แนวคิดการศึกษาที่เน้นผลการเรียนรู้แบบ
OBE : Outcome - based Education

22-23 March 2019

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School of Liberal Arts
King Mongkut’s University of Technology Thonburi

ASEAN University Network

Education Quality International
Quality Education Quality Life

1st AUN-QA Workshop
Applied Approach to Designing and Implementing OBE Framework

Bangkok, Thailand
23 – 26 January 2018

Facilitated by:
Mr. Johnson Ong Chee Bin (AUN-QA Expert)
Founder & Principal Consultant (eqi)

Workshop Goals

At the end of the workshop, participants will be able to:

- Review and revise your Programme Learning Outcomes (PLOs), Course Learning Outcomes (CLOs), Lessons Learning Outcomes
- Design Learning and Teaching Activities
- Develop Learning Outcomes Assessment Tools

Changing Educational Landscape

Five global mega trends shaping the future

Rapid urbanisation

Demographic and social change

Climate change and resource scarcity

Shift in global economic power

Technological breakthroughs

Expected increase in global food demand by 2030[1]

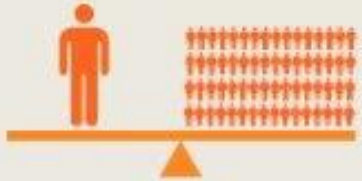
2030

We predict that seven of the world's biggest 12 economies in 2030 will come from emerging markets, the 'E7'[2]

Years taken for telephone to reach half of US households; the smartphone in under ten[3]

50% of the world's population growth between now and 2050 is expected to come from Africa[4]

1.5 million people are added to the global urban population every week[5]



The world's **85** richest people own as much wealth today as the poorest **3.5 billion**[6]

2015

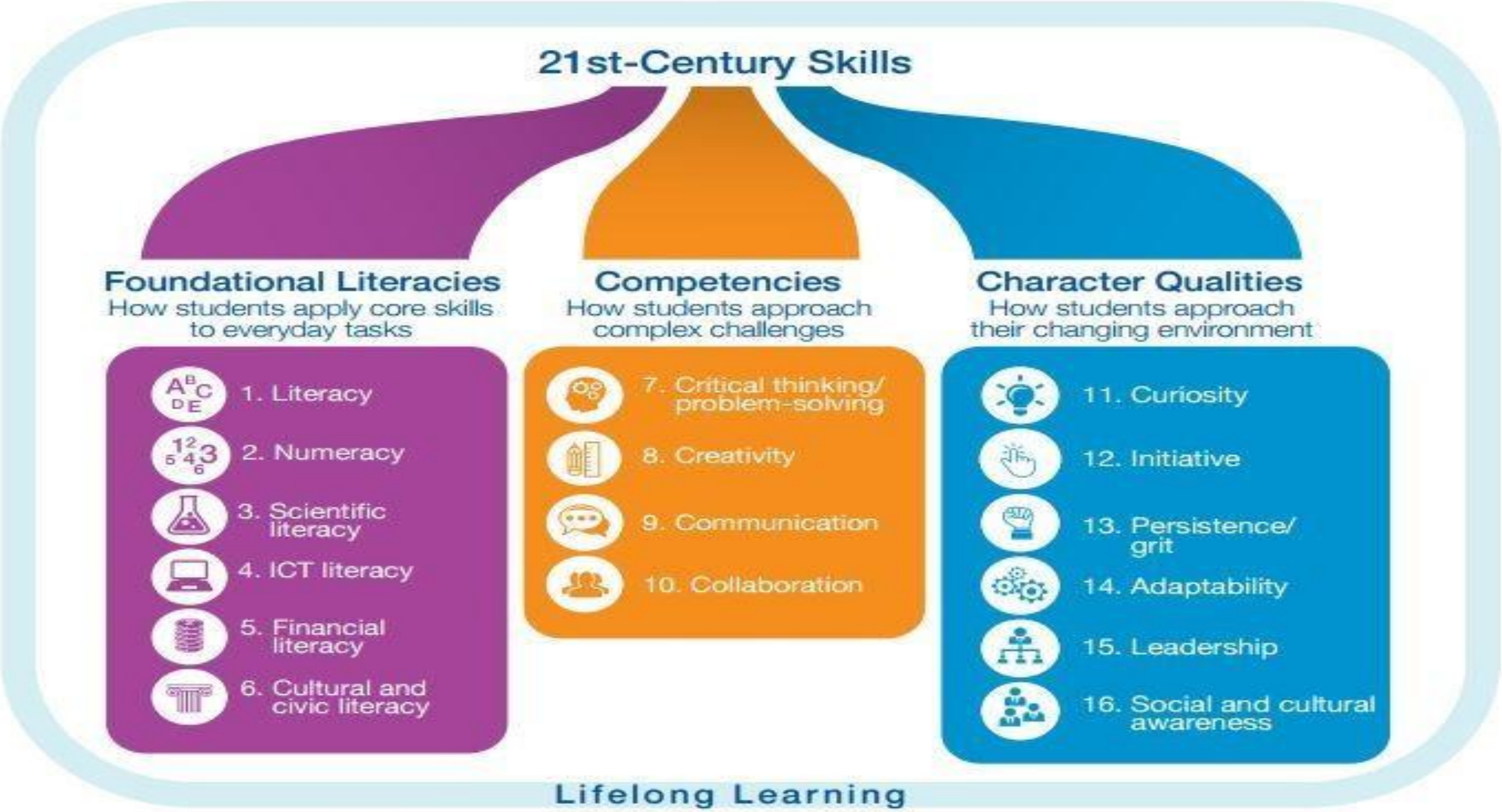
In 2015 the size of the middle class in Asia Pacific is expected to overtake Europe and North America combined[7]

