Mechanical Engineering Technology | 2017-2018 Assessment Report

1. Please give a brief overview of the assessment data you collected this year.

ABET Criterion 3 Student Learning Outcomes (time of graduation) with ours under the applicable one

a. An ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly defined engineering technology activities
b. An ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies
c. An ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes
d. An ability to design systems , components, or processes for broadly defined engineering technology problems appropriate to program educational outcomes
e. An ability to function effectively as a member or leader on a technical team
f. An ability to identify, analyze, and solve broadly defined engineering technology problems
g. An ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature
h. An understanding of the need for and an ability to engage in self-directed continuing professional development
i. An understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity
j. A knowledge of the impact of engineering technology solutions in a societal and global context
k. Commitment to quality, timeliness, and continuous improvement

Fall 2017 Assessment

Course: ENGR 213 Engineering Mechanics I – Fall 2017
Outcomes assessed: j

Outcome j states that a student will demonstrate

> A knowledge of the impact of engineering technology solutions in a societal and global context.

The following assignment was used to assess outcome j and the assessment rubric is provided below with the percent and (number) of students who achieved unsatisfactory, developing, satisfactory, or exemplary for each item in the rubric.

Paper: Chose a modern engineering innovation and write a 8-10 page paper (double spaced, font size 11 or 12) answering the following

1. Describe the problem that the innovation was seeking to solve.
2. Investigate and describe what constituencies (people, the environment, companies, etc) benefitted from the innovation and how they benefitted. Consider this on a global scale.
3. Investigate and describe what constituencies were negatively impacted by the innovation and how they were impacted.
4. Describe relationships and potential outcomes between affected constituencies
5. Based on the above, assess the solution on a global scale

Assessment was performed using the rubric below. In each category the percentage and (number) of students achieving each criteria is reported.

n = 19 students	Unsatisfactory	Developing	Satisfactory	Exemplary
Describes the project and its purpose	Fails to define problem or describe its purpose (0)	Gives little information about project and purpose (0)	Adequately describes project and purpose from one perspective 42.1% (8)	Thoroughly describes project and purpose from more than one perspective 57.9% (11)
Investigates and discusses what entities will benefit and how	Fails to describe what entities will benefit or how they will benefit	Identifies one benefit and which entity benefits 15.8%(3)	Identifies/discusses two to three benefits; local recipient entities; and the nature of the benefits 63.2%%, (12)	Thoroughly assesses multiple benefits and recipients and the nature of the benefit both locally and globally 21.0%, (4)
Investigates and discusses what entities will suffer and how	Fails to describe what entities will suffer or how they will suffer 5.3% (1)	Identifies one negative outcome and the recipient entity 36.8% (7)	Identifies/discusses two to three negative outcomes, local recipient entities; and the nature of the negative outcome 36.8%, (7)	Thoroughly assess multiple negative outcomes and recipients and the nature of the outcome locally and globally 21.1%, (4)
Describes realistic potential outcomes between affected parties	Fails to describe relationships or outcomes between affected groups 36.8%, (7)	Hypothesizes some outcomes, but fails to consider if they are realistic 21.1%, (4)	Identifies at least one potential realistic outcome in the context of relationships between entities 36.8%, (7)	Thoroughly discusses from more than one perspective realistic outcomes in the context of relationships between affected groups 5.3%, (1)
Assess and discuss global precedents	Makes no assessment 15.8% (3)	Makes some assessment but fails to consider global precedents 47.4%, (9)	Assesses based on one perspective and considers global precedents from this perspective 26.3%, (5)	Gives thorough assessment based on multiple perspectives and discusses global precedents from multiple perspectives 10.5%, (2)
Paper is well organized with correct spelling and grammar	Little organization and multiple grammar/spelling errors per page 5.3%, (1)	Paper has some inconsistent organization and 2 to 3 spelling/ grammar errors per page 52.6%, (10)	Paper is organized with no more than 1 spelling/grammar error per page 31.6%, (6)	Paper is well organized and only 5 or fewer spelling/grammar errors in entire paper 10.5%, (2)

Continuous improvement:

ENGR 213: Outcome j

Engineering students often have difficulty with basic grammar and spelling as is evidenced by the summary assessment. In Fall 2015 I allowed them to turn in a first draft for me to proofread before handing in the final paper, but only two students took advantage of this. In 2016, they were encouraged to use the campus Writing Center, but clearly did not. In Fall 2018, a first draft will be required. Students did not follow all directions for components needed for the paper – several simply wrote reports on new technologies. In Fall 2018, I will emphasize exactly what is expected and require a first draft to make sure they are not simply describing a new technology, but including a thorough analysis of its impact.

