

Outcome Based Education (OBE)

Outcome Based Assessment (OBA)

and

Taxonomy of Learning Domains

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Why This Briefing?

- PEC is a member of **WA (Washington Accord)**
 - The **Washington Accord** is an international accreditation agreement for professional engineering academic degrees, between the bodies responsible for accreditation in its signatory countries.
- Requirement by WA is a practicing **Outcome-Based Education (OBE)**.

<https://www.ieagreements.org/accords/washington/>



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Qualifications accredited or recognized by other signatories are recognised by each signatory as being substantially equivalent to accredited or recognised qualifications within its own jurisdiction.

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- **Sri Lanka** - Represented by Institution of Engineers Sri Lanka (IESL) (2014)
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- **India** - Represented by National Board of Accreditation (NBA) (2014)
- **United States** - Represented by Accreditation Board for Engineering and Technology (ABET) (1989)
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- **Costa Rica** - Represented by Colegio Federado de Ingenieros y de Arquitectos de Costa Rica (CFIA) (2020)
- **Pakistan** - Represented by Pakistan Engineering Council (PEC) (2017)
- **Peru** - Represented by Instituto de Calidad y Acreditacion de Programas de Computacion, Ingenieria y Tecnologia (ICACIT) (2018)

PROVISIONAL SIGNATORIES ARE RECOGNISED AS HAVING APPROPRIATE SYSTEMS AND PROCESSES IN PLACE TO DEVELOP TOWARDS BECOMING A FULL SIGNATORY

- **Chile** - Represented by Agencia Acreditadora Colegio De Ingenieros De Chile S A (ACREDITA CI)
Provisional Status Approved in 2018.
- **Thailand** - Represented by Council of Engineers Thailand (COET)
Provisional Status Approved in 2019.
- **Bangladesh** - Represented by The Institution of Engineers Bangladesh (IEB)
Provisional Status Approved in 2016.
- **Mexico** - Represented by Consejo de Acreditación de la Enseñanza de la Ingeniería (CACEI)
Provisional Status Approved in 2016.
- **Philippines** - Represented by Philippine Technological Council (PTC)
Provisional Status Approved in 2016.
- **Myanmar** - Represented by Myanmar Engineering Council (MEngC)
Provisional Status Approved in 2019.

What Is Outcome Based Engineering Education?

**IT'S NOT WHAT WE TEACH,
IT'S WHAT YOU LEARN**



Outcome-Based Education (OBE)

- OBE is an educational process that focuses on what students **can do** or the **qualities** they should develop after they are taught.
- OBE involves the restructuring of curriculum, assessment and reporting practices in education to reflect the achievement of **capabilities** or **qualities** rather than accumulation of course credits.
- It requires that the students demonstrate that they have learnt the required skills and content (quantitatively).



Focus and Benefits of OBE

- **OBE addresses the following key questions:**
 - **What** do we want the students to have or be able to do?
 - **How** can we best help students achieve it?
 - **How** will we know whether the students have achieved it?
 - **How** do we close the loop for further improvement (Continuous Quality Improvement (CQI))?
- **Benefits of OBE:**
 - More directed & coherent curriculum.
 - Well-rounded graduates who will be more “relevant” to industry & other stakeholders
 - Continuous Quality Improvement (CQI) is in place.