50% of global GDP is generated by the 300 largest metropolitan areas[8]

Around half of US jobs are at risk of being computerised over the next two decades[9]

source: PwC via @mikequindazzi

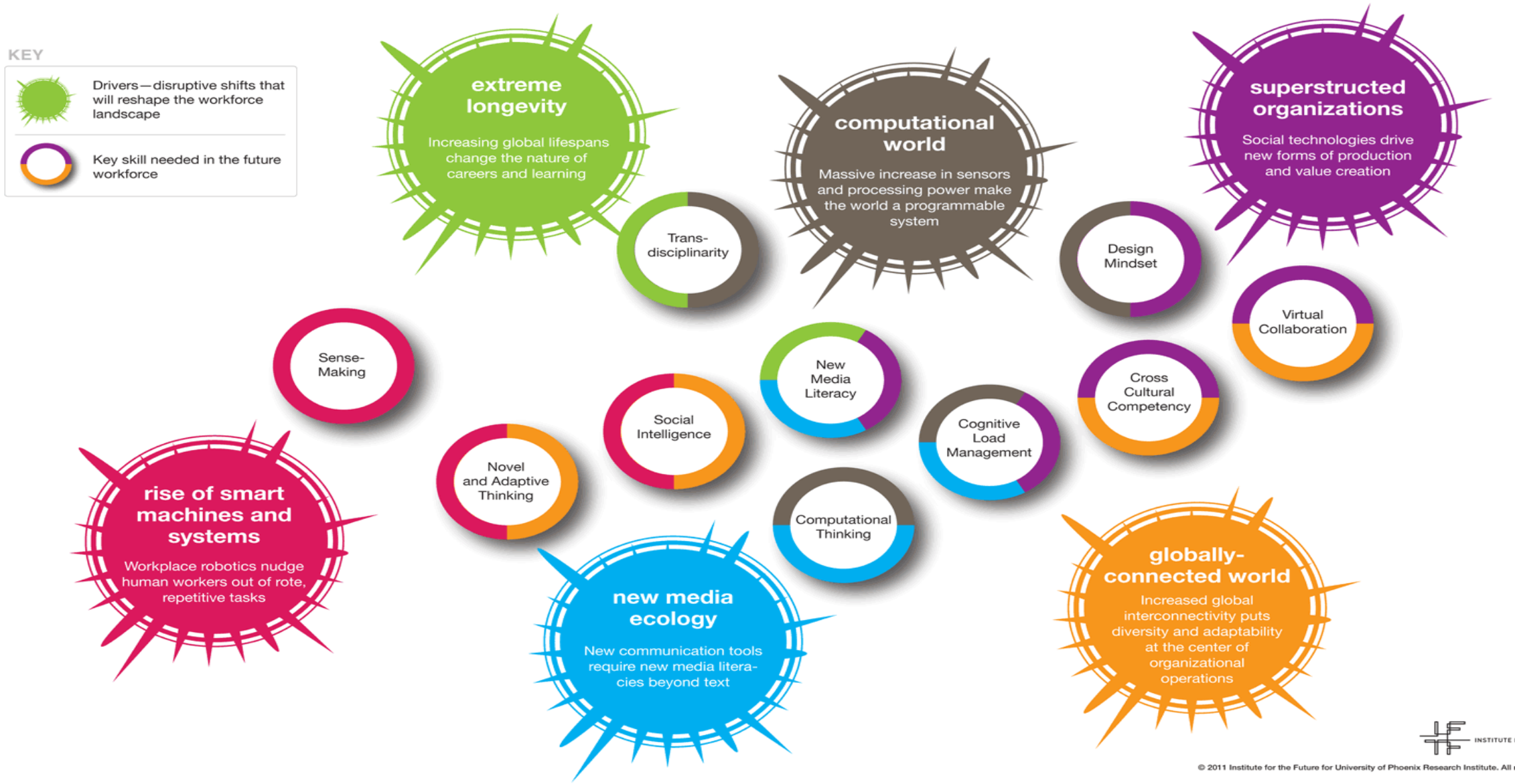
Exhibit 1: Students require 16 skills for the 21st century



Note: ICT stands for information and communications technology.

Future Work Skills 2020

While all six drivers are important in shaping the landscape in which each skill emerges, the color-coding and placement here indicate which drivers have particular relevance to the development of each of the skills.