ENGR 213 also meets the University requirement for a Writing Emphasis general education learning outcome. The above paper was also graded for writing emphasis using the rubric below.

Assessment for the second criteria, writing emphasis, was performed using the rubric below. In each category the percentage and (number) of students achieving each criteria is reported.

n = 19 students	Unsatisfactory	Developing	Satisfactory	Exemplary
Topic is thoroughly researched and properly cited	Topic is not researched much beyond given information	One or two appropriate references are used and cited	Three or four appropriate references are used and cited (5) 26.3%	Topic is thoroughly researched from multiple (5 or more) sources and is well cited 73.7%, (14)
Paper is well organized	Paper is not organized at all	Paper has some organization, but inconsistent 10.5%, (2)	Paper is organized according to the questions asked, but not well organized overall (4) 21.1%	Paper is organized according to topics and overall into an easy to follow flow of information 68.4%, (13)
Correct grammar and spelling are used throughout	Grammar and spelling are poor – many errors per page 15.7%, (3)	Grammar and spelling are marginally acceptable – 2 to 3 errors per page 57.9%, (11)	Grammar and spelling are good – no more than one error per page 21.1%, (4)	Grammar and spelling are near perfect – no more than 3 errors in entire paper 5.3%, (1)
Tables and figures illustrate concepts	No tables or figures are provided 42.1%, (8)	One figure or table is given – a map of area 5.3%, (1)	Tables and figures illustrate some concepts 31.6%, (6)	Tables and figures completely support the text 21.0%, (4)

Continuous improvement:

Students remain fairly poor writers. They were provided information on the campus Writing Center to help them, but it would appear that many did not take advantage of this. After Fall 2016, I said that I would require an early draft, but I did not do this in favor of sending them to the writing center. In Fall 2018, an early draft will be required.

Fall 17 and Spring 18 ET 400 Combined Assessment

ABET learning outcomes assessed: c, g, h, k

UWGB general education outcome assessed: Writing Emphasis (WE)

Rather than separate out mechanical from electrical or environmental engineering technology students, assessment was performed on all students with a single set of results.

ET 400 is the course assigned to the Engineering Technology internship. In addition to completing a minimum of a summer or semester long internship with a company in the appropriate field (electrical, environmental, mechanical engineering technology), each student will write a term paper documenting their experience and give an oral presentation at the end of the term. The course grade is based on evaluation by the internship supervisor, the written paper, and the presentation. ABET learning outcomes, specific assignments used to assess each one, and assessment rubrics are discussed below.

Criteria for the term paper are as follows:

Internship Experience Report:

At the end of the internship semester, each student will write a 12 to 20 page paper (double spaced) detailing their experience. The paper should follow the outline below and include all of the information in the outline.

1. Describe the company, what products it makes, what the markets are for the products.
2. Describe the manufacturing process. Include applicable graphics to explain.
3. Describe your position with the company including responsibilities.
4. Describe projects that you worked on including the goals of the projects, any experiments or design work applied to the project; methods for measurements and analysis of measurements taken; results of any experiments or design work; and how processes were improved as a result
5. Discuss skills attained relevant to both engineering technology and a future professional career
6. Describe any opportunities for additional training/professional development and what skills were learned

This paper will also be used to assess the Writing Emphasis requirement of the course

ABET outcome c states that the student will demonstrate: An ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes

This outcome was assessed by both Prof. Patricia Terry and each student's internship supervisor. Prof. Terry obtained the internship supervisor's assessment via a phone conversation if an electronic copy of the evaluation was not completed. The assessment rubric and a summary of the results are given below.

