: CH485 CD				Major of Cadet Assessed: Chemical Engineering					
	1 – Needs Improvement	1	2	3 – Meets Expectations	3	4	5 – Exceeds Expectations	5	N/A
Contemporary	Does not address the assignment. Lacks contemporary context. Uses generic arguments or essay lacks specificity.			Discusses contemporary nature of issue but context is weak or implied. Examples are few or lacking.	3.5 ±1.0		Uses numerous examples and scholarly articles to illustrate contemporary nature of issue.		
Technical Competence	Demonstrates poor or incomplete understanding of transport phenomena.			Demonstrates some knowledge of the technical content, but explanation lacks depth.	3.1 ±1.2		Demonstrates exceptional knowledge of technical content.		
Synthesis of Ideas	Does not connect contemporary issue with concepts in chemical engineering.			Makes connections with chemical engineering concepts, but the connections are weak or implied.	3.3 ±1.1		Makes very clear connections between the issue and chemical engineering concepts.		
Communication	Writing lacks organization or cohesion. Numerous grammatical errors that may interfere with meaning. Thesis lacking or implied.			Occasional grammar errors that do not impede meaning. Demonstrates ability to write a basic essay, but lacks cohesion or completeness. Thesis not fully supported.	3.0 ±1.2		Demonstrates an ability to effectively communicate in the essay format. Fully supported, clear, concise thesis. Writing style was exceptionally clear and articulate.		
Has the program satisfied this outcome? (Y/N)	Comments: Cadets were able to identify contemporary issue. They required work in discussing the technical aspect of the contemporary issue. Additionally, Cadets tend to just discuss points without a connection or overall premise. Most lacked an overall premise. As of draft 1, the program has not satisfied this outcome. Final Grade: 3.2/5						Assignment used for assessment: Heat and Mass Transfer Writing Assignment - Draft 1		

Your Name: LTC April Miller				Cadet Assessed: CH485 Cadets					
Your Position: CH485 CD				Major of Cadet Assessed: Chemical Engineering					
	1 – Needs Improvement	1	2	3 – Meets Expectations	3	4	5 – Exceeds Expectations	5	N/A
Contemporary	Does not address the assignment. Lacks contemporary context. Uses generic arguments or essay lacks specificity.			Discusses contemporary nature of issue but context is weak or implied. Examples are few or lacking.		4.5 ±.4	Uses numerous examples and scholarly articles to illustrate contemporary nature of issue.		
Technical Competence	Demonstrates poor or incomplete understanding of transport phenomena.			Demonstrates some knowledge of the technical content, but explanation lacks depth.		4.0 ±.6	Demonstrates exceptional knowledge of technical content.		
Synthesis of Ideas	Does not connect contemporary issue with concepts in chemical engineering.			Makes connections with chemical engineering concepts, but the connections are weak or implied.		3.9 ±.6	Makes very clear connections between the issue and chemical engineering concepts.		
Communication	Writing lacks organization or cohesion. Numerous grammatical errors that may interfere with meaning. Thesis lacking or implied.			Occasional grammar errors that do not impede meaning. Demonstrates ability to write a basic <u>essay</u> , but lacks cohesion or completeness. Thesis not fully supported.		3.9 ±.5	Demonstrates an ability to effectively communicate in the essay format. Fully supported, clear, concise thesis. Writing style was exceptionally clear and articulate.		
Has the program satisfied this outcome? (Y/N)	Comments: Cadets improved significantly, the majority clearly stated a premise. All Cadets were able to identify contemporary issue and improved on the technical aspect. Cadets still can work on connecting the details and technical aspect to the premise. The program now satisfies this outcome. Final Grade: 4.1/5						Assignment used for assessment: Heat and Mass Transfer Writing Assignment - Draft 2 / Final Draft		
Your Name: LTC April Miller				Cadet Assessed: 6 x CH485 Cadets					

