



Adapting the VALUE Rubrics to ABET ETAC Outcomes a-k

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Introduction

This paper presents suggestions of which VALUE metarubrics commissioned by the American Association of Colleges & Universities can be of use to assess student outcomes for engineering technology programs. Although many instructors use rubrics for grading, this paper presents rubrics which can be used for program assessment. Rubrics are an effective way to measure students' abilities. According to Spurlin, "Rubrics are sets of criteria or scoring guides that define what is expected of students."¹

The VALUE rubrics use the format shown in Figure 1. Criteria are listed down the left column, achievement levels listed across the top, and performance descriptions are supplied for each criterion/level combination.

		<i>Achievement Levels</i>			
		Capstone	Milestone	Milestone	Benchmark
Criteria	Criterion 1	Performance description			
	Criterion 2		Performance description		
	...			Performance description	
	Criterion 5				Performance description

Figure 1: VALUE Rubric Format

VALUE Project Background

The Association of American Colleges and Universities started the VALUE (Valid Assessment of Learning in Undergraduate Education) project in 2007². This program was created in order to better show educational benefits, quality of learning, and retention and graduation rates. Since there are no standardized tests for the Essential Learning Outcomes (ELOs), there was a need to develop a way to document and assess student learning in undergraduate education.

The VALUE project was driven by an advisory board made up of 12 people, national and international leaders. The main goal was to generate a way to evaluate student learning that was based on the work students produced through the curriculum across a set of Essential Learning Outcomes (ELOs) that faculty and professionals stated were critically important for student success.

Through this project, VALUE rubrics were created, for higher education, for the purpose of assessing the quality of student learning and achievement. These rubrics were not intended to be used for grading purposes, but for the purpose of collecting evidence of student learning.

For each completed rubric, a set of the most common criteria or characteristics of learning were identified. Achievement levels were separated into four different levels and performance descriptors for each level of criterion was established for each learning outcome.

The following are the VALUE Rubrics that have been created:

Intellectual and Practical Skills

- Inquiry and analysis
- Critical thinking
- Creative thinking
- Written communication
- Oral communication
- Reading
- Quantitative literacy
- Information literacy
- Teamwork
- Problem solving

Personal and Social Responsibility

- Civic knowledge and engagement—local and global
- Intercultural knowledge and competence
- Ethical reasoning
- Foundations and skills for lifelong learning
- Global Learning

Integrative and Applied Learning

- Integrative and applied learning

The VALUE Rubrics can be found in their entirety on the AAC&U website:

<http://www.aacu.org/value/rubrics>. Readers are encouraged to download complete copies of the rubrics. An example of one rubric, “Teamwork,” may be found in the appendix of this paper.

ETAC ABET Student Outcomes (a-k)

In the Criteria for Accrediting Engineering Technology Programs, The Engineering Technology Accreditation Commission of ABET requires each program to have documented student outcomes.

For baccalaureate degree programs, these student outcomes must include, but are not limited to, the following learned capabilities:

- 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 objectives;
- 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; and
- k. a commitment to quality, timeliness, and continuous improvement. ²

The document goes on to explain that the program must assess how well students attain these outcomes.

For the purpose of this study, we have divided the student outcomes into two groups: professional skills and technical skills:

Table 1: Professional vs. Technical Skills

Professional Skills	Technical Skills
e. technical team	a. knowledge . . . of the discipline . . .
g. communication . . . identify and use appropriate technical literature	b. apply knowledge of mathematics, science . . . to engineering technology problems
h. continuing professional development	c. standard tests and measurements . . . experiments
i. professional and ethical responsibilities, respect for diversity	d. design
j. solutions in a societal and global context	f. solve problems
k. quality, timeliness, and continuous improvement	

Table 2 presents a matrix of which VALUE Rubrics can support the ETAC student outcomes. Notice the clusters of like criteria.

Table 2: VALUE Rubrics Matched to Student Outcomes

	e. technical team	g. communication . . . identify and use appropriate technical literature	h. continuing professional development	i. professional and ethical responsibilities, respect for diversity	j. solutions in a societal and global context	k. quality, timeliness, and continuous improvement	a. knowledge . . . of the discipline . . .	b. apply knowledge of mathematics, science . . . to engineering technology problems	c. standard tests and measurements . . . experiments	d. design	f. solve problems
Inquiry and analysis			X			X	X		X		X
Critical thinking			X			X	X				
Creative thinking										X	X
Written communication		X									
Oral communication		X									
Reading		X	X								
Quantitative literacy		X				X		X			X
Information literacy		X	X								
Teamwork	X					X					
Problem solving								X	X	X	X
Civic knowledge & engagement — local & global				X	X						
Intercultural knowledge and competence	X			X	X						
Ethical reasoning				X							
Foundations and skills for lifelong learning			X								
Global Learning				X	X						
Integrative and Applied Learning			X								

