CACHE
Computer Aids in Chemical Engineering

Development of a Web-based Tool to Collect, Organize, and Analyze Assessment Data

University at Buffalo
The State University of New York
School of Engineering and Applied Sciences

Acknowledgements – University at Buffalo

- **Christine Human**
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ABET Resource Task Force of CACHE

- Peter Cummings, Vanderbilt University
- Frank Doyle, Harvard University
- Jeff Errington, University at Buffalo
- Marianthi Ierapetritou, Rutgers University
- David Kofke, University at Buffalo (Chair)
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Overview and Motivation

- ABET mandates engineering programs to assess the extent to which students are proficient in Student Outcomes
- Compliance requires collecting, organizing, and analyzing information from many people
- Many view this as a chore
- Tools that make this task easier are not available, but would be welcome (department head survey)
- Developments have been underway within the School of Engineering and Applied Sciences for several years

Student Outcomes

- What students are expected to know or to be able to do by the time of graduation (ABET Inc.)
  - Cumulative effect of education
  - OPTIONS: Adopt, Adapt or Add to ABET a through k
  - Most programs use ABET a through k
- ABET expects programs to assess student proficiency with respect to the SOs, and to use this analysis to inform modifications to the educational program
- How do you determine whether students have mastered the SOs?

Performance Indicators

- Specific measurable statements identifying student performances required to meet student outcomes
- Other names
  - performance criteria, performance measures
  - competencies, dimensions,
  - outcomes, standards,
  - specifications, metrics, etc.
- Written by the faculty. What is important for your program?
- Well stated PIs
  - Provide faculty with clear understanding for implementation in the classroom
  - Makes expectations explicit to the students
  - Focuses data collection

Example: Performance Indicators

Student Outcome (d): an ability to function on multidisciplinary teams

1. Assumes assigned roles and completes assigned work
2. Shows leadership; collaborates and assists teammates
3. Attends team meetings; comes prepared and shares information and ideas
4. Demonstrates civility and values alternate perspectives

(Descriptive) Rubrics

- Guide providing specific criteria for assessment
- Explicitly states the expectations of student performance
- Usually 3-5 performance levels
  - 3- Level: Weak, Average, Excellent
  - 4-Level: Unsatisfactory, Developing, Satisfactory, Exemplary
- Can be used for formative and summative assessment, and student self-assessment (indirect)
- Can also be used for grading

Example Rubric for Student Outcome (d)

Performance Indicator	Unsatisfactory	Developing	Satisfactory	Exemplary
Assumes assigned roles and completes assigned work.	Does not willingly assume team roles, and does not do assigned work.	Usually accepts assigned team roles, but does not complete all assigned work.	Accepts assigned team roles and does complete most of the assigned work.	Accepts all assigned team roles and completes all assigned work.
Shows leadership; collaborates and assists teammates.	Rarely takes leadership role, has difficulty collaborating, sometime willing to assist teammates.	Occasionally shows leadership, mostly collaborates, generally willing to assist teammates.	Shows an ability to lead when necessary, to collaborate, and is willing to assist teammates.	Takes leadership role, is a good collaborator, and always willing to assist teammates.
Attends team meetings; comes prepared and shares information and ideas.	Often misses meetings; routinely fails to prepare for meetings; does not share any information or offer any useful idea to address team's needs.	Absent from meetings occasionally; prepares somewhat for meetings; shares some information and offers some ideas but they are not clearly formulated.	Attends meetings regularly and participates effectively; comes prepared, shares information and offers useful ideas to meet team's needs.	Attends all meetings and participates enthusiastically; shares information and offers well-developed and clearly expressed ideas directly related to team's needs.
Demonstrates civility and values alternate perspectives.	Often discourteous to teammates and openly critical of them; does not want to listen to any alternate perspectives.	Not always considerate or courteous towards teammates; usually appreciates other perspectives, but not always willing to consider them.	Mostly courteous to teammates; values teammates' perspectives and, often willing to consider them.	Always courteous to teammates; values their perspectives, knowledge, and experiences, and always willing to consider them.