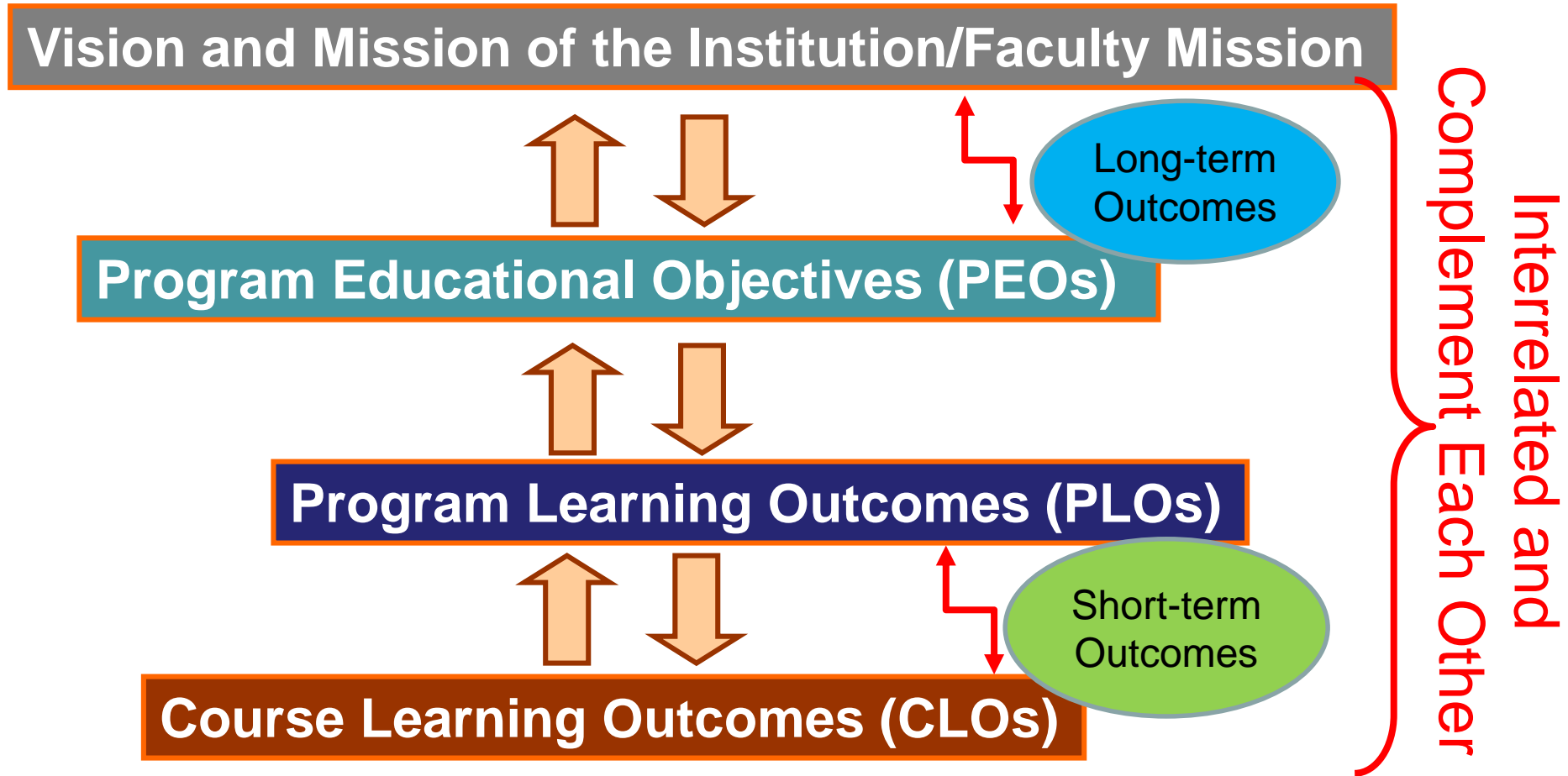
9 Criteria of OBE-based Accreditation

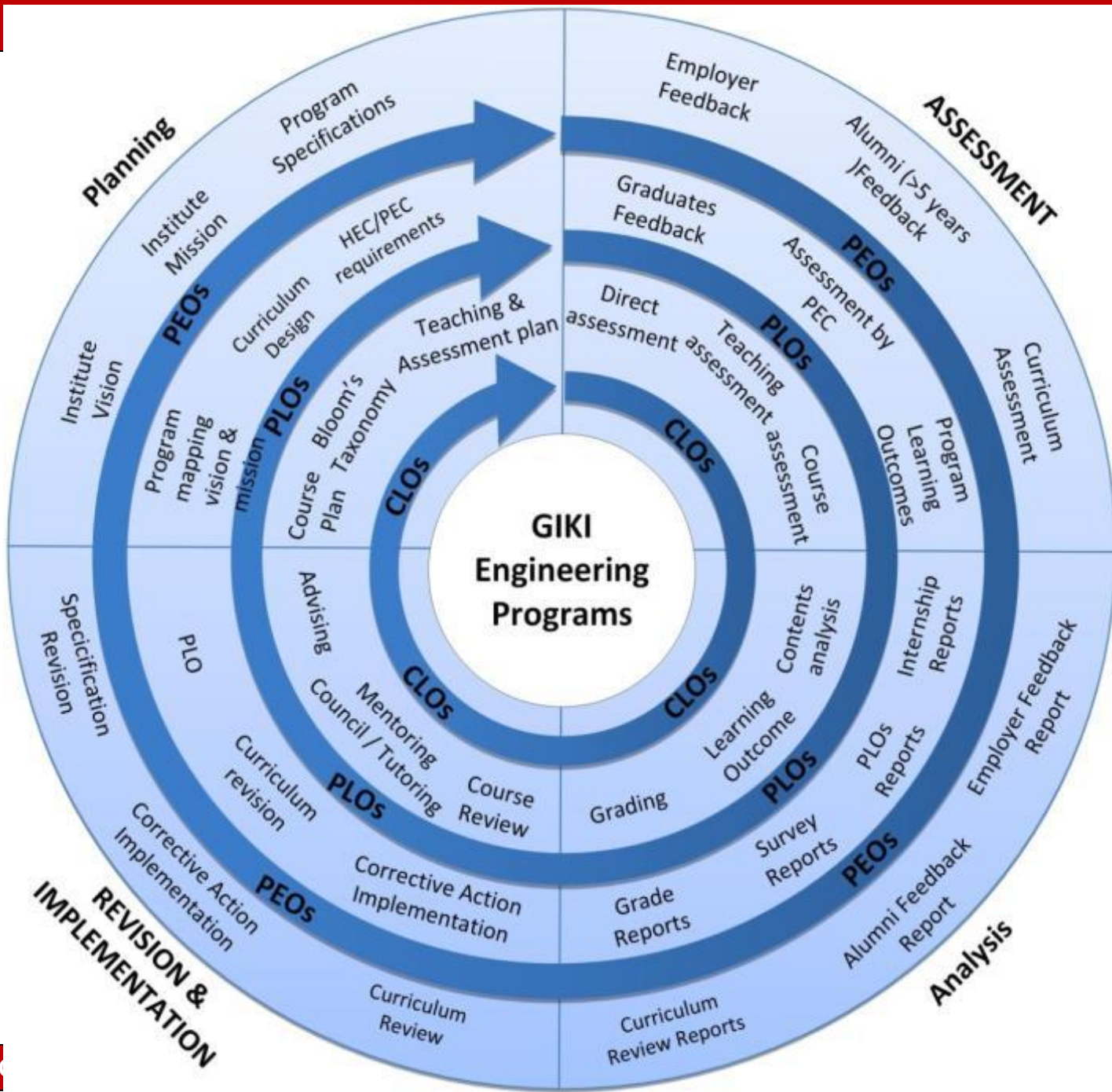
1. Criterion 1: Program Educational Objectives (PEOs)
2. Criterion 2: Program Learning Outcomes (PLOs)
3. Criterion 3: Curriculum and Learning Process
4. Criterion 4: Students
5. Criterion 5: Faculty and Support Staff
6. Criterion 6: Facilities and Infrastructure
7. Criterion 7: Institutional Support and Financial Resources
8. Criterion 8: Continuous Quality Improvement
9. Criterion 9: Industrial Linkages

