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Student Learning Outcomes Assessment and Curriculum Continuous Improvement Processes

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ABSTRACT

The aim is to implement an assessment process that will measure student-learning outcomes and develop a model for a continuous improvement process that will ensure student success in engineering, engineering technology and management programs. This process will include a methodology that adapts to changes in technology. It will adopt new tools and skills to improve student performance through the course and program.

This paper will specifically address the following topics

1. Implementing student learning outcomes assessment processes (course and program assessment).
2. Engaging students in problems and projects that stimulate their critical thinking and build communication and teamwork skills.
3. Implementation of curriculum continuous improvement processes that can enhance student learning outcomes in these programs.

A continuous quality improvement process and chart can be developed based on outcomes of both course- and program-level assessment. Based on this process and chart, the engineering, engineering technologies and management programs will conduct an ongoing review of both curriculum and syllabi based on the results of a course rubric indicator and implement a corrective action plan to improve the low rubric score of course tasks. Implementation of this process will provide instructors with a continuous assessment tool that can be used to check course contents, thereby indicating any new technology and teaching skills needed to enhance student performance through the course and program.

Keywords: Student Learning Outcomes Assessment, VGLU rubric indicator, continuous improvement

1. INTRODUCTION

A precise and detailed analysis of student learning outcomes assessment is developed based on the VGLU rubric score indicator. The VGLU rubric indicator can be implemented for the assessment of course and program based on ABET criteria 3. The VGLU score indicators measure the success of course objectives. The results of this process provide the instructor with a direct link to identify the weak part of the course outcomes and make the necessary changes to improve them. The program outcomes assessment is then conducted based on average VGLU score of all the courses that are offered in a given term.

This is one of several aspects of student learning outcomes assessment and curriculum change.

The course assessment template (J. Estell, 2005; H. Rahemi, and N. Seth, 2008) will include all imported data on grades on assignments and exams from an instructor's class roll-book, a course assessment table, and a student

learning outcomes assessment chart. The assessment template will facilitate the assessment process; additionally, it will provide the instructor a direct link to identify the weak part of the course outcomes and make the necessary changes to improve them.

The implementation of the curriculum improvement processes will create more vibrant undergraduate programs in engineering, engineering technology and management. The aim of the process is to improve student performance and understanding through the course and program and enhance student learning, critical thinking, communication, and teamwork skills.

2. STUDENT LEARNING OUTCOMES ASSESSMENT

A methodology for student learning outcomes evaluation and its improvement have been developed based on both course and program level assessment. Figure 1 is a graphical model of student learning outcomes methodology

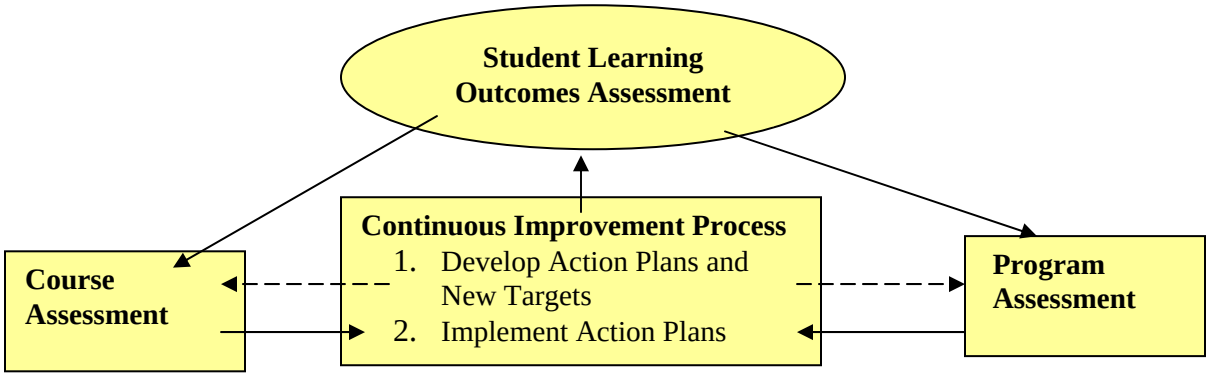


Figure 1: Student Learning Assessment Chart

A successful student learning outcomes evaluation and improvement process require the accomplishment of the following tasks by faculty members.