Assessment Rubric for ABET c: Assessment by Prof. Terry (Assessed primarily from the paper)

N = 22	Unsatisfactory	Developing	Satisfactory	Exemplary
Describe the purpose of measurements/ experimentation in context of process	Description not adequate to explain what is being performed or why	Gives some information about the tests/ measurements (2) 9.1%	Adequately describes tests/Measurements and why they are performed 72.7% (16)	Comprehensive description of tests/measurements in the context of the overall process 18.2% (4)
Properly conducts tests and collects data	Fails to apply correct scientific method such that data is meaningless	Conducts tests with only minor errors and records inputs and outputs	Conducts tests using scientific methods and records inputs and outputs 77.7% (17)	Conducts tests using scientific methods and records data on all process parameters that might be affected 22.7% (5)
Analyze data and interpret results	Fails to apply appropriate models for analysis	Applies at least one model with no significant errors and interprets results based on this	Applies correct models to analyze data and interprets results specific to the tests 68.2% (15)	Applies all correct models to data analysis and interprets results in the context of the entire process 31.8% (7)
Apply analysis for process improvement	Makes incorrect changes to process	Makes process changes based on single model	Correctly applies analysis to process changes 45.5% (10)	Correctly applies analysis to process changes and documents improvement 54.5% (12)
Document process improvement	Fails to document results	Provides minimal documentation of process improvement (2) 9.1%	Document results of process improvement in a manner that allows replication 45.5% (10)	Documents results of process improvement in a manner that allows replication and suggests further tests/experiments 45.4% (10)

Assessment Rubric for ABET c: Summary of internship supervisor reports

N = 22	Unsatisfactory	Developing	Satisfactory	Exemplary
Describe the purpose of measurements/ experimentation in context of process	Description not adequate to explain what is being performed or why	Gives some information about the tests/ measurements	Adequately describes tests/ Measurements and why they are performed 45.5% (10)	Comprehensive description of tests/ measurements in the context of the overall process 54.5% (12)
Properly conducts tests and collects data	Fails to apply correct scientific method such that data is meaningless	Conducts tests with only minor errors and records inputs and outputs (1)4.5%	Conducts tests using scientific methods and records inputs and outputs (11) 50%	Conducts tests using scientific methods and records data on all process parameters that might be affected 45.5% (10)
Analyze data and interpret results	Fails to apply appropriate models for analysis	Applies at least one model with no significant errors and interprets results based on this	Applies correct models to analyze data and interprets results specific to the tests 36.4% (8)	Applies all correct models to data analysis and interprets results in the context of the entire process 63.6% (14)
Apply analysis for process improvement	Makes incorrect changes to process	Makes process changes based on single model (1)4.5%	Correctly applies analysis to process changes (10) 45.5%	Correctly applies analysis to process changes and documents improvement 50% (11)
Document process improvement	Fails to document results	Provides minimal documentation of process improvement	Document results of process improvement in a manner that allows replication 59.1% (13)	Documents results of process improvement in a manner that allows replication and suggests further tests/experiments 40.9% (9)

ABET outcome g states that the student will demonstrate: An ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature

The term paper was used to assess the written and graphical communication components of g: with rubric and summary of results below. Assessment performed by Prof. Terry.

N = 22	Unsatisfactory	Developing	Satisfactory	Exemplary
Written articulation of experience	Fails to articulate experience at all	Text rambles, repeated reading needed to understand, key points not organized (1) 4.5%	Articulates experience, but writing is somewhat difficult to follow (11) 50%	Articulates experience clearly and concisely 45.5% (10)
Written organization	Little to no structure or organization is used	Some structure and organization is used	Generally well organized, but some sections not clearly identified 40.9% (9)	Organized in a logical sequence to enhance readers' comprehension 59.1% (13)
Professionally written to audience (professor and supervisors)	Writing style is inappropriate for the audience and the assignment	Style is informal or inappropriate to audience (3) 13.7%	Usually uses professional, scientific writing style appropriate to audience 54.5% (12)	Uses excellent professional, scientific writing style to appropriate audience 31.8% (7)
Quality of written work	Work is not presented neatly; many spelling/ grammar errors (4) 18.2%	Work has more than 3 spelling or grammar errors per page; is somewhat messy 27.3% (6)	Work is presented neatly with few grammar or spelling errors 54.5% (12)	Work is presented neatly; grammar and spelling are correct 33% (1)
Use of graphics: tables/graphs/ figures	No graphics are used (1) 4.5%	Graphics are presented, but flawed	Use of graphics is appropriate and usually in the correct format (6) 27.3%	Use of graphics is appropriate and all are in proper format 68.2% (15)

Assessment Rubric for ABET g (oral): Each student gave a 12-15 minute presentation of their work and answered audience questions. The ET 101 class was the audience.