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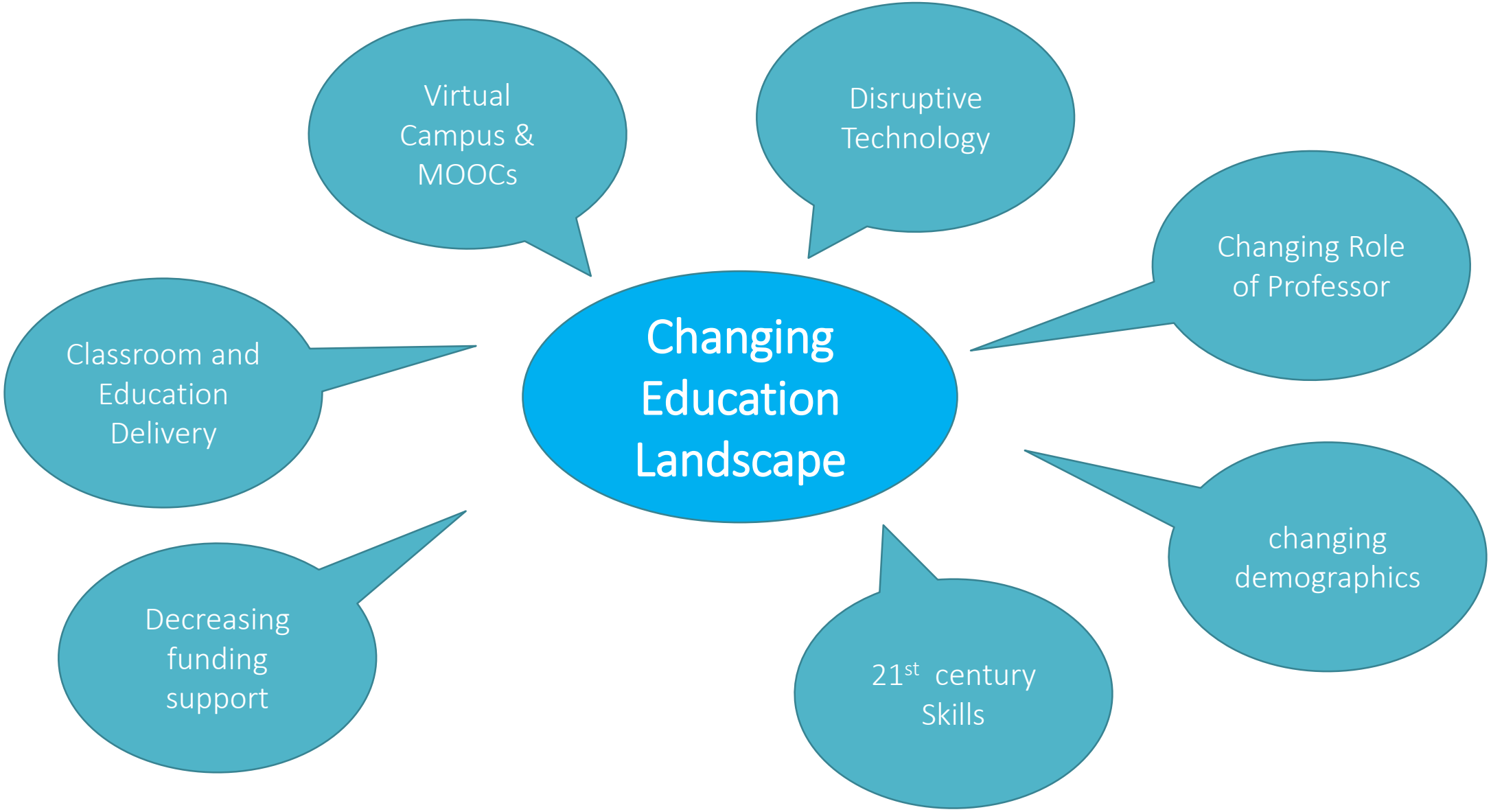