1. Prepare the class materials in a manner that facilitate student's understanding through the course.
2. Develop course tasks in an approach to stimulate student's critical thinking, problem solving, communication and teamwork activities.
3. Collect/grade assigned tasks and identify low, average and high achievers in the course.
4. Introduce adequate action plans that can improve learning outcomes of low achievers through the course tasks.
5. Develop a teaching strategy and adopt new tools and technology that are beneficial to all students taking the course.

The rubric indicator, VGLU, is developed to assess student-learning outcomes through the course and program based on the ABET criteria 3 (ABET- EAC, 2006-2007), (ABET-TAC, 2006-2007) program requirement. The following program outcomes (a through k) have been established to assess student's learning outcomes in Mechanical Engineering Technology Program (Vaughn College ABET Self-Study, 2007):

(a) Graduates will learn to apply knowledge of mathematics, science and engineering technology principles to analysis and design.
(b) Graduates will learn to design and conduct experiments and to analyze and interpret data with the use of computer applications current to industry.
(c) Graduates will be able to function on a multi-disciplinary team.
(d) Graduates will learn to identify, formulate, and solve problems related to engineering systems.
(e) Graduates will understand professional and ethical responsibility as they apply to engineering analysis and design.
(f) Graduates will be able to communicate effectively through oral presentation, writing and graphic communication.

(g) Graduates, through group projects and presentations, will gain the broad education necessary to understand the impact of engineering solutions in a global and societal context.
(h) Graduates will recognize the need for professional currency in their chosen profession and the need for lifelong learning.
(i) Graduates will have knowledge of contemporary issues both local and global and the impact of technology on society.
(j) Graduates will learn to use the experimental, analytical, statistical and computational tools to evaluate problems related to engineering design.
(k) Graduates will demonstrate a commitment to quality, timeliness and continuous improvement.

The indicator may also be used to assess student-learning outcomes for management programs. Those for the BS program in Airline Management (very similar to those of other management programs) are listed below:

(a) Graduates will be able to apply verbal and quantitative skills to address managerial issues.
(b) Graduates will be able to apply knowledge of basic and advanced principles of different functional areas of management.
(c) Graduates will demonstrate an appropriate mastery of issues and tools used in the airline industry.
(d) Graduates will be able to function individually and on multidisciplinary teams.
(e) Graduates will be able to communicate effectively orally and in writing.
(f) Graduates will understand professional, ethical and social responsibilities.
(g) Graduates will recognize the need for and possess the ability to pursue lifelong learning to the graduate level and beyond.
(h) Graduates will have a respect for diversity and knowledge of contemporary professional, societal and global issues.
(i) Graduates will demonstrate a commitment to quality, timeliness and continuous improvement.

The VGLU data based on rubric scores for the Vaughn College of Aeronautics and Technology are developed as follows to close the loop on the course and program assessment process.

"V = 3" Very good - Demonstrates an accurate understanding of the important concepts through the course. **V** can be used for a grade of B+ and A.
"G = 2" Good - Demonstrates a good understanding of important concepts with no significant errors – **G** can be used for a grade of C+ and B.
"L = 1" Low Performance - Demonstrates an incomplete understanding of the important concepts and has some notable misconceptions – **L** can be used for a grade of D and C.
"U = 0" Demonstrates unsatisfactory. **U** can be used for a grade of F.

The VGLU score of 1.5 is an average, representing what a student would need in order to satisfy the requirement for graduation.