VALUE Rubrics to Assess ABET Professionalism Skills

The method used for this study involved three main steps. First, the VALUE rubrics were reviewed and keywords extracted from the criteria and/or performance descriptors. These keywords were then matched to the ABET “a-k” student outcomes. Finally, a list of criteria, gathered from all the relevant VALUE rubrics, was identified for each student outcome. For some outcomes, an entire rubric was identified as applicable; for other outcomes, criteria from multiple rubrics were selected.

Student Outcome e: Technical Team

As expected, the VALUE rubric entitled “Teamwork VALUE Rubric” can be used in its entirety to assess students’ abilities to work in a technical team. (See appendix for the complete rubric.)

Criteria used by this rubric are:

- Contributes to Team Meetings
- Facilitates the Contributions of Team Members
- Individual Contributions Outside of Team Meetings
- Fosters Constructive Team Climate
- Responds to Conflict

In addition to the teamwork rubric, the “Intercultural Knowledge and Competence VALUE Rubric” has one criterion, *Empathy*, which can enhance measurement of students’ abilities to work in teams.

Table 3: Excerpt from "Intercultural Knowledge and Competence VALUE Rubric"

	Capstone	Milestones		Benchmark
	4	3	2	1
Skills - Empathy	Interprets intercultural experience from the perspectives of own and more than one worldview and demonstrates ability to act in a supportive manner that recognizes the feelings of another cultural group.	Recognizes intellectual and emotional dimensions of more than one worldview and sometimes uses more than one worldview in interactions.	Identifies components of other cultural perspectives but responds in all situations with own worldview.	Views the experience of others but does so through own cultural worldview.

Student Outcome g: Communication & Use of Technical Literature

There are five complete rubrics which can be used to measure various aspects of this student outcome. The first two, for written and oral communication, are similar to many other rubrics which are in use in engineering technology programs; this is expected because of the “meta-

rubric” nature of the VALUE rubrics. Lists of the criteria for each are given below; for performance descriptions, please see the complete rubrics.

Written Communication VALUE Rubric
Criteria:

- Context of and Purpose for Writing
- Content Development
- Genre and Disciplinary Conventions
- Sources and Evidence
- Control of Syntax and Mechanics

Oral Communication VALUE Rubric
Criteria:

- Organization
- Language
- Delivery
- Supporting Material
- Central Message

Both the information literacy and reading rubrics may also be used in their entirety to assess students’ abilities to “identify and use appropriate technical literature.”

Information Literacy VALUE Rubric Criteria:

- Determine the Extent of Information Needed
- Access the Needed Information
- Evaluate Information and its Sources Critically
- Use Information Effectively to Accomplish a Specific Purpose
- Access and Use Information Ethically and Legally

Reading VALUE Rubric Criteria:

- Genres
- Relationship to Text - *Making meanings with texts in their contexts*
- Analysis - *Interacting with texts in parts and as wholes*
- Interpretation - *Making sense with texts as blueprints for meaning*
- Reader's Voice - *Participating in academic discourse about texts*

Finally, one criterion from the quantitative reasoning rubric deals with communication which might be especially appropriate for engineering documents.

Table 4: Excerpt from "Quantitative Reasoning VALUE Rubric"

	Capstone	Milestones		Benchmark
	4	3	2	1
Communication <i>Expressing quantitative evidence in support of the argument or purpose of the work (in terms of what evidence is used and how it is formatted, presented, and contextualized)</i>	Uses quantitative information in connection with the argument or purpose of the work, presents it in an effective format, and explicates it with consistently high quality.	Uses quantitative information in connection with the argument or purpose of the work, though data may be presented in a less than completely effective format or some parts of the explication may be uneven.	Uses quantitative information, but does not effectively connect it to the argument or purpose of the work.	Presents an argument for which quantitative evidence is pertinent, but does not provide adequate explicit numerical support. (May use quasi-quantitative words such as "many," "few," "increasing," "small," and the like in place of actual quantities.)