N = 22	Unsatisfactory	Developing	Satisfactory	Exemplary
Oral articulation of experience	Fails to articulate experience at all	Speaker rambles, key points not organized	Articulates experience but somewhat difficult to follow (3) 13.6%	Articulates experience clearly and concisely 86.4% (19)
Presentation organization	Little to no structure or organization is used	Some structure and organization is used	Generally well organized 27.3% (6)	Organized in a logical sequence to enhance comprehension 72.7% (16)
Presentation quality	Student not prepared, presentation not appropriate	Style is informal or inappropriate to audience	Student mostly prepared; presentation is appropriate to audience 40.9% (9)	Student very well prepared, knowledgeable; presentation is appropriate to audience 59.1% (13)
Use of graphics: tables/graphs/ figures	No graphics are used	Graphics are presented, but flawed	Use of graphics is appropriate and usually in the correct format 18.2% (4)	Use of graphics is appropriate and all are in proper format 81.8% (18)
Stays within time limits	Student goes significantly over time limit (more than 6 minutes) (2) 9.1%	Student goes a little over time limit (about 3-5 minutes) or significantly under 18.2% (4)	Student is within 2 minutes of time limit 54.5% (12)	Presentation exactly meets time requirement 18.2% (4)
Answers questions	Student unable or unwilling to answer questions	Student attempts to answer questions, but in a rambling, insufficient manner	Student answers questions in an acceptable manner 54.5% (12)	Student willingly and concisely answers all relevant questions 45.5% (10)

ABET outcome h states that the student will demonstrate: An understanding of the need for and an ability to engage in self-directed continuing professional development

This outcome will be assessed both by the internship supervisor through interaction with the student and by Professor Terry through the internship report.

Assessment Rubric for ABET h: Prof. Terry

N = 22	Unsatisfactory	Developing	Satisfactory	Exemplary
Student seeks professional development opportunities through internship	Shows no interest in opportunities offered	Participates in opportunities only when required	Takes advantage of opportunities offered during internship 50% (11)	Actively seeks opportunities through internship supervisor 50% (11)
Student seeks professional development opportunities outside of internship	Participates in no professional or extra-curricular organizations	Participates in activities when required by a class (5) 22.7%	Takes advantage of activities offered by faculty 68.2% (15)	Actively seeks opportunities within professional societies or campus activities 9.1% (2)
Has knowledge of professional societies	Fails to identify or join professional societies	Identifies professional societies (9) 40.9%	Joins professional society 59.1% (13)	Joins professional society and actively engages on local chapter

ABET outcome k states that the student will demonstrate a: Commitment to quality, timeliness, and continuous improvement.

This outcome will be assessed by the internship field supervisor and sent to Professor Terry.

Assessment Rubric for ABET k:

N = 22	Unsatisfactory	Developing	Satisfactory	Exemplary
Demonstrates reliability	Does not reliably come to work on agreed upon schedule and misses meetings	Misses more than once a month without an acceptable reason; occasionally misses meeting	Rarely misses work and gives appropriate notification; never misses meetings (5) 22.7%	Only misses work for acceptable reasons and notifies supervisor in a timely manner; never misses meetings 77.3% (17)
Demonstrates commitment to timeliness	Often fails to arrive on time to work or meetings	Is late to work more than once a week or is late to or meetings	Rarely arrives late for work or meetings 18.2% (4)	Always arrives to work or meetings on time 81.8% (18)
Demonstrates commitment to quality	Quality of work is unacceptable	Quality of work needs significant improvement	Quality meets expectations for a student intern 45.5%% (10)	Quality significantly exceeds expectations for a student intern 54.5% (12)
Demonstrates commitment to improvement	Does not take direction well; ignores feedback	Sometimes takes direction well; sometimes open to feedback	Usually takes direction well; usually incorporates feedback into work 27.3% (6)	Always takes direction well; open to feedback and incorporates into work 72.7% (16)
Would you hire this student?	no	Possibly after graduation if significant growth occurs	Would consider for an open position. 13.6% (3)	Absolutely, with no reservations. 86.4% (19)