Your Name: LTC April Miller				Cadet Assessed: CH485 Cadets					
Your Position: CH485 CD				Major of Cadet Assessed: Chemical Engineering					
	1 – Needs Improvement	1	2	3 – Meets Expectations	3	4	5 – Exceeds Expectations	5	N/A
Contemporary	Does not address the assignment. Lacks contemporary context. Uses generic arguments or essay lacks specificity.			Discusses contemporary nature of issue but context is weak or implied. Examples are few or lacking.			Uses numerous examples and scholarly articles to illustrate contemporary nature of issue.	5.0 ±0	
Technical Competence	Demonstrates poor or incomplete understanding of transport phenomena.			Demonstrates some knowledge of the technical content, but explanation lacks depth.			Demonstrates exceptional knowledge of technical content.	4.7 ±.2	
Synthesis of Ideas	Does not connect contemporary issue with concepts in chemical engineering.			Makes connections with chemical engineering concepts, but the connections are weak or implied.			Makes very clear connections between the issue and chemical engineering concepts.	4.7 ±.3	
Communication	Writing lacks organization or cohesion. Numerous grammatical errors that may interfere with meaning. Thesis lacking or implied.			Occasional grammar errors that do not impede meaning. Demonstrates ability to write a basic essay, but lacks cohesion or completeness. Thesis not fully supported.			Demonstrates an ability to effectively communicate in the essay format. Fully supported, clear, concise thesis. Writing style was exceptionally clear and articulate.	4.8 ±.4	
Has the program satisfied this outcome? (Y/N)	Comments: Cadets that opted to submit the final draft were at the upper end of the rubric for Draft 2. The improvement was synthesis of ideas and adding more details with the technical aspect. This outcome is satisfied.						Assignment used for assessment: Heat and Mass Transfer Writing Assignment - Final Draft		
	Final Grade: 4.8/5								

The contemporary issues rubric was originally developed to assess old ABET student outcome k (demonstrating knowledge of contemporary issues). The rubric utilizes skills associated with acquiring new knowledge (new ABET student outcome 7). Our program therefore used the old rubric as one of our measures of the new outcome. The rubric has been re-designed for AY20 to more closely track the new outcome, but for AY19, we used the old version.

The rubric shown here was designed to assess performance in four skills associated with the ability to demonstrate knowledge of contemporary issues, namely: determining whether the issue is contemporary, technical competence of the cadet, synthesis of ideas, and communication. The rubrics are completed by the instructor to use as grades for specific assignments in his or her course. In this case, LTC Miller used two writing assignments in CH485. The first assignment was a first draft, and the second was the final draft for her assignment. The results are summarized on the previous page, using the actual rubric to format the results, with cadet average scores shown for each rubric item. The expected levels of attainment are color-coded red (indicating a need for improvement), yellow (minimal level of performance), and green (expectations are exceeded).

Level of Achievement of Student Outcome 8:

The program provides the graduate with a thorough grounding and working knowledge of the chemical sciences, including:

- (8.1) Chemistry.
- (8.2) Material and energy balances
- (8.3) Safety and environmental factors.
- (8.4) Thermodynamics of physical and chemical equilibria.
- (8.5) Heat, mass, and momentum transfer.
- (8.6) Chemical reaction engineering.
- (8.7) Continuous and staged separation operations.
- (8.8) Process dynamics and control.
- (8.9) Modern experimental and computing techniques.
- (8.10) Process design.

Assessment Instruments and Frequency:

1. Fundamentals of Engineering Examination, once/yr.
2. Average Course Grades for Chemical Engineering Students, once/yr.

Assessment Results:

1. Fundamentals of Engineering Examination, Table 4-14. For the Class of 2018, the breakdown by topic is shown in comparison to the national averages.

Subject	Outcome	Questions	USMA ChE	National (expected level of attainment)
Chemistry	8.1	8	10.5	10.2
Material & Energy Balances	8.2	8	9.4	9.5
Safety, Health, & Environmental	8.3	5	10.5	9.8
Thermodynamics	8.4	8	9.4	9.3
Heat Transfer	8.5	8	10.2	9.8
Fluid Mechanics/Dynamics	8.5	8	9.5	9.8
Chemical Reaction Engineering	8.6	8	10.3	9.7
Mass Transfer & Separations	8.7	8	9.2	9.7
Process Control	8.8	5	10.0	9.8
Computational Tools	8.9	4	9.4	10.3
Process Design & Economics	8.10	8	10.6	9.7