COURSE ASSESSMENT

The Vaughn College faculty course assessment template (H. Rahemi and N. Seth, 2008; H. Rahemi and G. Kizner, 2007), comprises two tables and a course assessment chart and includes all important data relevant to the course to satisfy ABET criteria 3. The first table is based on student class roll-book data, which can be imported to the template from SONIS, Excel or other database management programs. This table will include grades related to the course tasks and VGLU of each course task. The second table is known as course assessment template and it will include all materials related to the faculty course assessment report. It will provide the detail of the course assessment process with an adequate corrective action plan to improve low-VGLU performance tasks. This table will also assess selected program outcomes based on assigned course tasks.

COURSE DESCRIPTION: Enter precise catalog description of the course

STUDENT CLASS ROLL-BOOK DATA: Import student class roll-book data from any data base management program.

Table 1: Student Class Roll-Book Data – EGR235 Fall 2007

Student	HW #1	HW #2	HW #3	HW #4	Quiz	Exam1 20%	Exam2 20%	Final 40%	Total	Grade
	8	10	9	10	6	60	69	68	71.50	C
	7	6	7	8	5	56	70	64	64.20	D
	8	8	9	7	6	60	62	60	64.40	D
	-	8	9	8	8	40	76	72	69.50	C
	10	9	10	9	7	83	90	76	82.70	B
	10	10	10	10	9	88	96	87	91.80	A
	8	9	10	10	9	88	64	78	80.30	B
	8	9	8	8	6	65	66	76	72.60	C
VGLU	**(2410)**	**(5210)**	**(6110)**	**(4310)**	**(2150)**	**(2141)**	**(2150)**	**(1340)**		
Score	**2.14**	**2.50**	**2.63**	**2.38**	**1.63**	**1.50**	**1.63**	**1.63**		

2.1.3 COURSE ASSESSMENT TEMPLATE

This template provides details of the course assessment process with corrective action plan to improve the low VGLU performance tasks.

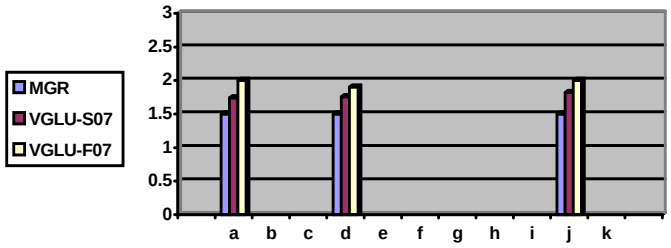
Table 2: Course Assessment Template

Course Outcomes	**Course Performance Tasks**	**VGLU Score for Selected Program Outcomes** **A**	**D**	**J**	**Action Plan**
CO-1: Understand concepts of the six major material groups and their characteristic properties with emphasis on their use in the aircraft design process.	HW#1	2.14		2.14	
CO-2: Understand some of the basic concepts of atomic structure, internal bonding, unit cell systems and the development of crystal systems.	HW#2 Quiz#1	2.50 1.63	 1.63	2.50 1.63	**1**
CO-3: Understand some of the important concepts of mechanical properties, such as, stress, strain, elastic modulus, shear modulus, modulus of resilience and fracture toughness.	HW#3 Exam#1	2.63 1.50	2.63	2.63 1.50	**2 & 3**
CO-4: Understand concepts of fracture mechanics and survey types of material failure.	Hw#4	2.38	2.38	2.38	
CO-5: Development of a criterion for the material selection	Exam#2	1.63		1.63	**3**
CO-6: Study of composite material and their application.	Final	1.63	1.63	1.63	
Outcome's VGLU Score		**2.00**	**2.06**	**2.00**	

Corrective action plans: (1) Referred low performing students to the tutoring center
(2) Assigned mentors to help low performing students
(3) Used office hours to add an hour of problem solving and exam preparation sessions prior to each exam

2.1.4 COURSE ASSESSMENT CHART

A chart can be developed based on the course assessment template to assess the student learning performance thorough the course for selected program outcome



The Blue bars represent the MGR=1.5, minimum VGLU requirement for the graduation. The red and yellow bars represent respectively what the actual course VGLU was for2007 and Fall 2007