This course also meets the UW-Green Bay general education learning outcome for Writing Emphasis

Assessment Rubric for Writing Emphasis: Term paper is assessed by Prof. Terry

N = 22	Unsatisfactory	Developing	Satisfactory	Exemplary
Paper includes all required components	Only two or three components are covered and not all at adequate level	Most components are included and most are at adequate level (3) 13.6%	Paper includes all required components 45.5% (10)	Paper gives thorough description of all components 40.9% 92)
Paper is well organized	Paper is not organized at all	Paper has some organization, but inconsistent	Paper is organized according to the questions asked, but not well organized overall (8) 36.4%	Paper is organized according to topics and overall into an easy to follow flow of information 63.6% (14)
Correct grammar and spelling are used throughout	Grammar and spelling are poor – many errors per page (4) 18.2%	Grammar and spelling are marginally acceptable – 2 to 3 errors per page 27.3% (6)	Grammar and spelling are good – no more than one error per page 36.3% (8)	Grammar and spelling are near perfect – no more than 3 errors in entire paper 18.2% (4)
Tables and figures illustrate concepts	No tables or figures are provided (2) 9.1%	One figure or table is given – a map of area	Tables and figures illustrate some concepts 59.1% (13)	Tables and figures completely support the text 31.8% (7)

Continuous improvement:

ABET c: Students generally did fine with ABET learning outcome c. Again, lab classes help students develop these skills, especially ET specific labs. More emphasis on quality lab reports may shift some students from the satisfactory to the exemplary mark. Two students scored "developing," but this was a much more representative pool than the first semester ET 400 ran. We need to make sure students have completed sufficient ET credits before doing an internship to make sure they know what is expected.

ABET g Written and graphical communication: As before, w students articulated their experiences in an organized paper, emphasis needs to be placed on correct grammar and punctuation. Faculty need to better emphasize the need for correct grammar and spelling and they should inform students of the Writing Center on campus to help students with these skills.

ABET g oral communication: Student presentations were for the most part very good. Almost one-third of students did need help staying within a set time limit. Perhaps a tutorial on presentation preparation would help with this. Presentations were well organized and students demonstrated knowledge of their companies and projects.

ABET h: UW-Green Bay students struggle a bit with continuing professional development. Most students carry a full academic load and work part time to pay tuition. This leaves little time for other activities. While students did take advantage of opportunities offered through employment and by faculty, many were not yet able to join professional societies. Time and expense were the biggest factors and these are difficult to overcome. Faculty will continue to encourage such activities and offer on campus activities.

ABET k: Internship supervisors gave high marks to all students, both through phone interview and written feedback. Many of the students (roughly 20) were hired by the companies that sponsored their internships. UW-Green bay students have the strong work ethic that this region is known for and tend, overall, to be reliable and hard working.

Writing Emphasis: As expected, students overall wrote well organized papers with required content, but grammar and spelling continue to be a challenge. We may need to consider a course specific to technical writing skills or, at least, spend some time in lower level courses emphasizing writing grammatically correct English. We also need to direct students to the campus Writing Center for help.

Spring 2018 Assessment

ET 118: Fluids 1

ABET Outcomes (c and f were assessed in this course.
The Engineering Technology Program must also satisfy the ABET Program Outcomes, which require a student to possess the following knowledge, skills, and attitudes (lower case letters are used to be consistent with ABET terminology). Not every Engineering Technology course is expected to meet every ABET Outcome.