Student Outcome h. Continuing Professional Development

Assessing lifelong learning is a difficult thing at the undergraduate level. However, educators can assess the skills necessary to engage in lifelong learning using the rubric for “Foundations and skills for lifelong learning.” The criteria used in this rubric are listed below; the complete rubric can be found on the AAC&U website here:

<http://www.aacu.org/value/rubrics/LifelongLearning.cfm>

Foundations and Skills for Lifelong Learning VALUE Rubric Criteria:

- Curiosity
- Initiative
- Independence
- Transfer
- Reflection

In addition, criteria from five other rubrics can also be used:

Table 6: Additional Criteria to Assess Outcome "h"

VALUE Rubric	Criteria to measure “an understanding of the need for and an ability to engage in self-directed continuing professional development”
Inquiry & Analysis	<ul style="list-style-type: none">• Topic selection• Existing Knowledge, Research, and/or Views
Critical Thinking	<ul style="list-style-type: none">• Evidence (Selecting and using information to investigate a point of view or conclusion)• Influence of context and assumptions
Reading	<ul style="list-style-type: none">• Comprehension
Information Literacy	<ul style="list-style-type: none">• Evaluate Information and its Sources Critically
Integrative and Applied Learning	<ul style="list-style-type: none">• Connections to Experience (Connects relevant experience and academic knowledge)• Reflection and Self-Assessment (Demonstrates a developing sense of self as a learner, building on prior experiences to respond to new and challenging contexts (may be evident in self-assessment, reflective, or creative work))

An engineering technology program might choose to start with using only the “Foundations and Skills for Lifelong Learning VALUE Rubric” and then add additional criteria if more information is needed to identify student challenges.

Student Outcome i. Professional and Ethical Responsibilities & Respect for Diversity

For the purposes of identifying rubrics for this outcome, it can be divided into two parts: ethics & diversity. Ethics can be assessed using the “Ethical Reasoning VALUE Rubric” in its entirety.

The criteria are:

- Ethical Self-Awareness
- Understanding Different Ethical Perspectives/Concepts
- Ethical Issue Recognition
- Application of Ethical Perspectives/Concepts
- Evaluation of Different Ethical Perspectives/Concepts

In addition, there is one criterion from Information Literacy which may easily apply in many assignments to assess ethics:

Table 7: Excerpt from "Information Literacy VALUE Rubric"

	Capstone	Milestones		Benchmark
	4	3	2	1
Access and Use Information Ethically and Legally	Students use correctly all of the following information use strategies (use of citations and references; choice of paraphrasing, summary, or quoting; using information in ways that are true to original context; distinguishing between common knowledge and ideas requiring attribution) and demonstrate a full understanding of the ethical and legal restrictions on the use of published, confidential, and/or proprietary information.	Students use correctly three of the following information use strategies (use of citations and references; choice of paraphrasing, summary, or quoting; using information in ways that are true to original context; distinguishing between common knowledge and ideas requiring attribution) and demonstrates a full understanding of the ethical and legal restrictions on the use of published, confidential, and/or proprietary information.	Students use correctly two of the following information use strategies (use of citations and references; choice of paraphrasing, summary, or quoting; using information in ways that are true to original context; distinguishing between common knowledge and ideas requiring attribution) and demonstrates a full understanding of the ethical and legal restrictions on the use of published, confidential, and/or proprietary information.	Students use correctly one of the following information use strategies (use of citations and references; choice of paraphrasing, summary, or quoting; using information in ways that are true to original context; distinguishing between common knowledge and ideas requiring attribution) and demonstrates a full understanding of the ethical and legal restrictions on the use of published, confidential, and/or proprietary information.

“A respect for diversity” can be measured using three other Personal and Social Responsibility VALUE Rubrics: Civic Engagement, Global Learning and Intercultural Knowledge. Table 8 lists these rubrics and the associated criteria.

Table 8: Additional Criteria to Assess Outcome "i": Diversity

	Capstone	Milestones		Benchmark
	4	3	2	1
Civic Engagement Rubric: Diversity of Communities and Cultures	Demonstrates evidence of adjustment in own attitudes and beliefs because of working within and learning from diversity of communities and cultures. Promotes others' engagement with diversity.	Reflects on how own attitudes and beliefs are different from those of other cultures and communities. Exhibits curiosity about what can be learned from diversity of communities and cultures.	Has awareness that own attitudes and beliefs are different from those of other cultures and communities. Exhibits little curiosity about what can be learned from diversity of communities and cultures.	Expresses attitudes and beliefs as an individual, from a one-sided view. Is indifferent or resistant to what can be learned from diversity of communities and cultures.
Global Learning Rubric: Cultural Diversity	Adapts and applies a deep understanding of multiple worldviews, experiences, and power structures while initiating meaningful interaction with other cultures to address significant global problems.	Analyzes substantial connections between the worldviews, power structures, and experiences of multiple cultures historically or in contemporary contexts, incorporating respectful interactions with other cultures.	Explains and connects two or more cultures historically or in contemporary contexts with some acknowledgement of power structures, demonstrating respectful interaction with varied cultures and worldviews.	Describes the experiences of others historically or in contemporary contexts primarily through one cultural perspective, demonstrating some openness to varied cultures and worldviews.
Intercultural Knowledge Rubric: Attitudes - Openness	Initiates and develops interactions with culturally different others. Suspends judgment in valuing her/ his interactions with culturally different others.	Begins to initiate and develop interactions with culturally different others. Begins to suspend judgment in valuing her/ his interactions with culturally different others.	Expresses openness to most, if not all, interactions with culturally different others. Has difficulty suspending any judgment in her/ his interactions with culturally different others, and is aware of own judgment and expresses a willingness to change.	Receptive to interacting with culturally different others. Has difficulty suspending any judgment in her/ his interactions with culturally different others, but is unaware of own judgment.