Assessment Tool

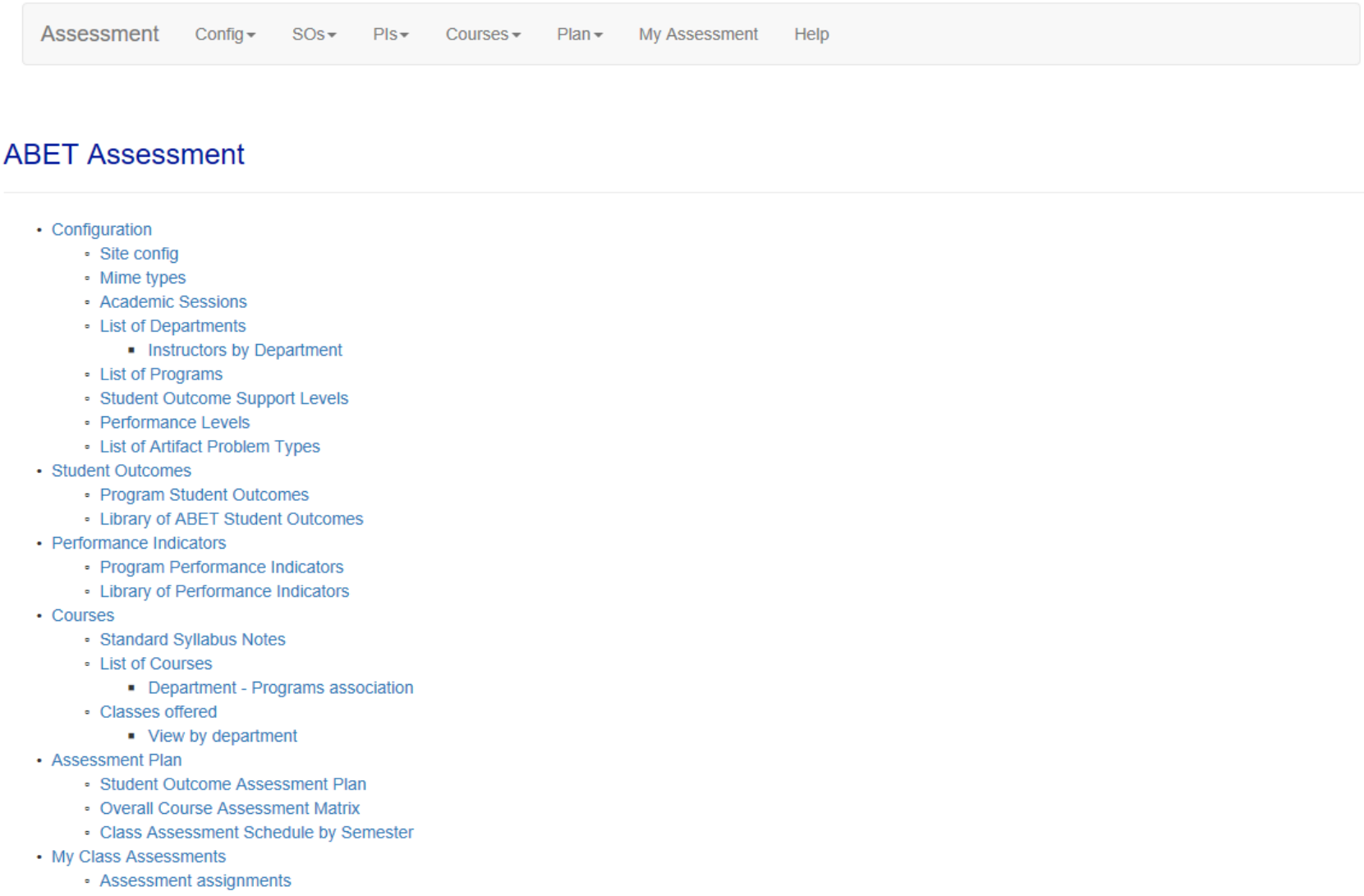
- For direct assessment of student work
- Component of overall assessment plan (to include indirect assessment, norm referenced exams, …)
- Uses performance indicators and (descriptive) rubrics
- Modules