Figure 2: Program Learning Outcomes

PROGRAM ASSESSMENT

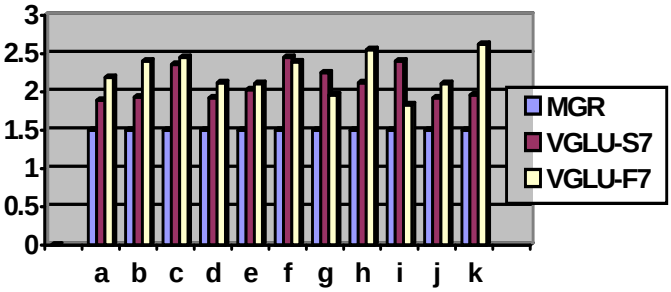
As a direct measure, all courses offered in a given term are used to assess program outcomes performance. The program evaluator (department head or program coordinator) then determined what learning outcomes are not being adequately achieved and provides adequate action plans to improve them. Instructors use those suggestions and take proper actions to implement them through their courses.

Table 3: Mechanical Engineering Technology Program Learning Outcomes Assessment

Course	a	b	c	d	e	f	g	h	i	j	k	Shortfall in Learning Outcomes
CDE117-11 Solid Edge	2.78	2.78	2.78			2.78		2.78				
CDE385-01 CATIA I		1.96	1.76	2.17		2.02		2.01		2.01		K
CDE385-10 CATIA I		2.20	2.34	2.36		2.67		2.20		2.20		K
DP409 Degree Project	2.33	2.67		2.33	2.67	2.83		2.67		2.33	2.67	
EGR115-1 Eng. Mech. I	1.91			1.86						1.86		
EGR210-01 Thermo	1.69			1.69						1.69		
EGR215-1 Eng. Mech. II	1.77			1.80						1.80		
EGR220-01 Str. of Mat.	2.00			1.95						1.96		
EGR220L-01 Mat.-LAB	2.56		2.56			2.56					2.56	
EGR235-01 Material Sci.	2.00			1.90						2.00		
EGR340-01 Comp. Met.	2.22		2.08	2.22		2.08				2.50		
EGR345-01 Fluid Mech.	2.25			2.16						2.21		
EGR440-01 Heat Tran.	2.53			2.49						2.52		F
HIS141 Global Civ. II					1.61		1.61		1.61			
MAT115 Pre-Calculus	1.61			1.61								
MAT120 Calculus I	1.51			1.51								J
ENG110 English 1						1.68	1.68					
ENG120 English II						2.48	2.48					
Physics 120 Physics I	2.86		2.86	2.86				2.86				J
Physics 220 Physics II	2.76		2.76	2.76				2.76				J
POL254 American Gov.					2.05		2.05		2.05			
VGLU Average	**2.19**	**2.40**	**2.45**	**2.12**	**2.11**	**2.39**	**1.96**	**2.55**	**1.83**	**2.11**	**2.62**	

2.3.1 PROGRAM ASSESSMENT CHART

A chart is developed based on overall VGLU average score to assess program student learning outcomes for Spring 2007 and Fall2007.



The blue bars (**MGR**) represent the minimum VGLU score (VGLU = 1.5) for the graduation requirement and the red and yellow bars respectively represent what the program actually achieved in Spring 2007 and Fall 2007.

Figure 3: Program Learning Outcomes Evaluation for BS Mechanical Engineering Technology.

2.3.2 PROGRAM OBJECTIVES ASSESSMENT

Program Educational Objectives (PEO) For the BS Mechanical Engineering Technology were developed to satisfy program outcomes which describe what students are expected to know and be able to do by the time of graduation. Students are expected to

1. possess a strong foundation and knowledge in mathematics, basic science, and fundamentals of mechanical engineering technology.
2. be proficient in analytical skills and modern tools used in the mechanical engineering technology fields
3. develop mechanical engineering technology component and systems utilizing experimental and analytical tools
4. have mastery in communication and teamwork skills to work within and lead multi-disciplinary teams
5. conduct themselves in a socially responsible manner and adapt to local and global changes with the understanding of the need for continuous improvement and lifelong learning