Student Outcome j: Societal and Global Context

This outcome requires programs to assess student’s “knowledge of the impact of engineering technology solutions in a societal and global context.” Of all the VALUE rubrics, the Global Learning Rubric most closely matches this outcome, and may be used in its entirety. Criteria are:

- Global Self-Awareness
- Perspective Taking
- Personal and Social Responsibility
- Understanding Global Systems
- Applying Knowledge to Contemporary Global Contexts

In addition, criteria from two other Personal and Social Responsibility Rubrics can add insight to student achievement.

Table 9: Additional Criteria to Assess Outcome "j"

VALUE Rubric	Criteria to measure “a knowledge of the impact of engineering technology solutions in a societal and global context”
Civic Engagement	<ul style="list-style-type: none"> • Analysis of Knowledge • Civic Action and Reflection
Intercultural Knowledge	<ul style="list-style-type: none"> • Knowledge- <i>Knowledge of cultural worldview frameworks</i> • Skills – <i>Empathy</i>

Student Outcome k. Quality, Timeliness, and Continuous Improvement

For the purpose of this analysis this outcome has been broken into two parts: quality & continuous improvement and timeliness. The criteria to measure a commitment to continuous improvement come from the techniques of Lean Six-Sigma methodology. These criteria are presented in Table 10.

Table 10: Criteria to Assess Outcome "k": Quality and Continuous Improvement

VALUE Rubric	Criteria to measure “a knowledge of the impact of engineering technology solutions in a societal and global context”
Inquiry & Analysis	<ul style="list-style-type: none"> • Analysis • Conclusions • Limitations and Implications
Critical Thinking	<ul style="list-style-type: none"> • Conclusions and related outcomes (<i>implications and consequences</i>)
Quantitative Literacy	<ul style="list-style-type: none"> • Application / Analysis - <i>Ability to make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis</i>

The only VALUE rubric which directly measures timeliness is the Teamwork rubric, which quantifies students' ability to meet a deadline.

Table 11: Excerpt from "Teamwork VALUE Rubric" to assess Timeliness

	Capstone	Milestones		Benchmark
	4	3	2	1
Individual Contributions Outside of Team Meetings	Completes all assigned tasks by deadline; work accomplished is thorough, comprehensive, and advances the project. Proactively helps other team members complete their assigned tasks to a similar level of excellence.	Completes all assigned tasks by deadline; work accomplished is thorough, comprehensive, and advances the project.	Completes all assigned tasks by deadline; work accomplished advances the project.	Completes all assigned tasks by deadline.

It might be necessary to revise the performance indicators if most students do not meet the "Benchmark" achievement level.

VALUE Rubrics to Assess ABET Technical Skills

Engineering technology faculty are less likely to look to VALUE rubrics to assess technical skills, since most of the rubrics were created for use in general education courses. However, there are still applications for the rubrics to measure student achievement of the more technical outcomes.

Student Outcome a: select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities

There are two rubrics that can be used for application of outcome a. The first rubric, Critical Thinking VALUE Rubric, has one criterion, Explanation of Issues that can be used to measure the students understanding.

Table 12: Excerpt from "Critical Thinking VALUE Rubric"

	Capstone	Milestones		Benchmark
	4	3	2	1
Explanation of Issues	Issue/ problem to be considered critically is stated clearly and described comprehensively, delivering all relevant information necessary for full understanding.	Issue/ problem to be considered critically is stated, described, and clarified so that understanding is not seriously impeded by omissions.	Issue/ problem to be considered critically is stated but description leaves some terms undefined, ambiguities unexplored, boundaries undetermined, and/ or backgrounds unknown.	Issue/ problem to be considered critically is stated without clarification or description

In addition to the Critical Thinking rubric, the Inquiry and Analysis VALUE Rubric includes the entire criterion for outcome a. The list of criteria is given below; for performance descriptions, please see the complete set of rubrics.