(c) An ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes;
(f) An ability to identify, analyze, and solve broadly defined engineering technology problems;

ABET C was assessed via the following laboratory experiment on buoyancy.
Students worked in groups of 3-4 and rotated until each of the 4 sections was complete. They then completed a lab report that included:

Lab Introduction
Procedures for each section
Data and results from each section
Sources of error
Conclusions

Fluids Lab 4: Bouyancy

The buoyant force upward on a submerged object (Fb) due to the fluid in which the object is submerged is equal to the weight of the fluid displaced by the submerged object.

Theoretically, this means:

$$F_b = m_{fluid}\, g,$$

$$m_{fluid} = \rho_{fluid}\, V_{displaced}$$

$$\Rightarrow F_b = \rho_{fluid}\, V_{displaced}\, g$$

ρ is the density of the fluid, V is the volume of the object that is submerged (if the object is completely submerged, the volume displaced is the volume of the entire object), *g* is acceleration due to gravity. This model for the buoyant forces is called Archimedes' Principle.

If you weigh an object while it is under water, you will find it weighs less than if it were in air. That is because when you weigh a submerged object, you are actually measuring the weight minus the buoyant force. If you do this with a mass scale, then the apparent mass, $m_{apparent}$ (mass in the water), will be less than the actual mass, m_{actual} (mass in the air). The difference between the apparent mass and the actual mass will be due to the buoyant force on the object.

Experimentally, this means:

$F_b = m_{\text{actual}}\, g - m_{\text{apparent}}\, g = (m_{\text{actual}} - m_{\text{apparent}})g$

If you use a spring scale that measures force directly, the buoyant force is the force on the object in air – force on the object when it is submerged in a fluid.

The buoyant force for objects like bottles or beakers that float can be determined in the same way using the apparatus shown below.

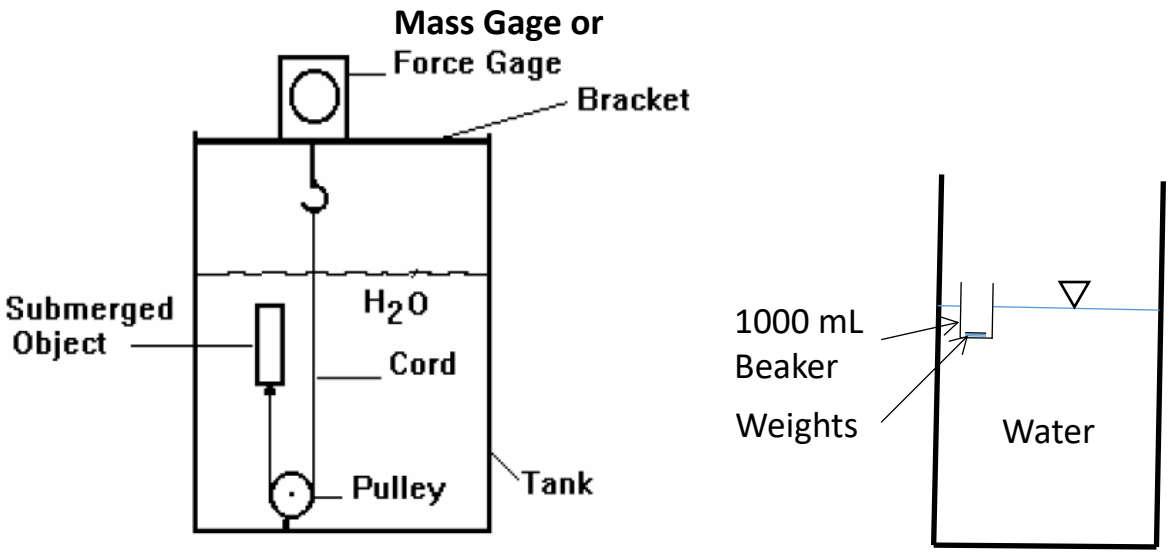

Figure 1. Measuring buoyancy of floating objects.

The buoyant force for objects that do not float (e.g., steel and aluminum) can be determined with the apparatus shown below. Note the only difference between the apparatus for floating objects and the apparatus for non-floating objects is the addition of the pulley.