2. Course grades for the last six years are shown below, Table 4-2.

Chemical Engineering Student Outcome 12										
Course ↓		Advanced Chemistry	Mater. & Energy Bal.	Thermodynamics	Transport	Reaction Engineering	Separations	Dynamics & Control	Experiment & Compute	Process Design
		8.1	8.2	8.4	8.5	8.6	8.7	8.8	8.9	8.10
CH383	Organic Chemistry I	3.14								
CH365	Chem. Eng. Thermo.			3.68						
CH362	Mass & Energy Balances		3.63							
CH363	Separation Processes						3.76			
CH364	Chem. Reaction Eng.					3.27				
CH459	Chem. Eng. Laboratory								3.52	
CH485	Heat and Mass Transfer				3.14					
CH400	Chemical Engineering Sem.			4.08		4.08	4.08	4.08		
CH402	Chem. Eng. Process Des.									3.27
MA366	Vector Calculus									
ME311	Thermal-Fluid Systems I			3.67	3.67					
ME312	Thermal-Fluid Systems II			3.35	3.35					
CE300	Fund. Eng. Mech. & Des.									
EE301	Intro. To Elec. Engineering									
XE472	Dyn. Modeling & Control							2.94		
Average Grade 2019		3.14	3.63	3.69	3.39	3.67	3.92	3.51	3.52	3.27
Average Grade 2018		2.87	3.72	3.51	3.20	3.66	3.67	3.53	3.42	3.37
Average Grade 2017		3.15	3.21	3.65	3.25	3.66	3.67	3.31	3.54	2.73
Average Grade 2016		3.19	3.57	3.43	3.32	3.64	3.57	3.55	3.70	3.43
Average Grade 2015		3.33	3.63	3.43	3.33	3.72	3.71	3.60	3.67	3.4
Average Grade 2014		3.41	3.64	3.72	3.67	3.59	3.81	3.82	3.87	3.60
<i>Previous 5-year Running Average (expected level of attainment)</i>		<i>3.19</i>	<i>3.55</i>	<i>3.55</i>	<i>3.35</i>	<i>3.65</i>	<i>3.69</i>	<i>3.56</i>	<i>3.64</i>	<i>3.31</i>
Standard Deviation 2019		0.96	0.60	0.72	0.63	0.49	0.37	0.69	0.44	1.14

Table 4-3. Faculty Evaluation of Chemical Engineering Student Outcomes

Chemical Engineering Student Outcomes	Faculty Evaluation
On completion of the chemical engineering program, our graduates are able to:	
1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	4.86 ± 0.38
2. 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.	4.57 ± 0.53
3. Communicate effectively with a range of audiences.	4.43 ± 0.53
4. 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.	4.71 ± 0.49
5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	4.86 ± 0.38
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	4.57 ± 0.53
7. Acquire and apply new knowledge as needed, using appropriate learning strategies.	4.43 ± 0.53
8. Understand the chemical engineering curriculum, including chemistry, material and energy balances, safety and environmental factors, thermodynamics of physical and chemical equilibria, heat, mass, and momentum transfer, chemical reaction engineering, continuous and staged separation processes, process dynamics and control, modern experimental and computing techniques, and process design.	4.86 ± 0.38
5- Excellent; 4 – Very Good; 3 – Acceptable; 2 – Weak ; 1 – Poor	

Table 4-4. Advisory Board Evaluation of Chemical Engineering Student Outcomes

Chemical Engineering Student Outcomes	Advisory Board's Evaluation
On completion of the chemical engineering program, our graduates are able to:	
1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	4.88 ± 0.35
2. 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.	4.75 ± 0.46
3. Communicate effectively with a range of audiences.	4.50 ± 0.53
4. 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.	4.69 ± 0.46
5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	4.88 ± 0.35
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	4.50 ± 0.53
7. Acquire and apply new knowledge as needed, using appropriate learning strategies.	4.81 ± 0.26
8. Understand the chemical engineering curriculum, including chemistry, material and energy balances, safety and environmental factors, thermodynamics of physical and chemical equilibria, heat, mass, and momentum transfer, chemical reaction engineering, continuous and staged separation processes, process dynamics and control, modern experimental and computing techniques, and process design.	4.63 ± 0.52
5- Excellent; 4 – Very Good; 3 – Acceptable; 2 – Weak ; 1 – Poor	

Table 4-5. Summary of Chemical Engineering Student Outcomes Performance.

Chemical Engineering Student Outcomes	Program Director's Summary
On completion of the chemical engineering program, our graduates are able to:	
1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	5
2. 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.	5
3. Communicate effectively with a range of audiences.	4
4. 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.	5
5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	5
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	5
7. Acquire and apply new knowledge as needed, using appropriate learning strategies.	5
8. Understand the chemical engineering curriculum, including chemistry, material and energy balances, safety and environmental factors, thermodynamics of physical and chemical equilibria, heat, mass, and momentum transfer, chemical reaction engineering, continuous and staged separation processes, process dynamics and control, modern experimental and computing techniques, and process design.	5
5- Excellent; 4 – Very Good; 3 – Acceptable; 2 – Weak ; 1 – Poor	