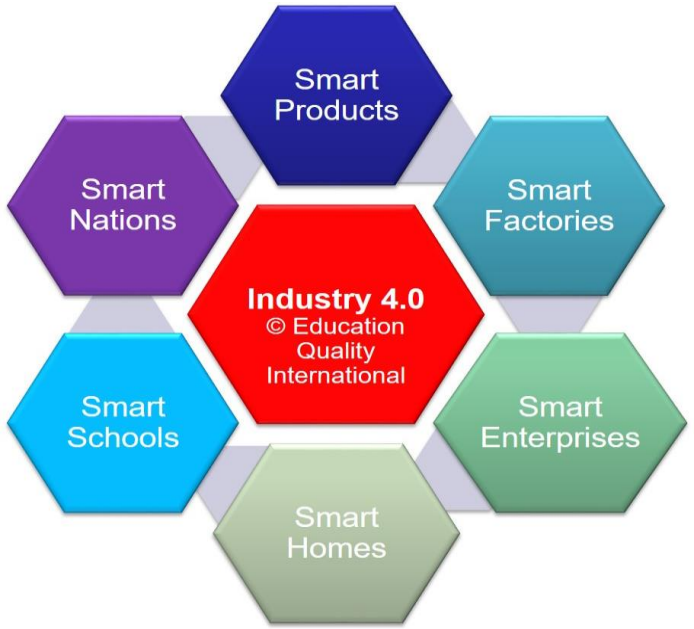
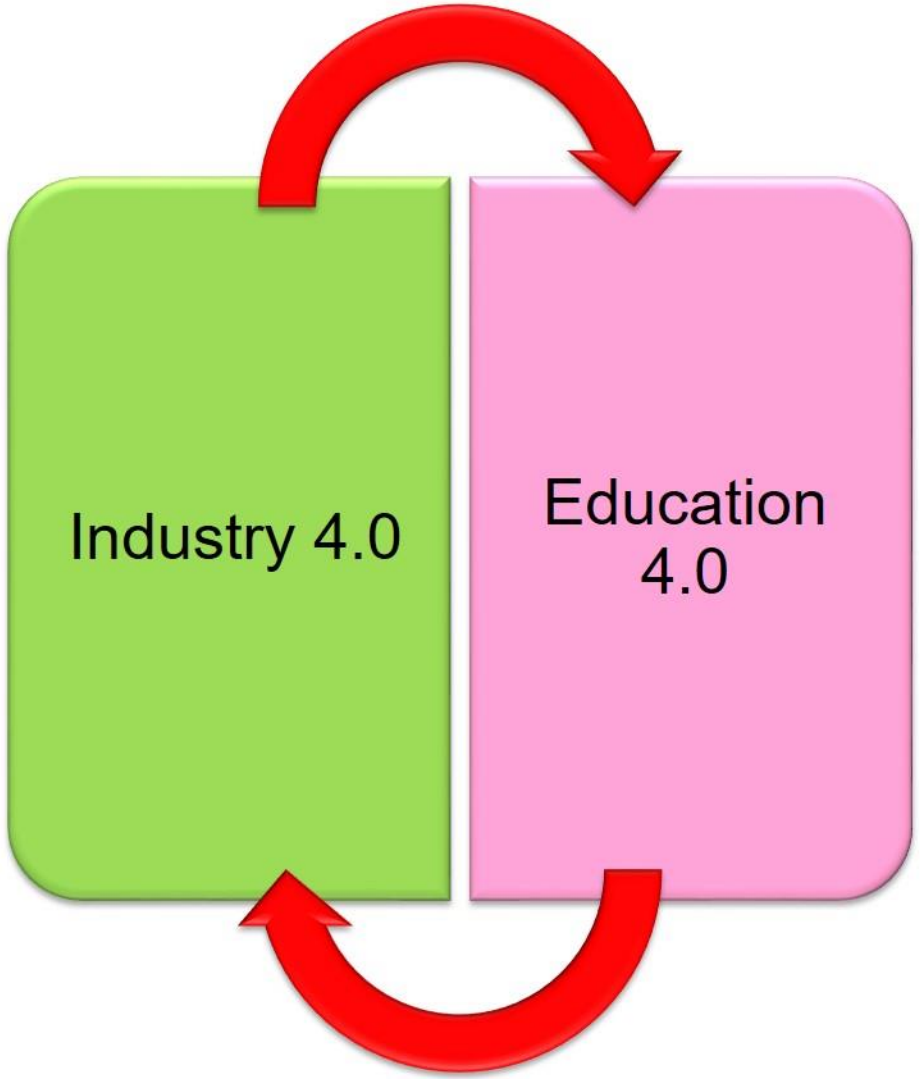
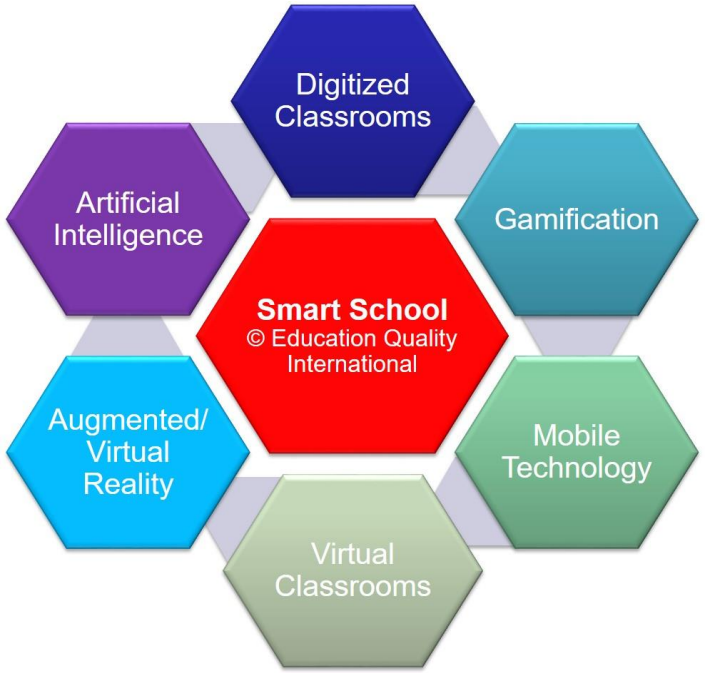