1. Student Outcomes (SO)
2. Performance Indicators (PI) and Rubrics
3. Courses
   - Mapping of SOs to program courses (curriculum map)
   - Syllabus module
4. Assessment Plan
5. My Class Assessments
   - Faculty input of artifacts
   - Presentation of results
6. Program-wide evaluation/analysis of assessments

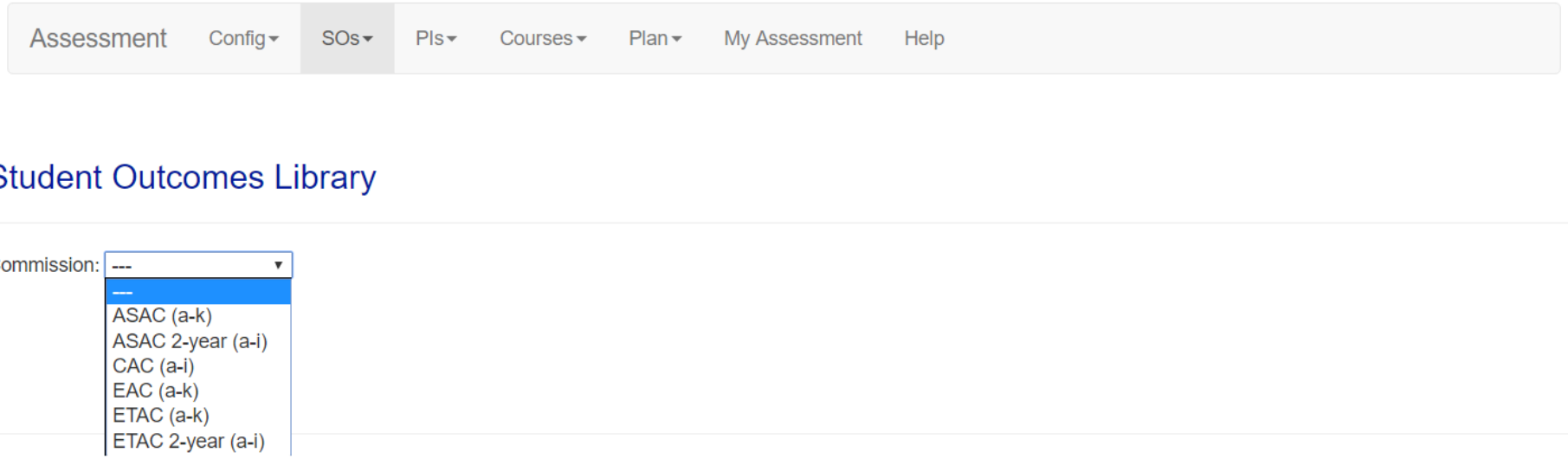
Beta Testers

- If you're interested in testing the software, please let us know!
  - Dave Kofke (kofke@buffalo.edu)
  - Jeff Errington (jerring@buffalo.edu)

Screenshot – Main Page



Screenshot – Student Outcome Library



Screenshot – Student Outcomes

Program Student Outcomes - Chemical Engineering

Program: Chemical Engineering ▾ 2016-17 ▾

Access: Full ▾

Log of changes made

Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they process through the program.

id (a-k)	Student Outcome	
a	an ability to apply knowledge of mathematics, science, and engineering	
b	an ability to design and conduct experiments, as well as to analyze and interpret data	
c	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	
d	an ability to function on multidisciplinary teams	
e	an ability to identify, formulate, and solve engineering problems	
f	an understanding of professional and ethical responsibility	
g	an ability to communicate effectively	
h	the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	
i	a recognition of the need for, and an ability to engage in life-long learning	

Screenshot – Performance Indicators

Program Performance Indicators - Civil Engineering

Program: Civil Engineering ▾ 2016-17 ▾

Access: Full ▾

Log of changes made

Performance indicators are specific, measureable statements identifying student performance(s) required to meet the outcome; confirmable through evidence.