<https://www.pec.org.pk/Downloadables/Accreditation/PEC%20OBA-Manual%202014.pdf>



A Model Hierarchy of Outcomes





Continuous Quality Improvement (CQI) Process



GIK Institute's Vision and Mission

Vision

The Institute aspires for the leadership role in pursuit of excellence in engineering, sciences and technology.

Mission

The Institute is to provide excellent teaching and research environment to produce graduates who distinguish themselves by their professional competence, research, entrepreneurship, humanistic outlook, ethical rectitude, pragmatic approach to problem solving, managerial skills and ability to respond to the challenge of socio-economic development to serve as the vanguard of techno-industrial transformation of the society.



Faculty Mission

Faculty of Engineering Sciences

To produce capable engineers working as responsible global citizens, future leaders of society and leading practitioners of Engineering Sciences.



Program Educational Objectives

Faculty of Engineering Sciences

Program Educational Objectives		
PEO 1	Competent and Multifaceted Engineers	Graduates having a <u>strong scientific foundation</u> practicing as competent, <u>continuously developing engineers</u> in Engineering Sciences related fields.
PEO 2	Professionalism and Leadership	Graduates providing <u>leadership in their organizational and technical capacities</u> , working whether as an individual or as part of a team.
PEO 3	Broader Perspective	Graduates acting as <u>ethical and responsible professionals</u> providing solutions <u>with due consideration to economic, environmental and safety impacts of their work on society.</u>

Table 0-1: Program Education Objectives (PEOs)



The 12 PLOs

Faculty of Engineering Sciences

1. *Engineering Knowledge*
2. *Problem Analysis*
3. *Design/Development of Solutions*
4. *Investigation*
5. *Modern Tool Usage*
6. *The Engineer and Society*
7. *Environment and Sustainability*
8. *Ethics*
9. *Individual and Teamwork*
10. *Communication*
11. *Project Management*
12. *Lifelong Learning*

Graduates must meet all 12 PLOs (attributes)

<https://www.pec.org.pk/Downloadables/Accreditation/PEC%20OBA-Manual%202014.pdf>



The 12 PLOs

Faculty of Engineering Sciences

- 1. GA1 Engineering Knowledge:** An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
- 2. GA2 Problem Analysis:** An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
- 3. GA3 Design/Development of Solutions:** An ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

<https://www.pec.org.pk/Downloadables/Accreditation/PEC%20OBA-Manual%202014.pdf>



The 12 PLOs

Faculty of Engineering Sciences

4. **GA4 Investigation:** An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
5. **GA5 Modern Tool Usage:** An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations
6. **The Engineer and Society:** An ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.



The 12 PLOs

Faculty of Engineering Sciences

7. **GA7 Environment and Sustainability:** An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
8. **GA8 Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
9. **GA9 Individual and Teamwork:** An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.

<https://www.pec.org.pk/Downloadables/Accreditation/PEC%20OBA-Manual%202014.pdf>



The 12 PLOs

Faculty of Engineering Sciences

- 10. GA10 Communication:** An ability to communicate effectively, orally as well as in writing, on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11. GA11 Project Management:** An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
- 12. GA12 Lifelong Learning:** An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