Changing Education Landscape
Virtual Campus & MOOCs
Disruptive Technology
Changing Role of Professor
Classroom and Education Delivery
Decreasing funding support
21st century Skills
changing demographics

Education 4.0







Education 4.0 relates education as ubiquitous where people, things and machines are connected to produce personalised learning. This new ecosystem transforms education institution into an innovation-producing ecosystem.

OBE & AUN QA

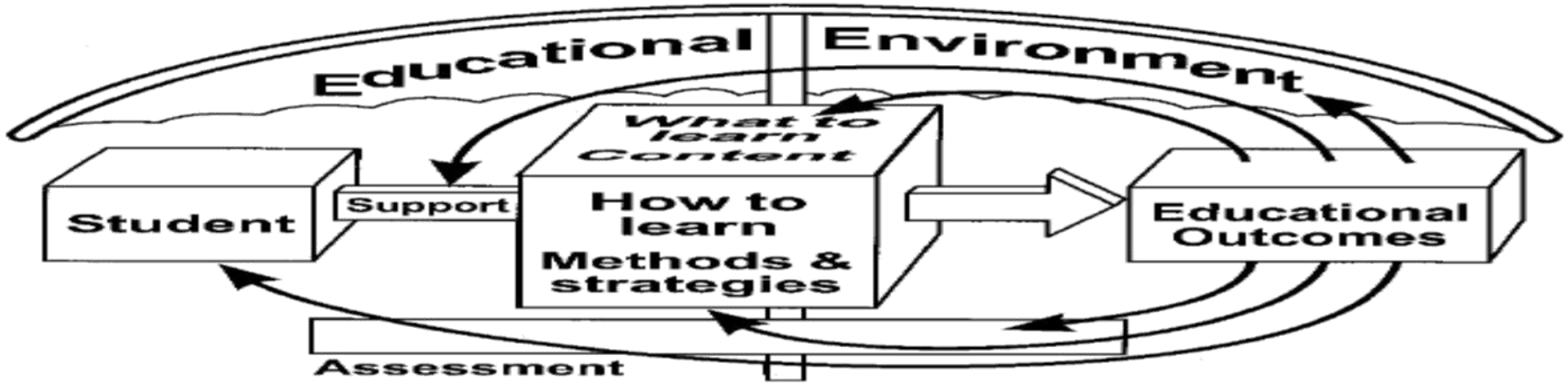
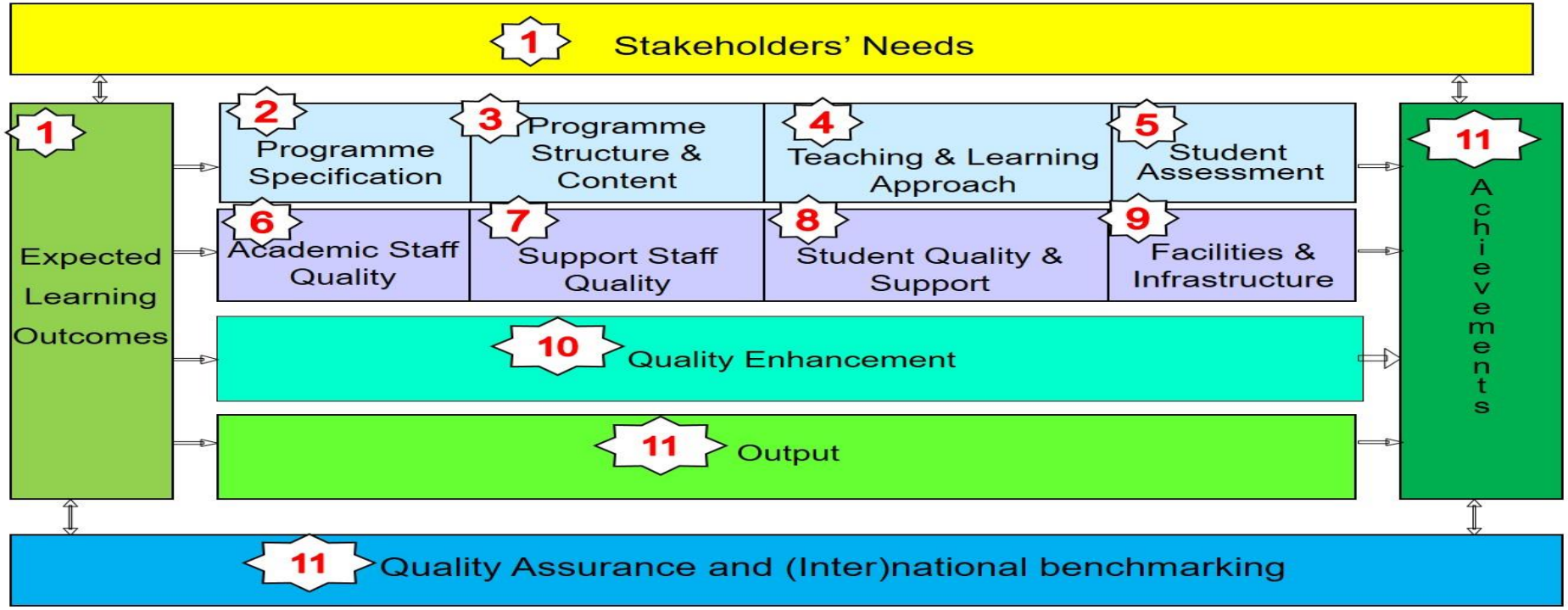


Figure 1. A model for the curriculum emphasising the importance of educational outcomes in curriculum planning.

Source: Harden (1986)

OBE



AUN-QA

Stakeholders’ Needs and Engagement

Identify stakeholders

Key Stakeholders: those who can significantly influence or are important to the success of programme

.....

.....

.....