Table 4: Relationship of Program Objectives to VGLU Score of Program Outcomes

Program Objectives	a	b	c	d	e	f	g	h	i	j	k	Average Outcomes
Objective 1	2.19			2.12						2.11		2.14
Objective 2		2.40		2.12						2.11		2.21
Objective 3		2.40								2.11		2.26
Objective 4			2.45		2.11	2.39	1.96					2.21
Objective 5					2.11	2.39	1.96	2.55	1.83		2.62	2.24

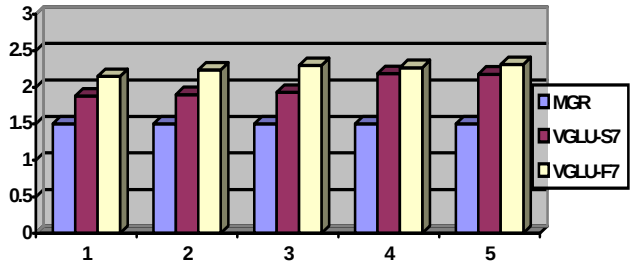


Figure 4: Program Objectives Evaluation, BS Mechanical Engineering Technology

2.4 CURRICULUM ANALYSIS AND CONTINUOUS IMPROVEMENT PROCESSES

A continuous quality improvement process for both Mechanical Engineering Technology and Management programs is in place, based on an ongoing course and program assessment process that continuously changes with changes in technology and adopts new tools and skills to improve students' performance in courses and programs. Program evaluators will address any shortfall in program outcomes with suggestions for improvement to the Student Learning Outcomes (SLO) committee. The SLO committee, after reviewing those suggestions, provides an action plan and directs instructors to take necessary actions through the course tasks to improve those learning outcomes that have not been satisfactorily achieved.

A continuous quality improvement process chart can be developed based on both course and program level assessment results. Based on this chart, the Engineering Technologies and Management departments will conduct an ongoing review of both curriculum and syllabi based on the VGLU results of course and program. Instructors are required to develop and implement the corrective action plan to improve the low VGLU results of course tasks. Implementation of this chart will provide program evaluators as well as instructors with dynamic assessment tools that can be used to check program and course contents and adopt new technology and teaching skills to enhance student performance through the course and program

Management programs at Vaughn College follow the requirements of the International Assembly for Collegiate Business Education (IACBE). IACBE is a strong advocate of course and program assessment based on achievement of outcomes. This assessment then forms the basis of closing the loop based on improvements indicated by that process (Vaughn College, IACBE Self Study, 2007).