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

	Label	Performance Indicator	Unsatisfactory	Developing	Satisfactory	Exemplary	
	PARAMETERS	Applies knowledge of physical phenomenon to identify the key parameters to measure.	Does not understand physical phenomena, has limited understanding of key parameters.	Has basic idea of the physical phenomena and recognizes some key parameters.	Understands the physical phenomena and selects most of the key parameters.	Demonstrate comprehensive understanding of the physical phenomena and selects appropriate key parameters.	
	DESIGN	Specifies appropriate test methods/standards and selects appropriate test apparatus/equipment(s).	No systematic plan for data collection. Cannot select the appropriate equipment(s).	Develops a simplistic experimental plan without recognizing the entire scope of the study. Needs help to select proper equipment(s).	Needs limited guidance in formulating the experimental plan and selecting appropriate equipment(s).	Formulates an experimental plan of data collection with appropriate equipment(s) to attain a stated objective with no guidance.	
	CONDUCT	Conducts experiment to appropriate test	Conducts experiment without	Does not completely follow test standard	Conducts experiment in accordance with most	Conducts experiment in compliance with test	

Screenshot – Syllabus Tool

CIE 415: Prof Practice Issues

Session 2016-17 ▾ Fall 2016 ▾

Format for printing | Edit course info

Reorder headings

Log of changes made

Syllabus Upload (PDF)

Fall 2016

Choose File No file chosen

Upload

Credit hours: 3

Contact hours

Section	Pattern	Pattern Key	Type	Date range	Time
000	Monday,Wednesday,Friday	MWF	Lecture	Aug 29 - Dec 9, 2016	9:00AM - 9:50AM

Instructor Details

- Name: Christine Human
  - Office location: 242 Ketter Hall
  - Email address: chuman@buffalo.edu

Teaching Assistant Details

- Name: Courtney Bentley

Screenshot – Assessment Plan

Student Outcome Assessment Plan - Civil Engineering

Program: Civil Engineering ▾

Access: Program ▾

The assessment plan specifies your plan for direct assessment of student outcomes in program courses. Student outcomes are assessed on a cycle such that some subset of student outcomes are assessed every year during the cycle. You can determine how many years the cycle lasts.

Assessment cycle period: 3 ▾ years

Assessment plan start session: 2016-17 ▾ Fall ▾

Year	a	b	c	d	e	f	g	h	i	j	k
#1 (AY 2016-17)	☐	☐	☐	☐	☐	☐	✔	✔	✔	✔	☐
#2 (AY 2017-18)	☐	✔	☐	✔	☐	✔	☐	☐	☐	☐	☐
#3 (AY 2018-19)	✔	☐	✔	☐	✔	☐	☐	☐	☐	☐	✔

Submit

Screenshot – Assessment Plan

Overall Course Assessment Matrix - Civil Engineering

Program: Civil Engineering ▾

Access: Program ▾

The matrix below maps between courses and student outcomes to be assessed. Marking a course / student outcome indicates that you want that student outcome assessed in that course, subject to the restriction that the student outcome will only be assessed during years specified by your assessment plan.

SO	a	b	c	d	e	f	g	h	i	j	k
Total #	4	3	3	3	5	2	4	4	3	3	4
CIE 177											
CIE 303				✔							✔
CIE 308	✔										✔
CIE 323					✔						
CIE 324											✔
CIE 327	✔										
CIE 334	✔	✔									

Screenshot – Assessment Plan

Assessment Status by Semester - Civil Engineering

Program: Civil Engineering ▾ 2016-17 ▾ Fall 2016 ▾

Search:

Artifact	Course	Instructor	Student Outcomes	Status	Delegate
CIE327 Outcome(b) assessment Fall 2016	CIE 327 000 CIE 327 A CIE 327 B CIE 327 C CIE 327 D CIE 327 E	[redacted]	b	Finished	jakubryb
	CIE 340 000		h	Unstarted	
	CIE 340 000		j	Unstarted	
	CIE 415 000		g	Unstarted	
	CIE 415 000		i	Unstarted	
	CIE 415 000		j	Unstarted	
Homework 1	CIE 428 000		c	Scoring Finished	mvs
	CIE 439 A		h	Unstarted	

Screenshot – Artifact Submission

Assessment for CIE 360 (Fall 2016)

Delete this artifact

Program:	Environmental Engineering
Sections:	A, B, C, D, 000
Artifact name:	
Problem type:	Exam
Delegate username:	
Problem statement:	Choose File No file chosen Add another file
Problem solution:	Choose File No file chosen Add another file

Problem notes (e.g. additional materials supplied, open/closed book exam)

Screenshot – Artifact Submission

Performance indicators to be assessed:

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

- [x] Assumes assigned roles and completes assigned work.
- [ ] Shows leadership; collaborates and assists teammates.
- [ ] Attends team meetings; comes prepared and shares information and ideas.
- [ ] Demonstrates civility and values alternate perspectives.