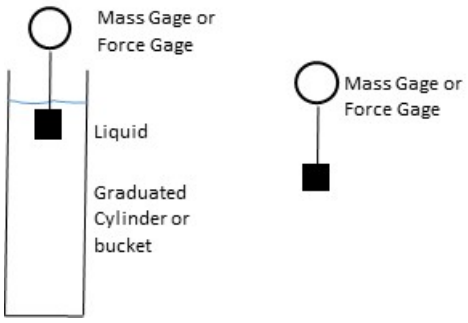

Figure 2. Measuring buoyancy of non-floating objects.

Lab Tasks

Station 1 – Floating objects

1. Determine the buoyancy of objects that float in water by measuring the force of gravity on the objects in the air and submerged in water. Note that the volume of the milk jug is 3.84 L. The volume of the wood block should be determined by measuring the dimensions of the block. The volume of the Toilet Float should be determined by submerging the float in a beaker of water filled to the top, capturing the displaced water in a bucket, and measuring the volume of displaced water with a graduated cylinder.
    a. Milk jug
    b. Wood Block

Object	Volume	Mass or Force in Air	Mass or Force Submerged	Buoyant force

Station 2-

2. Determine the buoyant force required to displace a beaker to the 800 mL and 900 ml marks using the 10 g weights. Note you will have to add about 120g of weight in order for the beaker to stay upright as you add the rest of the weights. A mass balance is provided to determine the weight of the beaker.
    a. One measurement each for all four groups.

Object	Volume	Mass of Beaker in Air	Mass Added to Displace Beaker to 900 mL Mark	Buoyant fprce
Beaker	800 mL			
	900 ml			

Station 3 – Large, Non-Floating Objects

1. Determine the buoyant force on objects that do not float in water by measuring the force of gravity on the objects in the air and submerged in water. The volume of the 2 kg and 5 kg weight can be determined by submerging the weights in a beaker of water filled to the top, capturing the displaced water in a bucket, and measuring the volume of displaced water with a graduated cylinder. **Note: hold on to the weights when submerging in the beaker, so you don't drop the weight and break the beaker.**

    a. 2 kg weight.
    b. 5 kg weight

Object	Volume	Mass or Force in Air	Mass or Force Submerged	Buoyant Force

Station 4 – Small, Non-Floating Objects

1. Determine the buoyant force on objects that do not float in water by measuring the force of gravity on the objects in the air and submerged in water.
    a. All three groups – aluminum, copper, and lead blocks

Object	Volume	Mass or Force in Air	Mass or Force Submerged	Buoyant Force
Aluminum Block				
Copper Block				
Lead Block				
Steel				

ABET outcome C was assessed with the following rubric. Student results are shown.

ABET c: An ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes;

N = 16	Unsatisfactory	Developing	Satisfactory	Exemplary
Correctly perform buoyancy experiment on floating objects	Fails to perform adequately	Performs experiment, but is unable to convert collected data to buoyant force (3) 18.8%	Correctly sets up experiment, but makes an error in determining mass, volume, or buoyant force or forgets units (3) 18.8%	Correctly sets up experiment, collects data (mass and volume), and calculates buoyant force all with correct units (10) 62.5%
Correctly perform buoyancy experiment on the floating beaker	Fails to perform test adequately	Performs experiment, but is unable to convert collected data to buoyant force (2) 12.5%	Correctly sets up experiment, but makes an error in determining mass, volume, or buoyant force or forgets units (5) 31.3%	Correctly sets up experiment, collects data (mass and volume), and calculates buoyant force all with correct units (9) 56.2%

Correctly perform buoyancy experiment on large, non-floating objects	Fails to perform test adequately	Performs experiment, but is unable to convert collected data to buoyant force (1) 6.3%	Correctly sets up experiment, but makes an error in determining mass, volume, or buoyant force or forgets units (5) 31.3%	Correctly sets up experiment, collects data (mass and volume), and calculates buoyant force all with correct units (10) 62.5%
Correctly perform buoyancy experiment on small non-floating objects	Fails to perform test adequately	Performs experiment, but is unable to convert collected data to buoyant force (1) 6.3%	Correctly sets up experiment, but makes an error in determining mass, volume, or buoyant force or forgets units (4) 25%	Correctly sets up experiment, collects data (mass and volume), and calculates buoyant force all with correct units (11) 68.7%
Interpret experiments to understand and demonstrate buoyancy	Offers no interpretation (1) 6.3%	Performs experiments and calculates buoyancy (with no or minor error) (2) 18.8%	Performs experiments, but offers no overall interpretation of buoyancy (5) 31.3%	Interprets all 4 experiments fully to the concept of buoyancy (7) 43.8%
Analyzes error sources for process improvements	Identifies no error sources (1) 6.3%	Identifies only one error source (2) 12.5%	Identifies several error sources (12) 75%	Identifies several error sources for the labs and offers suggestions for improving (1) 6.3%