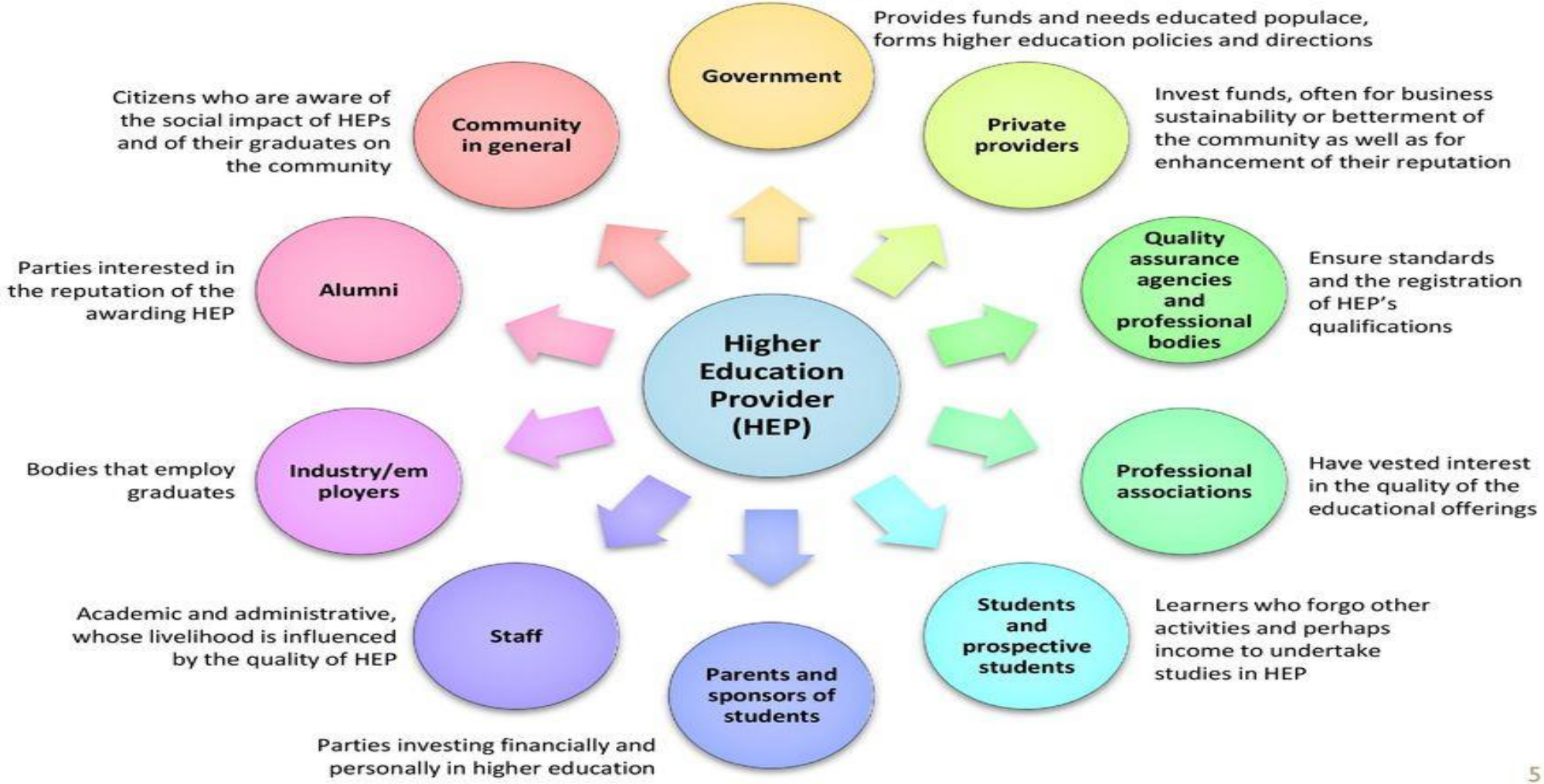
.....