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Explain how the assignment covers the performance indicators being assessed.

Screenshot – Artifact Submission

Assessment for CIE 360 (Fall 2016)

Edit basic artifact info

Program:	Environmental Engineering
Artifact name:	test
Problem type:	Exam
Problem solution:	
Problem solution:	

Performance Indicators for this Artifact

Label	Performance Indicator	Unsatisfactory	Developing	Satisfactory	Exemplary
ROLE	Assumes assigned roles and completes assigned work.	Does not willingly assume team roles, and does not do assigned work.	Usually accepts assigned team roles, but does not complete all assigned work.	Accepts assigned team roles and does complete most of the assigned work.	Accepts all assigned team roles and completes all assigned work.

Student Performance

Student	Performance
Student 1	N/A U **D** S E
Student 2	N/A U D **S** E
Student 3	N/A U D S **E**
Student 4	N/A U D **S** E

Screenshot – Artifact Submission

Assessment Student Work for CIE 360 (Fall 2016)

Program: Environmental Engineering

Artifact name: test

Problem type: Exam

Please upload student work for the following students:

- 10% — Student 1
  Choose File No file chosen
  Add another file
- 30% — Student 2
  Choose File No file chosen
  Add another file
- 50% — Student 3
  Choose File No file chosen
  Add another file
- 70% — Student 4
  Choose File No file chosen
  Add another file
- 90% — Student 5
  Choose File No file chosen
  Add another file

Continue

Screenshot – Completed Artifact

Assessment Summary for CIE 415 (Fall 2015)

Program:	Civil Engineering
Artifact name:	ASCE Infrastructure Reportcard
Problem type:	Team Homework
Problem Statement	ASCE-Reportcard.docx Infrastructure-rubric.pdf

Problem notes:

Both civil and environmental engineering students take CIE 415. Groups of only civil engineering students were included in this analysis. The problem statement and the grading rubric are attached.

Delete this artifact

Performance Indicators for this Artifact

Label	Performance Indicator	Unsatisfactory	Developing	Satisfactory	Exemplary
(g) an ability to communicate effectively					
MECHANICS	Uses proper composition, grammar and spelling.	Many wordy sentences, too many passive verbs, and repetitive words/sentences. Numerous spelling and grammatical errors.	Some wordy sentences, many passive verbs, and few repetitive words/sentences. Several spelling and grammatical errors. Several spelling and grammatical errors.	Mostly direct sentences, uses active verbs and a variety of sentences/words. Minor misspellings and/or grammatical errors.	Direct and concise sentences, uses active verbs, and no run-on or sentence fragments. Negligible misspellings and/or grammatical errors.
FIGURE	Uses figures and	Figures and tables are poorly	Figures and tables are	Figures and tables are neat and	Figures and tables are presented