Continuous improvement: Students, for the most part, performed at an acceptable level on this learning outcome. While they performed calculations correctly, many forget to include units. In the future, I must remind them of the need for proper units assigned to any number and include this requirement in grading homework. Given that this is a freshman level course, I am not surprised that students did not interpret results at a higher level or offer suggestions for improving the experimental design. In subsequent courses, I can discuss with them how to assess error sources and recommend improvements in design.

ABET (f): An ability to identify, analyze, and solve broadly defined engineering technology problems

This outcome was assessed with the following question from the last (3) exam:

1. A power plant uses pumped storage to maximize its energy efficiency. During low energy demand hours, water is pumped to an elevation of 20 m. The piping system is 200 meters long and includes one sharp edged tank inlet, one sharp edge tank exit, and 10 90^{o} threaded smooth bends. The pipe diameter is 20 cm and $\varepsilon/D = 0.01$. The water's volumetric flow rate is 0.08 m^3/ sec, which gives a velocity of 2.55 m/sec. Using the Moody table to estimate the friction factor, f, estimate total ΔP for the system and the pump power requirement if the efficiency is 60%.

Assessment was performed with the following rubric with results shown:

N=19	Unsatisfactory	Developing	Satisfactory	Exemplary
Correctly identifies total correct equation for ΔP	Fails to identify correct pressure loss equation (1) 5.3%	Sets up equation, but with major errors (4)21.1%	Correctly sets up equation with one error in pressure loss terms (2) 10.5%	Correctly sets up experiment, collects data equation with all pressure loss terms (12) 63.1%
Correctly estimates Reynolds number and determines Moody friction factor	Fails to estimate Reynold's number or friction factor (2)10.5%	Estimates Reynolds number and friction factor with major error or multiple minor ones (3) 15.8%	Estimates Reynolds number and friction factor with minor error (10) 52.6%	Correctly estimates Reynolds number and determines Moody friction factor (4) 21.1%
Estimates ΔP from friction loss	Does not apply correct equation (1) 5.3%	Major error in determining ΔP (2) 10.5%	Applies Moody eqn with minor error or with wrong friction factor to estimate ΔP (8) 42.1%	Applies correct Moody friction factor to Bernoilli eqn for ΔP (8) 42.1%
Correctly estimates ΔP for fittings	Fails to get K_l values and/or does not estimate loss from fittings (2)10.5%	Leaves out more than one K_l for fittings and/or does not correctly apply ΔP equation (2)10.5%	Gets all but one K_l values for fittings and/or makes minor error in estimating ΔP (8) 42.1%	Correctly gets the K_l fric loss values for all fittings and estimates ΔP (7) 36.9%
Correctly calculates pump requirement	Fails to calculate pump power (1)5.3%	Applies either incorrect, but close, equation or has major errors (3) 21.1%	Applies correct equation with minor error (10) 52.6%	Applies total ΔP to correct equation for pump power (4) 21.1%

Continuous improvement: Students performed acceptably at identifying the correct equation, but were not consistently successful with calculating all the terms in the equation for pressure loss. Most students made minor errors in estimating the friction factor or determining the total pressure loss coefficient from pipe fittings and turns, etc…More students than I would consider to be acceptable had difficulty separating out the three terms in the equation (pressure loss from friction, minor losses from fittings and pipe configuration, and elevation change). The best way to learn is by practice, so next semester there will be more example problems and homework problems addressing multi-part equations. Since this is a first year course, students may not have encountered a three-term equation and may need more practice.

2. How will you use what you've learned from the data that was collected?

For each assessed outcome in the above report, Continuous Improvement was included to describe how the assessment will be used to improve student learning in subsequent semesters.