Inquiry and Analysis VALUE Rubric Criteria:

- Topic Selection
- Existing Knowledge, Research, and/or Views
- Design Process
- Analysis
- Conclusions
- Limitations and Implications

Student Outcome b: knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies;

There are two rubrics which can be used to measure various aspects of this student outcome. The first one, Problem Solving, can be used in its entirety. Below are the criteria, for performance descriptions, please view the complete set of rubrics.

Problem Solving VALUE Rubric Criteria:

- Define Problem
- Identify Strategies
- Propose Solutions/Hypotheses
- Evaluate Potential Solutions
- Implement Solution
- Evaluate Outcomes

The second rubric used for outcome b is the Quantitative Literacy VALUE Rubric. There are four criteria in this rubric that can be used to assess a students' knowledge in STEM (Science, Technology, Engineering, and Math) and its problem application. Below are excerpts from the VALUE rubric.

Table 13: Excerpt from "Quantitative Literacy VALUE Rubric"

	Capstone	Milestones		Benchmark
	4	3	2	1
Interpretation - Ability to explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words)	Provides accurate explanations of information presented in mathematical forms. Makes appropriate inferences based on that information. <i>For example, accurately explains the trend data shown in a graph and makes reasonable predictions regarding what the data suggest about future events.</i>	Provides accurate explanations of information presented in mathematical forms. <i>For instance, accurately explains the trend data shown in a graph.</i>	Provides somewhat accurate explanations of information presented in mathematical forms, but occasionally makes minor errors related to computations or units. <i>For instance, accurately explains trend data shown in a graph, but may miscalculate the slope of the trend</i>	Attempts to explain information presented in mathematical forms, but draws incorrect conclusions about what the information means. <i>For example, attempts to explain the trend data shown in a graph, but will frequently misinterpret the nature of that trend, perhaps by confusing positive and negative trends.</i>

			<i>line.</i>	
Representation - <i>Ability to convert relevant information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words)</i>	Skillfully converts relevant information into an insightful mathematical portrayal in a way that contributes to a further or deeper understanding.	Competently converts relevant information into an appropriate and desired mathematical portrayal.	Completes conversion of information but resulting mathematical portrayal is only partially appropriate or accurate.	Completes conversion of information but resulting mathematical portrayal is inappropriate or inaccurate.
Calculation	Calculations attempted are essentially all Successful and sufficiently comprehensive to solve the problem. Calculations are also presented elegantly (clearly, concisely, etc.)	Calculations attempted are essentially all successful and sufficiently comprehensive to solve the problem.	Calculations attempted are either unsuccessful or represent only a portion of the calculations required to comprehensively solve the problem.	Calculations are attempted but are both unsuccessful and are not comprehensive.
Application / Analysis - <i>Ability to make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis</i>	Uses the quantitative analysis of data as the basis for deep and thoughtful judgments, drawing insightful, carefully qualified conclusions from this work.	Uses the quantitative analysis of data as the basis for competent judgments, drawing reasonable and appropriately qualified conclusions from this work.	Uses the quantitative analysis of data as the basis for workmanlike (without inspiration or nuance, ordinary) judgments, drawing plausible conclusions from this work.	Uses the quantitative analysis of data as the basis for tentative, basic judgments, although is hesitant or uncertain about drawing conclusions from this work.

Student Outcome c. conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes

There are three rubrics which can be used to measure various aspects of this student outcome. The first one, Problem Solving, can be used in its entirety. Below are the criteria, for performance descriptions, please view the complete set of rubrics.

Problem Solving VALUE Rubric Criteria:

- Define Problem
- Identify Strategies
- Propose Solutions/Hypotheses
- Evaluate Potential Solutions
- Implement Solution
- Evaluate Outcomes

The second rubric used for outcome c is the Inquiry and Analysis VALUE Rubric. There are three criteria in this rubric that can be applied; Table 14 shows the relevant parts.

Table 14: Excerpt from "Inquiry and Analysis VALUE Rubric"

	Capstone	Milestones		Benchmark
	4	3	2	1
Analysis	Organizes and synthesizes evidence to reveal insightful patterns, differences, or similarities related to focus.	Organizes evidence to reveal important patterns, differences, or similarities related to focus.	Organizes evidence, but the organization is not effective in revealing important patterns, differences, or similarities.	Lists evidence, but it is not organized and/or is unrelated to focus.
Conclusions	States a conclusion that is a logical extrapolation from the inquiry findings.	States a conclusion focused solely on the inquiry findings. The conclusion arises specifically from and responds specifically to the inquiry findings.	States a general conclusion that, because it is so general, also applies beyond the scope of the inquiry findings.	States an ambiguous, illogical, or unsupported conclusion from inquiry findings.
Limitations and Implications	Insightfully discusses in detail relevant and supported limitations and implications.	Discusses relevant and supported limitations and implications.	Presents relevant and supported limitations and implications.	Presents limitations and implications, but they are possibly irrelevant and unsupported.