Centre for Quality Assurance

Universiti Kebangsaan Malaysia

Quality drives innovation

Stakeholders of Higher Education



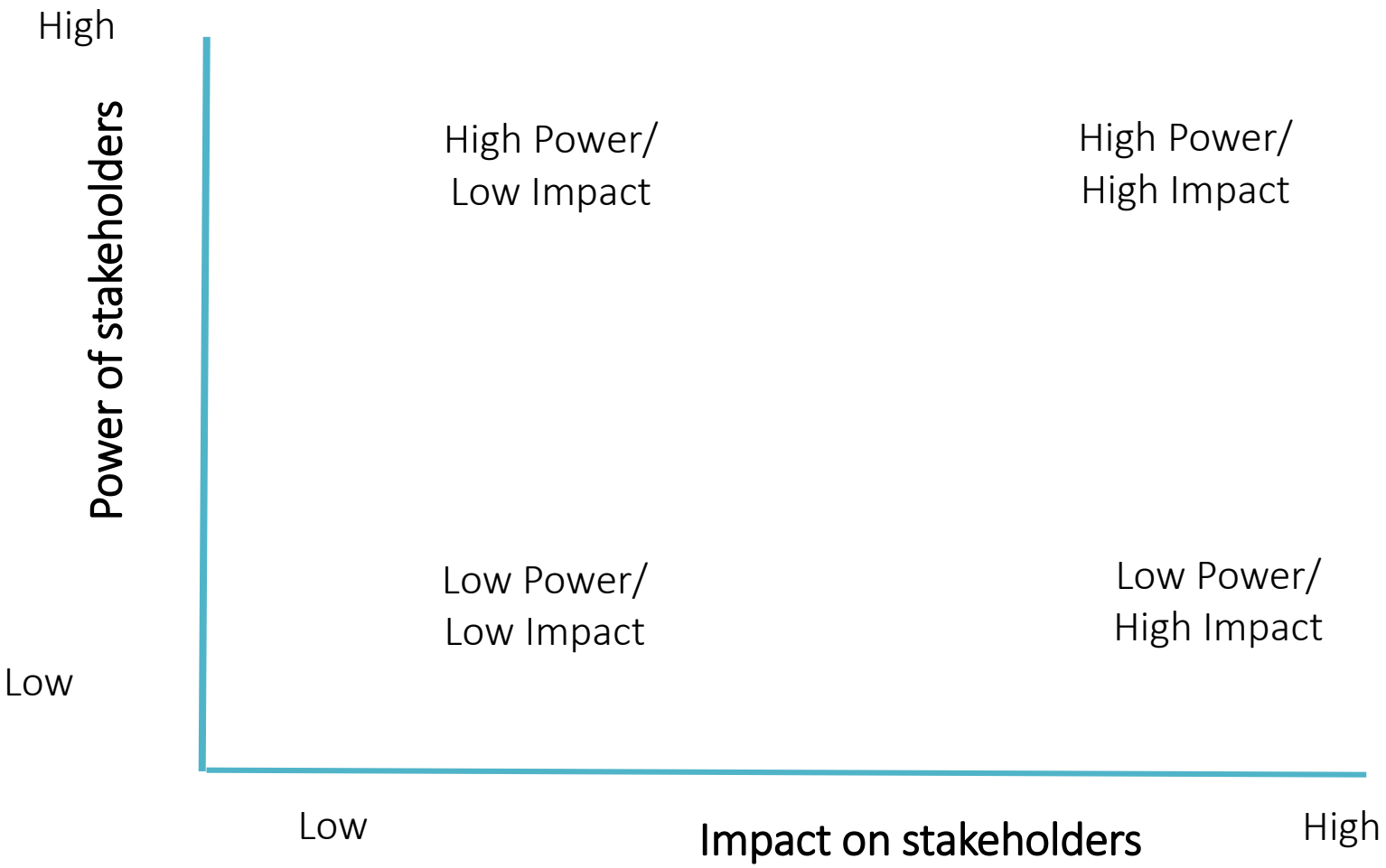
Plan – Stakeholders' Needs Analysis

Curriculum is important to …	Because they have a right to …
Students and their families	… a curriculum that will provide them with life opportunities.
Teachers	… contribute to a process in which they are among the acknowledged experts, and to know what is expected of them and their students.
Employers	… know that students are being prepared to enter the world of work.
Tertiary education institutions	… know that students are well prepared for post-school study.
Communities	… know that students will be aware of their social and community responsibilities.
Governments	… know that schools are contributing to the development of a national consensus on economic, political and social goals such as equity, inclusion and sustainable development.

Source: "What Makes a Quality Curriculum", UNESCO IBE, 2016

Plan – Stakeholders' Needs Analysis

Types of Stakeholder	
Subject matter Experts	Representatives of the professional regulatory body, subject specialists
Learners	Current and past students
Teachers	Educators, faculty members
Society	Employers, service personnel, community members, political leaders, labour organisations
Curriculum specialists	Curriculum design experts



Power: Stakeholders that have power to influence changes or decisions
Impact: Stakeholders that are affected by the changes or decisions.

Engagement Strategies

Engagement Strategies	Notify	Inform
Level of Engagement	- Untargeted publicity - Information made available	- Stakeholders are regularly and reliably informed
Roles of Stakeholders	- Passive recipients of information	- Passive recipients of contextualised information - Dialogue with stakeholders is implicitly welcomed but not explicitly invited
Engagement Tools	- Website - University documents (e.g. Annual reports, brochures, bulletin, emails etc.)	- Briefings - Regular blogs - Targeted letters - Emails

Adapted by Bartholomew, P., Freeman R (2009, 2010) as part of T-SPARC at Birmingham City University from 'Levels of learner voice participation' in 'Rudd, T., Colligan, F. and Naik, R. (2006) "Learner Voice: a handbook from Futurelab". Bristol, Futurelab.

Engagement Strategies

Engagement Strategies	Consult	Involve
Level of Engagement	- Obtain views from stakeholders - Stakeholders receive feedback on decisions taken	- Work with stakeholders throughout decision making process to ensure views are understood and taken into consideration
Roles of Stakeholders	- Stakeholders as respondents - Dialogue/consultation partners	- Stakeholders as partners - Stakeholders participation/appointment in some activities
Engagement Tools	- Surveys or polls - Interviews - Focus groups - Consultation workshops	- Workshops - Open interviews - Joint consultations - Active focus groups - Voting

Adapted by Bartholomew, P., Freeman R (2009, 2010) as part of T-SPARC at Birmingham City University from 'Levels of learner voice participation' in 'Rudd, T., Colligan, F. and Naik, R. (2006) "Learner Voice: a handbook from Futurelab". Bristol, Futurelab.