Screenshot – Completed Artifact

Student Performance

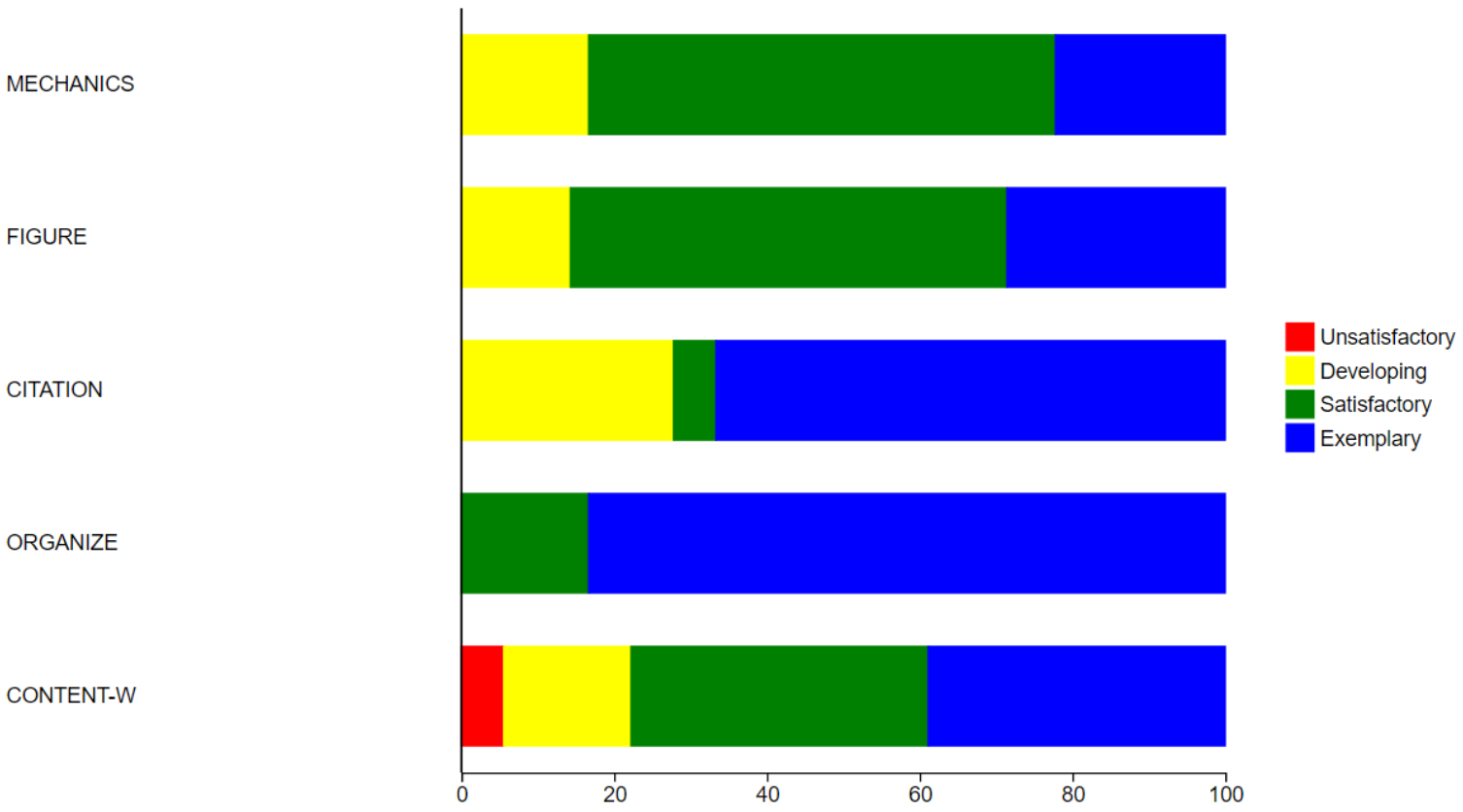
Total # of teams in CIE program: 18

Performance Indicator	N/A	Unsatisfactory	Developing	Satisfactory	Exemplary
(g) an ability to communicate effectively					
MECHANICS	0	0 (0%)	3 (17%)	11 (61%)	4 (22%)
FIGURE	11	0 (0%)	1 (14%)	4 (57%)	2 (29%)
CITATION	0	0 (0%)	5 (28%)	1 (6%)	12 (67%)
ORGANIZE	0	0 (0%)	0 (0%)	3 (17%)	15 (83%)
CONTENT-W	0	1 (6%)	3 (17%)	7 (39%)	7 (39%)
(i) a recognition of the need for, and an ability to engage in life-long learning					
SOURCE	0	0 (0%)	0 (0%)	1 (6%)	17 (94%)
LEARN	0	0 (0%)	1 (6%)	6 (33%)	11 (61%)
(j) a knowledge of contemporary issues					
IMPACT	0	2 (11%)	1 (6%)	3 (17%)	12 (67%)