The third rubric, Integrative Learning, has one criterion that can be used for this outcome which is shown in Table 15.

Table 15: Excerpt from "Integrative Learning VALUE Rubric"

Transfer - <i>Adapts and applies skills, abilities, theories, or methodologies gained in one situation to new situations</i>	Adapts and applies, independently, skills, abilities, theories, or methodologies gained in one situation to new situations to solve difficult problems or explore complex issues in original ways.	Adapts and applies skills, abilities, theories, or methodologies gained in one situation to new situations to solve problems or explore issues.	Uses skills, abilities, theories, or methodologies gained in one situation in a new situation to contribute to understanding of problems or issues.	Uses, in a basic way, skills, abilities, theories, or methodologies gained in one situation in a new situation.
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Student Outcome d. design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives

There are two rubrics which can be used to measure various aspects of this student outcome. The first one, Creative Thinking, has three criteria that apply. Table 16 shows excerpts from the VALUE rubric.

Table 16: Excerpt from "Creative Thinking VALUE Rubric"

Solving Problems	Not only develops a logical, consistent plan to solve problem, but recognizes consequences of solution and can articulate reason for choosing solution.	Having selected from among alternatives, develops a logical, consistent plan to solve the problem.	Considers and rejects less acceptable approaches to solving problem.	Only a single approach is considered and is used to solve the problem.
Innovative Thinking <i>Novelty or uniqueness (of idea, claim, question, form, etc.)</i>	Extends a novel or unique idea, question, format, or product to create new knowledge or knowledge that crosses boundaries.	Creates a novel or unique idea, question, format, or product.	Experiments with creating a novel or unique idea, question, format, or product.	Reformulates a collection of available ideas.
Connecting, Synthesizing, Transforming	Transforms ideas or solutions into entirely new forms.	Synthesizes ideas or solutions into a coherent whole.	Connects ideas or solutions in novel ways.	Recognizes existing connections among ideas or solutions.

The second Rubric that applies is the Problem Solving Rubric. Two of the criteria apply here. Below are excerpts from the VALUE rubric.

Table 17: Excerpt from "Problem Solving VALUE Rubric"

Propose Solutions/ Hypotheses	Proposes one or more solutions/ hypotheses that indicates a deep comprehension of the problem. Solution/ hypotheses are sensitive to contextual factors as well as all of the following: ethical, logical, and cultural dimensions of the problem.	Proposes one or more solutions/ hypotheses that indicates comprehension of the problem. Solutions/ hypotheses are sensitive to contextual factors as well as the one of the following: ethical, logical, or cultural dimensions of the problem.	Proposes one solution/ hypothesis that is "off the shelf" rather than individually designed to address the specific contextual factors of the problem.	Proposes a solution/ hypothesis that is difficult to evaluate because it is vague or only indirectly addresses the problem statement.
Evaluate Potential Solutions	Evaluation of solutions is deep and elegant (for example, contains thorough and insightful explanation) and includes, deeply and thoroughly, all of the following: considers history of problem, reviews logic/ reasoning, examines feasibility of solution, and weighs impacts of solution.	Evaluation of solutions is adequate (for example, contains thorough explanation) and includes the following: considers history of problem, reviews logic/ reasoning, examines feasibility of solution, and weighs impacts of solution.	Evaluation of solutions is brief (for example, explanation lacks depth) and includes the following: considers history of problem, reviews logic/ reasoning, examines feasibility of solution, and weighs impacts of solution.	Evaluation of solutions is superficial (for example, contains cursory, surface level explanation) and includes the following: considers history of problem, reviews logic/ reasoning, examines feasibility of solution, and weighs impacts of solution.

Student Outcome f. an ability to identify, analyze, and solve broadly-defined engineering technology problems;

Problem solving is a complex skill, and several of the VALUE rubrics can contribute to its measurement. The Problem Solving VALUE rubric is an obvious choice. The criteria are:

- Define Problem
- Identify Strategies
- Propose Solutions/ Hypotheses
- Evaluate Potential Solutions
- Implement Solution
- Evaluate Outcomes

The Creative Thinking Rubric is another one that can be used in its entirety for problem solving skills. The criteria for this rubric are:

- Acquiring Competencies
- Taking Risks
- Solving Problems
- Embracing Contradictions
- Innovative Thinking
- Connecting, Synthesizing, Transforming

For the performance descriptions of the Critical Thinking rubric, please see the complete set of rubrics.