<https://www.pec.org.pk/Downloadables/Accreditation/PEC%20OBA-Manual%202014.pdf>



FES PEOs, PLOs mapping

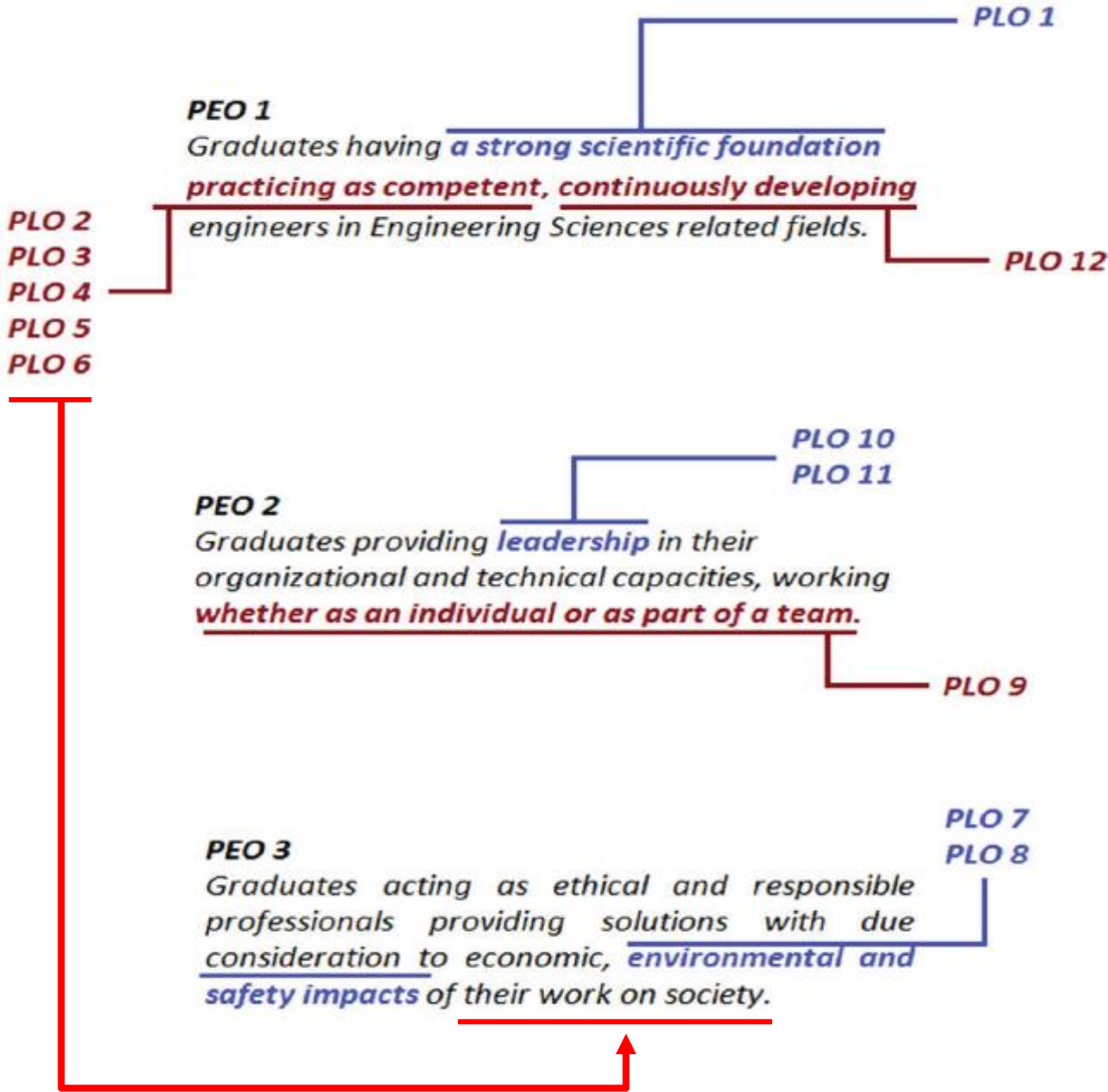




Figure 2-1: PEOs encompass with the Graduate Attributes





Course Learning Outcomes (CLOs): Learning Domains


Taxonomy of Learning - A brief introduction - Editor (Roland E. Pittman)


- 

1. **Cognitive** 
Bloom's Model

Skills in the **cognitive domain** revolve around knowledge, comprehension, and critical thinking on a particular topic
- 

2. **Affective** 
Krathwohl and Bloom's Model

Skills in the **affective domain** describe the way people react emotionally and their ability to feel other living things' pain or joy.
- 

3. **Psychomotor** 
Simpson's Model

Skills in the **psychomotor domain** describe the ability to physically manipulate a tool or instrument like a hand or a hammer.

cog·ni·tive

BrE /ˈkɒɡnətɪv/ ⓘ

NAme /ˈkɑːɡnətɪv/ ⓘ

adjective

WORD ORIGIN

EXAMPLE BANK

[usually before noun]

connected with mental processes of understanding

- ◆ a child's cognitive development
- ◆ cognitive psychology

af·fec·tive ^{AW}

BrE /əˈfektɪv/ ⓘ

NAme /əˈfektɪv/ ⓘ

adjective

WORD ORIGIN

(technical)

- ◆ connected with emotions and attitudes
- ◆ affective disorders

psy·cho·met·ric

BrE /ˌsaɪkəˈmetrɪk/ ⓘ

NAme /ˌsaɪkəˈmetrɪk/ ⓘ

adjective

[only before noun] (technical)