(g) an ability to communicate effectively

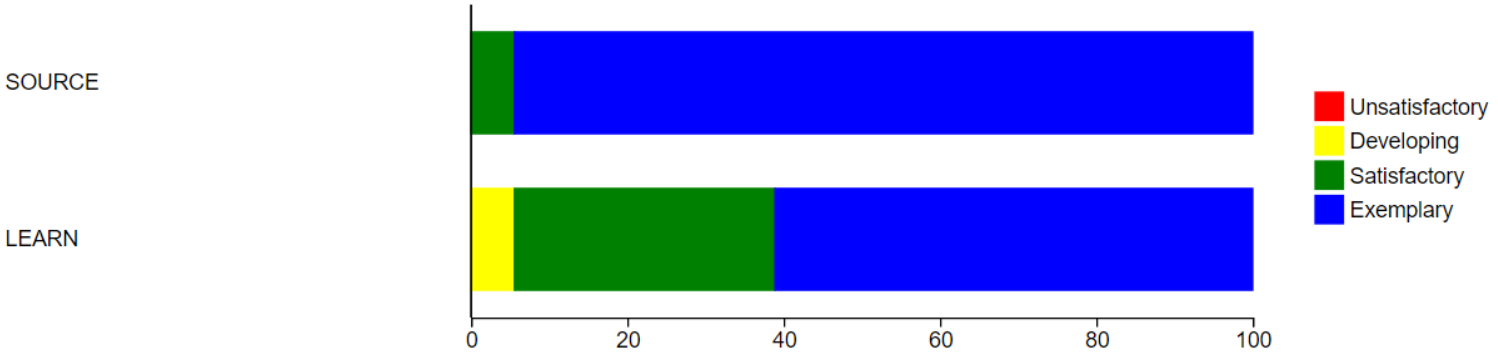
Screenshot – Completed Artifact

(g) an ability to communicate effectively

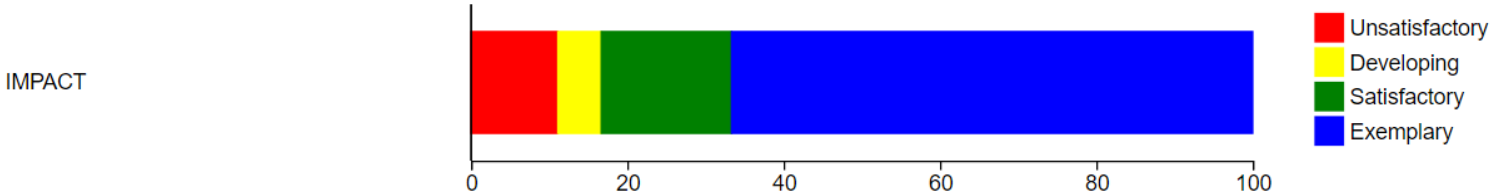


Screenshot – Completed Artifact

(i) a recognition of the need for, and an ability to engage in life-long learning



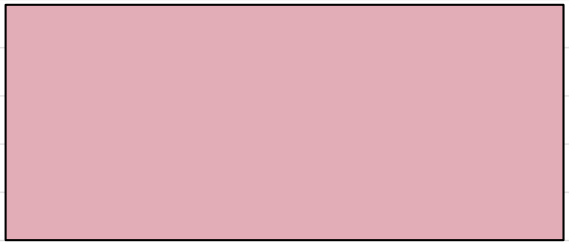
(j) a knowledge of contemporary issues



Screenshot – Completed Artifact

Student Work

Performance Indicator	10%	30%	50%	70%	90%
(g) an ability to communicate effectively					
MECHANICS	S	S	S	E	E
FIGURE	S	E	S	S	E
CITATION	D	D	E	E	S
ORGANIZE	E	E	E	E	E
CONTENT-W	U	E	S	E	S
(i) a recognition of the need for, and an ability to engage in life-long learning					
SOURCE	E	S	E	E	E
LEARN	E	S	S	E	E
(j) a knowledge of contemporary issues					
IMPACT	E	E	E	D	E

Percentile	Files
10%	
30%	
50%	
70%	
90%	

Screenshot – Completed Artifact

Faculty Input

Explain how the assignment covers the performance indicators being assessed.

Given the context and level of difficulty of the assignment, comment on the student performance.

Do you have any suggestions to improve performance at the course level?

Do you have any suggestions to improve performance at the program level?

Do you have any comments/suggestions to improve the performance indicators or rubrics?