In addition to the Problem Solving and Creative Thinking rubrics, there are two criteria from the Inquiry and Analysis Rubric that apply to this outcome. Below are excerpts from the VALUE rubric.

Table 18: Excerpt from "Inquiry and Analysis VALUE Rubric"

Design Process	All elements of the methodology or theoretical framework are skillfully developed. Appropriate methodology or theoretical frameworks may be synthesized from across disciplines or from relevant sub-disciplines.	Critical elements of the methodology or theoretical framework are appropriately developed, however, more subtle elements are ignored or unaccounted for.	Critical elements of the methodology or theoretical framework are missing, incorrectly developed, or unfocused.	Inquiry design demonstrates a misunderstanding of the methodology or theoretical framework.
Analysis	Organizes and synthesizes evidence to reveal insightful patterns, differences, or similarities related to focus.	Organizes evidence to reveal important patterns, differences, or similarities related to focus.	Organizes evidence, but the organization is not effective in revealing important patterns, differences, or similarities.	Lists evidence, but it is not organized and/or is unrelated to focus.

The last rubric that applies to this outcome is the Quantitative Literacy Rubric. The one criterion that applies can be viewed in Table 19.

Table 19: Excerpt from "Quantitative Literacy VALUE Rubric"

Application / Analysis - <i>Ability to make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis</i>	Uses the quantitative analysis of data as the basis for deep and thoughtful judgments, drawing insightful, carefully qualified conclusions from this work.	Uses the quantitative analysis of data as the basis for competent judgments, drawing reasonable and appropriately qualified conclusions from this work.	Uses the quantitative analysis of data as the basis for workmanlike (without inspiration or nuance, ordinary) judgments, drawing plausible conclusions from this work.	Uses the quantitative analysis of data as the basis for tentative, basic judgments, although is hesitant or uncertain about drawing conclusions from this work.
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Implementation

All the VALUE rubrics have descriptions and suggestions for use. Through implementation of these rubrics, we are able to collect data on the achievement of outcomes. Once criteria are selected they can be applied specifically to student work. Typically, the rubrics will be applied to a course assignment, such as a particular activity, report, or presentation. They can also be used to assess a co-curricular experience, such as an internship or competition.

By using a rubric with clear performance descriptions, inter-rater reliability is improved and faculty will more accurately track improvement in student achievement which might be credited to changes in the program rather than changes in rater opinion. For example, an instructor may observe weak teamwork skills in a class one semester, and change the training students receive in conflict resolution the following semester. The instructor monitors the results using the teamwork rubric. If student performance improves, it is likely due to the change of training. Of course, improvement might be due to other factors, but by using a rubric, we lessen the chance that the improvement is due to instructor attitudes.

Twelve case studies have been conducted and are presented on the ACC&U website. The vast majority of applications are in general education. However, the College of Business of Lewis University reports using the Critical Thinking Rubric in their economics courses. Business faculty scored embedded assignments to assess student learning⁴. Other case studies describe how the VALUE rubrics were adapted to local needs.

Conclusion

The VALUE Rubrics provide a valuable resource to assess student achievement associated with general education. Several of the rubrics may be applied in whole or in part to assess student outcomes as required for ABET accreditation. The VALUE rubrics are well suited to assess professionalism skills, such as communication and societal context and some technical skills such as problem solving. They can also serve as a starting point to create new rubrics to assess other skills.

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TEAMWORK VALUE RUBRIC

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The VALUE rubrics were developed by teams of faculty experts representing colleges and universities across the United States through a process that examined many existing campus rubrics and related documents for each learning outcome and incorporated additional feedback from faculty. The rubrics articulate fundamental criteria for each learning outcome, with performance descriptors demonstrating progressively more sophisticated levels of attainment. The rubrics are intended for institutional-level use in evaluating and discussing student learning, not for grading. The core expectations articulated in all 15 of the VALUE rubrics can and should be translated into the language of individual campuses, disciplines, and even courses. The utility of the VALUE rubrics is to position learning at all undergraduate levels within a basic framework of expectations such that evidence of learning can be shared nationally through a common dialog and understanding of student success.

Definition

Teamwork is behaviors under the control of individual team members (effort they put into team tasks, their manner of interacting with others on team, and the quantity and quality of contributions they make to team discussions.)