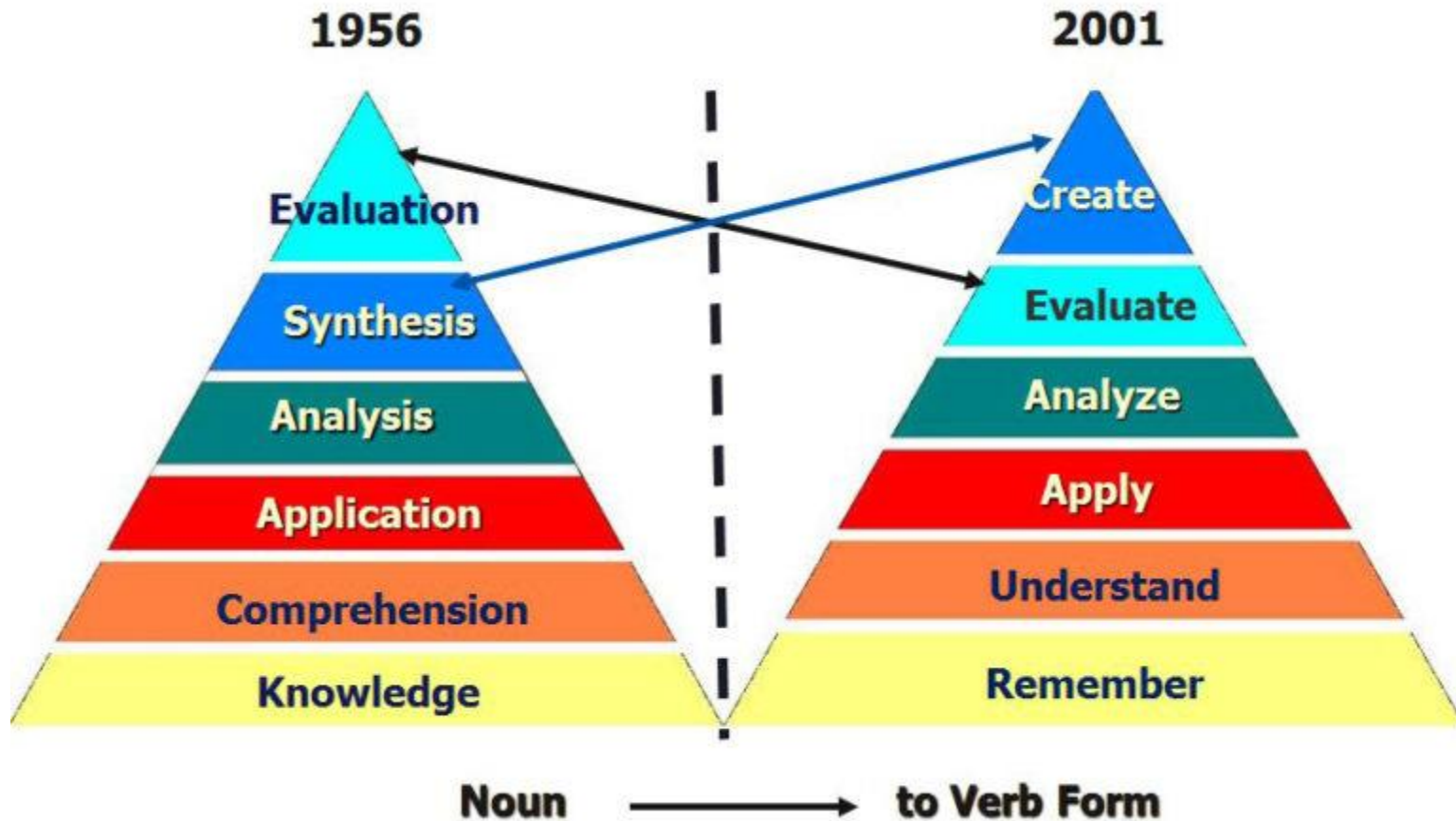
used for measuring mental abilities and processes

- ◆ psychometric testing

Learning Domains: Cognitive Domain Levels

Bloom's Taxonomy

Krathwohl Taxonomy



<https://thesecondprinciple.com/essential-teaching-skills/blooms-taxonomy-revised/>



Learning Domains: Cognitive Domain Levels

Courses

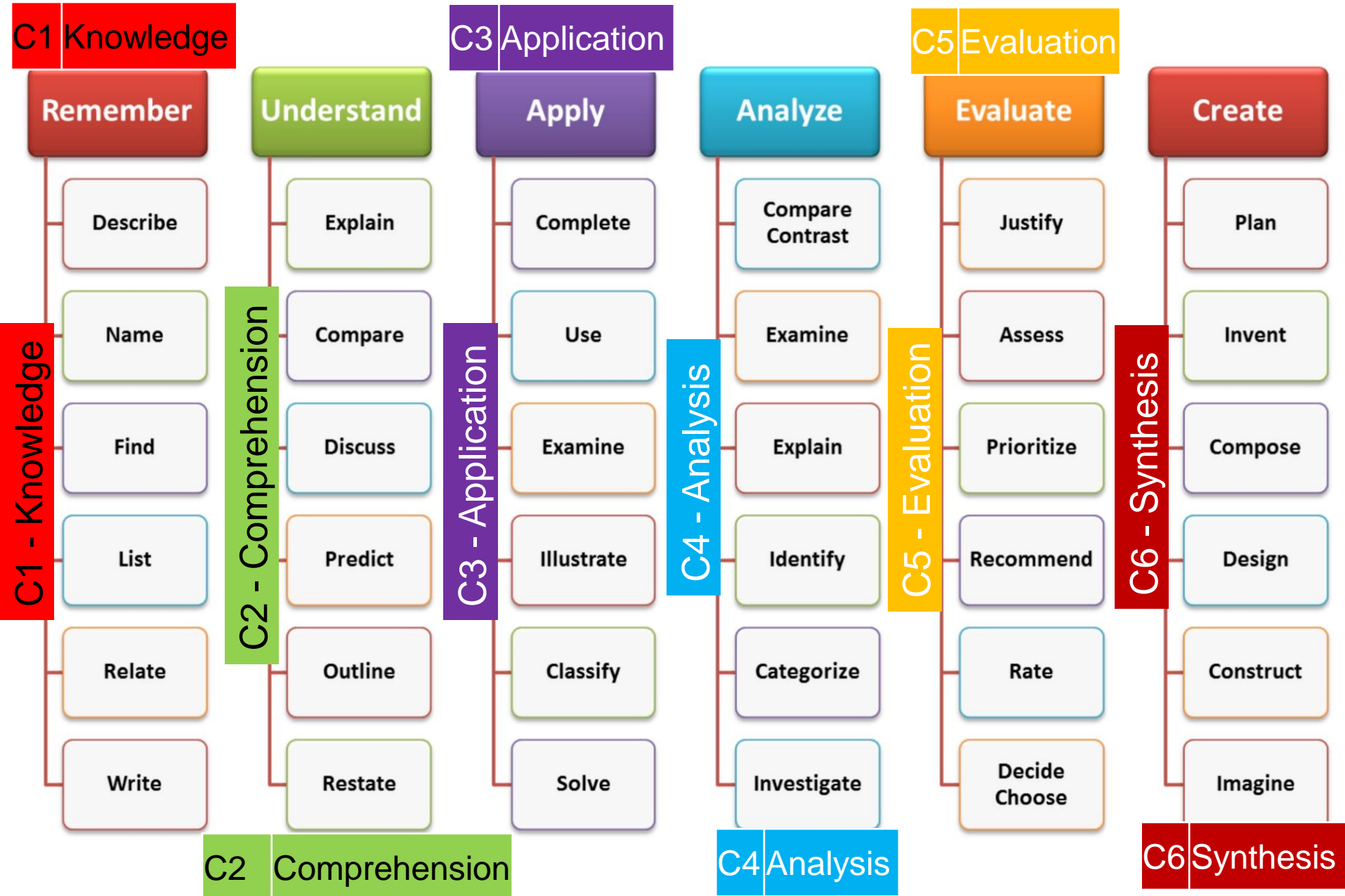
C1 Knowledge	Exhibit memory of learned materials by recalling facts, terms, basic concepts and answers
C2 Comprehension	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating the main ideas
C3 Application	Using acquired knowledge. Solve problems in new situations by applying acquired knowledge, facts, techniques and rules in a different way
C4 Analysis	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations
C5 Evaluation	Present and defend opinions by making judgments about information, validity of ideas or quality of work based on a set of criteria
C6 Synthesis	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions

<http://www.teacherprofiles.co.uk/uploads/documents/originals/Bloom's%20Taxonomy.pdf>

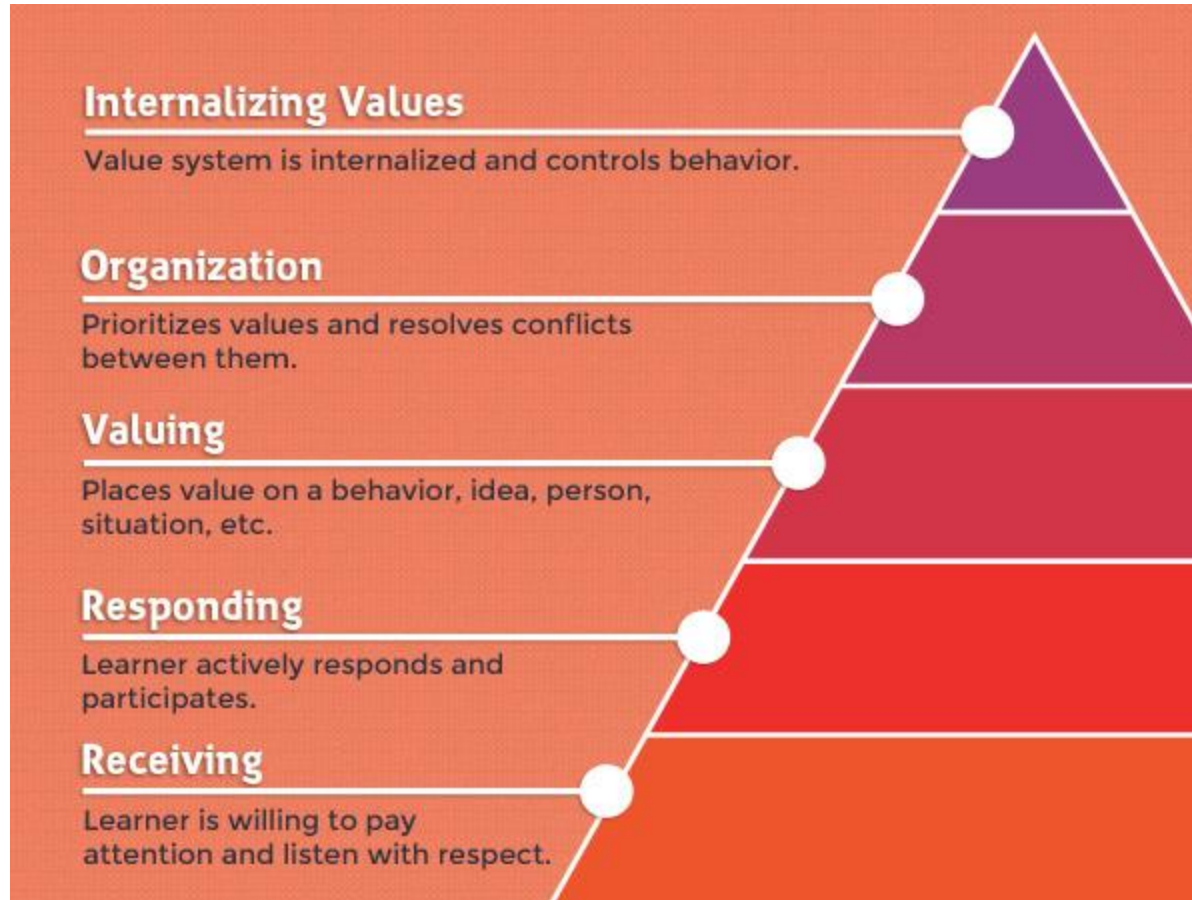
https://www.apu.edu/live_data/files/333/blooms_taxonomy_action_verbs.pdf



Bloom's Taxonomy – Cognitive (Sample Verbs)



Learning Domains: Affective Domain levels



<https://www.vectorsolutions.com/resources/blogs/teaching-attitudes-the-affective-domain-of-learning-and-learning-objectives/>



Lea BLOOM'S AFFECTIVE TAXONOMY

rels

DOES THE STUDENT ACT CONSISTENTLY WITH THE NEW VALUE?