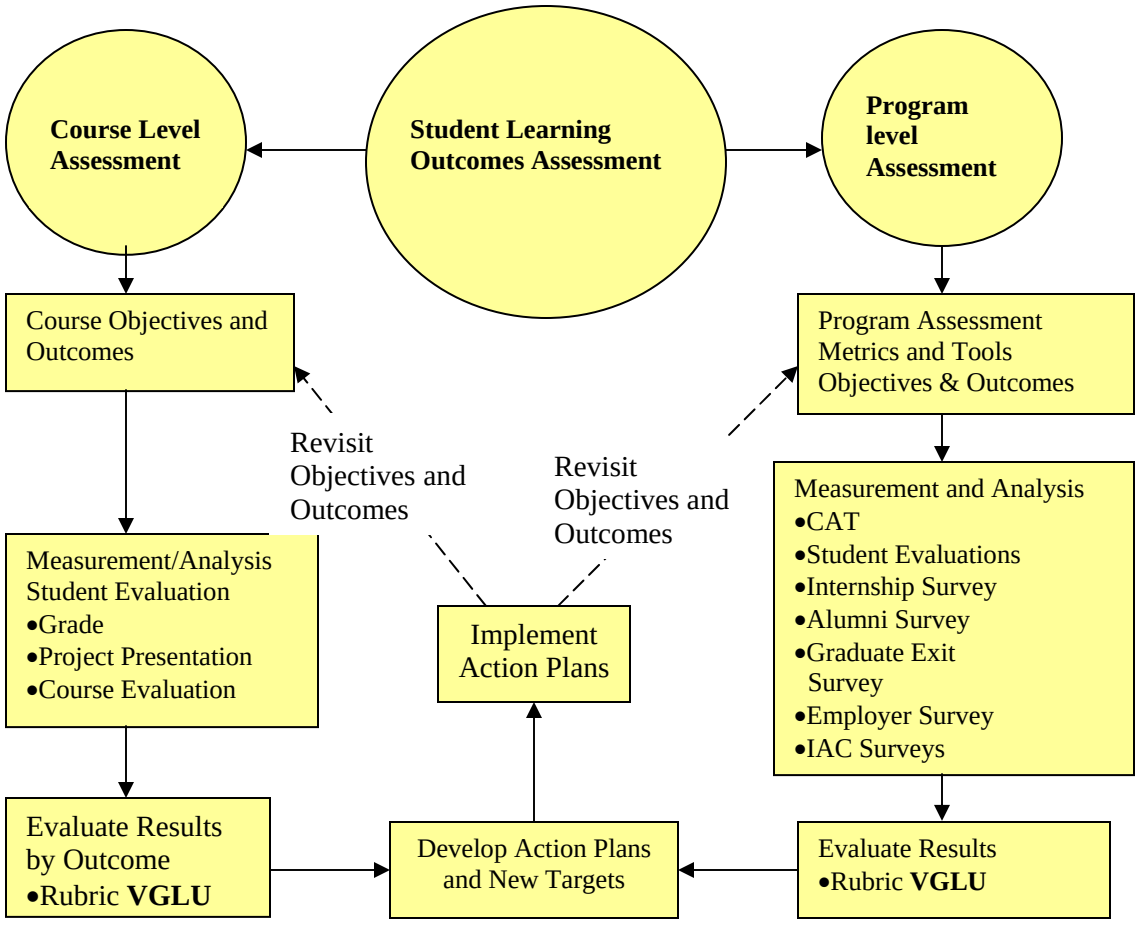


Figure 5: Student Learning Outcomes Assessment and Curriculum Continuoues Improvement Process

3. CONCLUTION

The Engineering, Engineering Technologies and Management Departments will conduct an ongoing review of both curriculum and syllabi based on the VGLU results of CAT. This review is conducted based on the analysis of course and program assessment to ensure improvement in student learning outcomes.

This report provides an in-depth analysis of how well the "Department Outcomes" are implemented through the program. The Outcome Evaluation chart is a graphical representation of how success in achieving the Course Objectives relates to the Department Outcomes.

The course assessment implementation based on VGLU indicator can help faculty members improve their course outcomes performance by adding necessary changes to the course. Low VGLU score tasks alert the instructor to take adequate actions to improve the student learning outcomes in future tasks.

The recommendation and action plans that the program evaluator introduces to address shortfalls in program outcomes is essential to the successful implementation of all programs. For example, the mechanical engineering technology program incorporated MATLAB programming into two engineering courses EGR340 (Computational Method in Engineering) and EGR370 (Engineering Analysis-FEA) by adding a half-hour lab to each to teach and prepare students for programming. These changes to the courses enhance students' critical thinking and problem solving skills through the program.

In summary, the required changes based on recommendations of program evaluators and SLO committee and the implementation of instructors' modifications to the course are expected to produce the following results

1. The program evaluator's recommendation will help instructors to improve their course outcomes by adopting the necessary changes to the course in an approach to stimulate students' critical thinking, problem solving, communication and teamwork and other learning outcomes through the program.
2. The suggested corrective actions by instructor will result in a teaching strategy that is beneficial to all level of students through the course.
3. The process provides a direct link between course learning outcomes and program learning outcomes as one aspect of curriculum change and improvement.

4. REFERRENCE

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