Framing Language

Students participate on many different teams, in many different settings. For example, a given student may work on separate teams to complete a lab assignment, give an oral presentation, or complete a community service project. Furthermore, the people the student works with are likely to be different in each of these different teams. As a result, it is assumed that a work sample or collection of work that demonstrates a student's teamwork skills could include a diverse range of inputs. This rubric is designed to function across all of these different settings.

Two characteristics define the ways in which this rubric is to be used. First, the rubric is meant to assess the teamwork of an individual student, not the team as a whole. Therefore, it is possible for a student to receive high ratings, even if the team as a whole is rather flawed. Similarly, a student could receive low ratings, even if the team as a whole works fairly well. Second, this rubric is designed to measure the quality of a **process**, rather than the quality of an **end product**. As a result, work samples or collections of work will need to include some evidence of the individual's interactions within the team. The final product of the team's work (e.g., a written lab report) is insufficient, as it does not provide insight into the functioning of the team.

It is recommended that work samples or collections of work for this outcome come from one (or more) of the following three sources: (1) students' own reflections about their contribution to a team's functioning; (2) evaluation or feedback from fellow team members about students' contribution to the team's functioning; or (3) the evaluation of an outside observer regarding students' contributions to a team's functioning. These three sources differ considerably in the resource demands they place on an institution. It is recommended that institutions using this rubric consider carefully the resources they are able to allocate to the assessment of teamwork and choose a means of compiling work samples or collections of work that best suits their priorities, needs, and abilities.

TEAMWORK VALUE RUBRIC

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Definition

Teamwork is behaviors under the control of individual team members (effort they put into team tasks, their manner of interacting with others on team, and the quantity and quality of contributions they make to team discussions)

Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet benchmark (cell one) level performance.

	Capstone 4	3	Milestones 2	Benchmark 1
Contributes to Team Meetings	Helps the team move forward by articulating the merits of alternative ideas or proposals.	Offers alternative solutions or courses of action that build on the ideas of others.	Offers new suggestions to advance the work of the group.	Shares ideas but does not advance the work of the group.
Facilitates the Contributions of Team Members	Engages team members in ways that facilitate their contributions to meetings by both constructively building upon or synthesizing the contributions of others as well as noticing when someone is not participating and inviting them to engage.	Engages team members in ways that facilitate their contributions to meetings by constructively building upon or synthesizing the contributions of others.	Engages team members in ways that facilitate their contributions to meetings by restating the views of other team members and/or asking questions for clarification.	Engages team members by taking turns and listening to others without interrupting.
Individual Contributions Outside of Team Meetings	Completes all assigned tasks by deadline; work accomplished is thorough, comprehensive, and advances the project. Proactively helps other team members complete their assigned tasks to a similar level of excellence.	Completes all assigned tasks by deadline; work accomplished is thorough, comprehensive, and advances the project.	Completes all assigned tasks by deadline; work accomplished advances the project.	Completes all assigned tasks by deadline.
Fosters Constructive Team Climate	Supports a constructive team climate by doing all of the following: <ul style="list-style-type: none"> Treats team members respectfully by being polite and constructive in communication. Uses positive vocal or written tone, facial expressions, and/or body language to convey a positive attitude about the team and its work. Motivates teammates by expressing confidence about the importance of the task and the team's ability to accomplish it. Provides assistance and/or encouragement to team members. 	Supports a constructive team climate by doing any three of the following: <ul style="list-style-type: none"> Treats team members respectfully by being polite and constructive in communication. Uses positive vocal or written tone, facial expressions, and/or body language to convey a positive attitude about the team and its work. Motivates teammates by expressing confidence about the importance of the task and the team's ability to accomplish it. Provides assistance and/or encouragement to team members. 	Supports a constructive team climate by doing any two of the following: <ul style="list-style-type: none"> Treats team members respectfully by being polite and constructive in communication. Uses positive vocal or written tone, facial expressions, and/or body language to convey a positive attitude about the team and its work. Motivates teammates by expressing confidence about the importance of the task and the team's ability to accomplish it. Provides assistance and/or encouragement to team members. 	Supports a constructive team climate by doing any one of the following: <ul style="list-style-type: none"> Treats team members respectfully by being polite and constructive in communication. Uses positive vocal or written tone, facial expressions, and/or body language to convey a positive attitude about the team and its work. Motivates teammates by expressing confidence about the importance of the task and the team's ability to accomplish it. Provides assistance and/or encouragement to team members.
Responds to Conflict	Addresses destructive conflict directly and constructively, helping to manage/resolve it in a way that strengthens overall team cohesiveness and future effectiveness.	Identifies and acknowledges conflict and stays engaged with it.	Redirecting focus toward common ground, toward task at hand (away from conflict).	Passively accepts alternate viewpoints/ideas/opinions.