Concerned with **PATTERNS OF ADJUSTMENT**
Act, Discriminate, Display, Influence, Internalize, Listen, Modify, Perform, Practice, Propose, Qualify, Question, Revise, Serve, Solve, Use, Verify

CHARACTERIZATION BY VALUE

WHAT IS THE AFFECTIVE DOMAIN?
Includes behaviors indicating attitudes, awareness, attention, concern, interest, and responsibility. Often assessed by ability to listen and respond in the environment and by attitudes and values appropriate for the field of study.

HAS THE STUDENT COMBINED AND CONCEPTUALIZED A NEW VALUE GIVING IT PRIORITY?

Concerned with the development of a **PHILOSOPHY OF LIFE**
Adhere, Alter, Arrange, Codify, Combine, Compare, Defend, Discriminate, Display, Explain, Generalize, Identify, Integrate, Modify, Order, Organize, Prepare, Relate, Systemize, Weigh

ORGANIZATION

DOES THE STUDENT SHOW INVOLVEMENT & COMMITMENT?

Concerned with **ATTITUDES & APPRECIATION**
Accept, Complete, Defend, Describe, Devote, Differentiate, Explain, Follow, Form, Initiate, Invite, Join, Justify, Propose, Pursue, Read, Report, Seek, Select, Share, Study, Work

VALUING

CAN THE STUDENT SHOW A NEW BEHAVIOR DUE TO AN EXPERIENCE?

Concerned with **INTEREST, SEEKING, & ENJOYMENT**
Answer, Assist, Complete, Comply, Conform, Cooperate, Discuss, Examine, Greet, Help, Label, Obey, Perform, Practice, Present, Read, Recite, Report, Respond, Select, Tell, Write

RESPONDING

IS THE STUDENT AWARE OF OR RESPONDING TO THE ENVIRONMENT?

Concerned with **SIMPLE AWARENESS & SELECTIVE ATTENTION**
Accept, Ask, Attend, Choose, Describe, Develop, Follow, Give, Hold, Identify, Locate, Name, Point to, Recognize, Select, Sit Erect, Reply, Use

RECEIVING

<https://lynnleasphd.com/2018/08/23/krathwohl-and-blooms-affective-taxonomy/>



Learning Domains: Psychomotor Domain levels

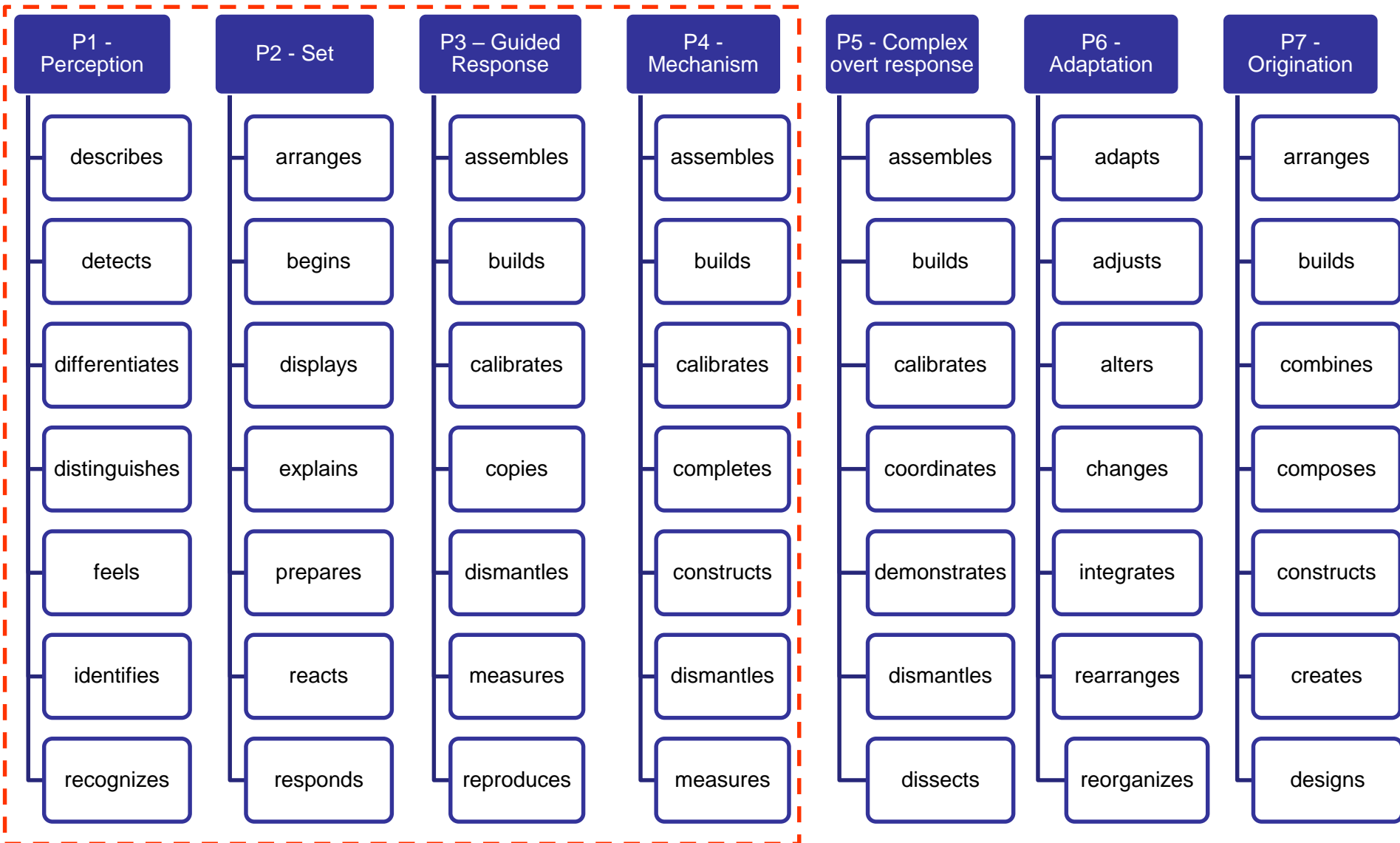
<https://www.sun.ac.za/english/learning-teaching/ctl/Documents/Summary%20of%20all%20domains.pdf>

Labs	P1	Perception	The ability to use sensory cues to guide motor activity. <u>Examples: Detects non-verbal communication cues.</u>
	P2	Set	Readiness to act. <u>Examples: Knows and acts upon a sequence of steps in a manufacturing process.</u> Recognize one's abilities and limitations
	P3	Guided response	The early stages in learning a complex skill that includes imitation and trial and error. <u>Examples: Performs a mathematical equation as demonstrated</u>
	P4	Mechanism	This is the intermediate stage in learning a complex skill. <u>Examples: Use a personal computer. Repair a leaking tap. Drive a car.</u>
	P5	Complex overt response	The skillful performance of motor acts that involve complex movement patterns. <u>Examples: Maneuvers a car into a tight parallel parking spot. Operates a computer quickly and accurately.</u>
	P6	Adaptation	Skills are well developed and the individual can modify movement patterns to fit special requirements. <u>Examples: Responds effectively to unexpected experiences.</u>
	P7	Origination	Creating new movement patterns to fit a particular situation or specific problem. <u>Examples: Constructs a new theory. Develops a new and comprehensive training programming</u>



Psychomotor (Sample Verbs)

<https://www.sun.ac.za/english/learning-teaching/ctl/Documents/Summary%20of%20all%20domains.pdf>



Labs

Sample Mapping of Courses to PLOs

Annex D – Mapping of Courses on PLOs, learning domains and taxonomy levels

Nomenclature used in this table: The value in any cell in the following table contains a combination of capital letters and numerals. Capital letters indicate the learning domain, i.e. C= Cognitive, P= Psychomotor and A= Affective, and the numbers indicate the Bloom's taxonomy level for the nomenclature, i.e. C331 in column 1 for CS101 indicates that this course is only mapped to PLO 1, and the two CLOs for this course are mapped to Cognitive level 3, whereas one CLO is mapped to Cognitive level 1.

Semester No.	Course Code	Engineering Courses Course Title	Learning Domains and Taxonomy Levels												
			1	2	3	4	5	6	7	8	9	10	11	12	
1	CH101	Chemistry for Engineers							C34						
	CH161	Occupational Health and Safety							C34						
	CS101	Introduction to Computing	C331												
	CS101L	Computing Lab	P333												
	HM101	English Language and Communication Skills											A2C33		
	ME101	Workshop Practice													
	MT101	Calculus I	C333												
	PH101	Mechanics	C333												
	PH101L	Mechanics Lab	P333												

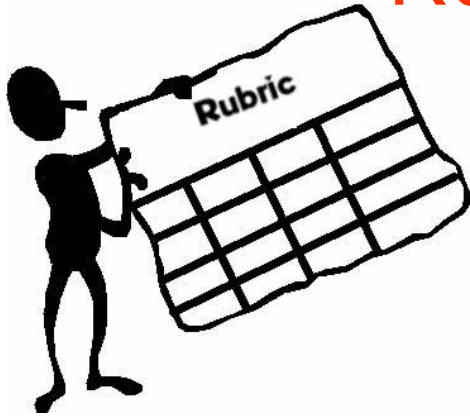


Supporting Components in OBE

- Open-ended Labs (more on these in upcoming talks)
- Complex Engineering Problems (more on these in upcoming talks)
- Rubric-based assessment
- Participation of faculty and staff in OBE



Rubrics-based assessment



There are three common types of rubrics:

- Analytic Rubrics
- Developmental Rubrics
- Holistic Rubrics

CLOs	PLOs	Taxonomy Level	Excellent	Good	Satisfactory	Poor	Score
			7.5-5.0	4.9-2.5	2.4-0.1	0	
CLO2	PLO4	P-3 (Guided Response)	Student can independently perform thermal characterization	Student can perform thermal characterization with minimal help	Student can perform thermal characterization with some help	Student cannot perform thermal characterization	
CLO3	PLO8	A-3 (Valuing)	Student followed all lab protocols completely	Student followed some lab protocols	Student barely followed lab protocols	Student did not follow lab protocols	
Total score in Lab							/15



Participation of faculty and staff in OBE

- Ownership of the OBE-based system by the faculty and staff (if any component of OBE fails, the entire faculty/staff fails).
- Submission of course/lab files on due time (at the end of each semester).
- Compilation of data by OBE sub-teams on time (such as meeting minutes, CQI cycles etc.)



Feel free to contact:
OBE Coordinator
HoD/Dean
Batch Advisor
Course Instructors

Thank you
for listening