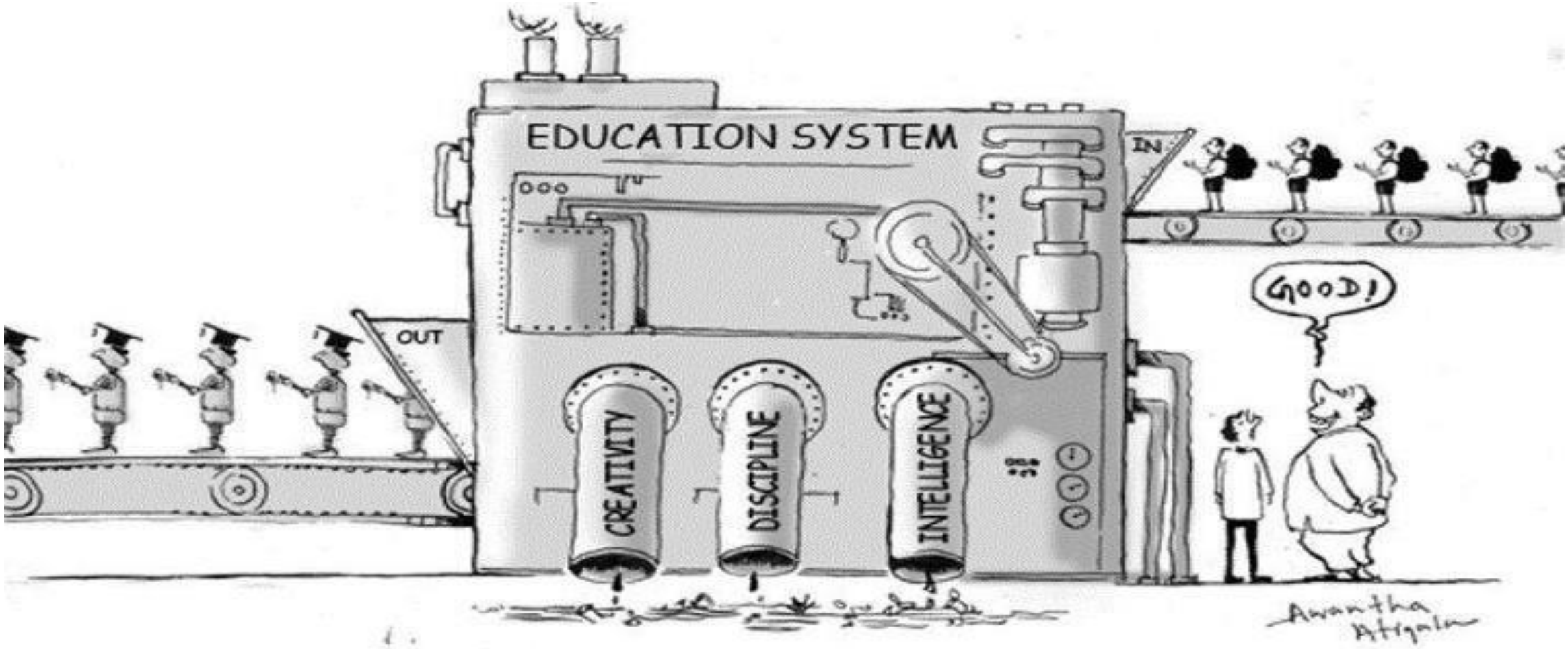
Engagement Strategies

Engagement Strategies	Collaborate	Empower
Level of Engagement	- Decisions are undertaken in partnership with stakeholders	- Stakeholders set agenda for change - Self-organisation and management responsibilities
Roles of Stakeholders	- Stakeholders as collaborators - Stakeholders in management committees - Stakeholders interest groups - Stakeholders shape policies	- Stakeholders as designers/managers of resources, policies, events, learning - Stakeholder managers
Engagement Tools	- Stakeholder-led consultations/interviews - Open forums - Joint retreats	- Agenda setting - Stakeholders manage programmes, consultation activities and tools development

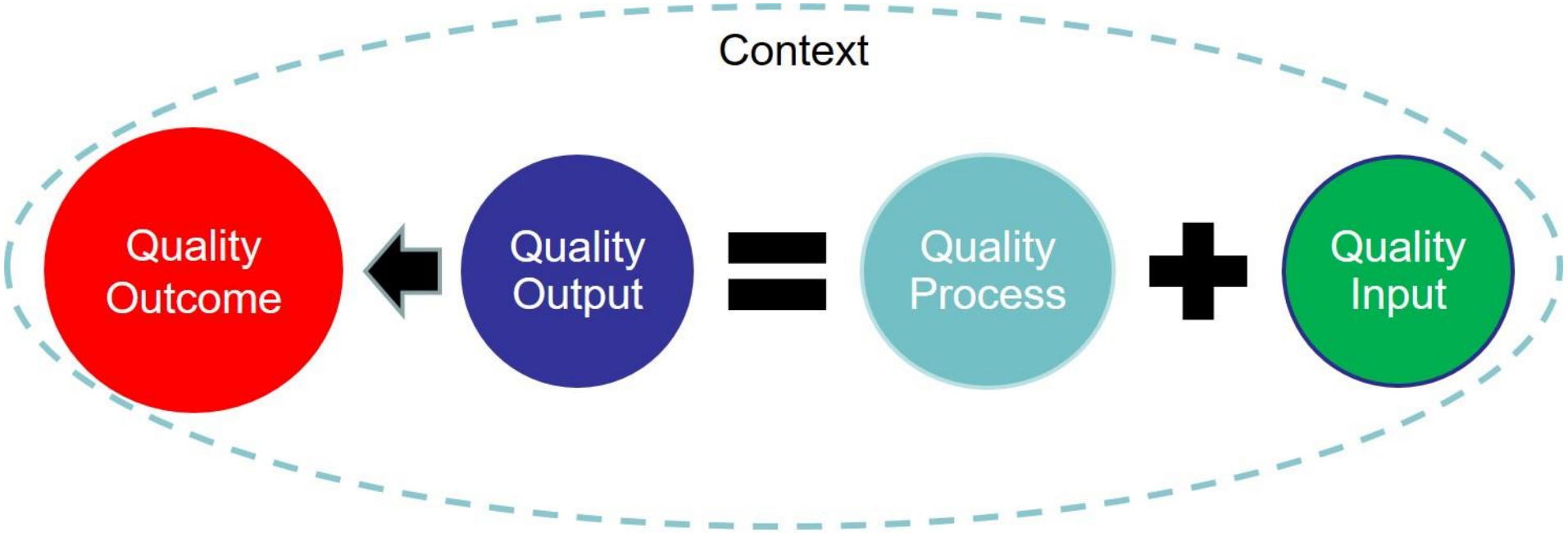
Adapted by Bartholomew, P., Freeman R (2009, 2010) as part of T-SPARC at Birmingham City University from 'Levels of learner voice participation' in 'Rudd, T., Colligan, F. and Naik, R. (2006) "Learner Voice: a handbook from Futurelab". Bristol, Futurelab.

https://www.udemy.com/outcome-based-education-and-academic-quality-assurance/

Traditional Education System



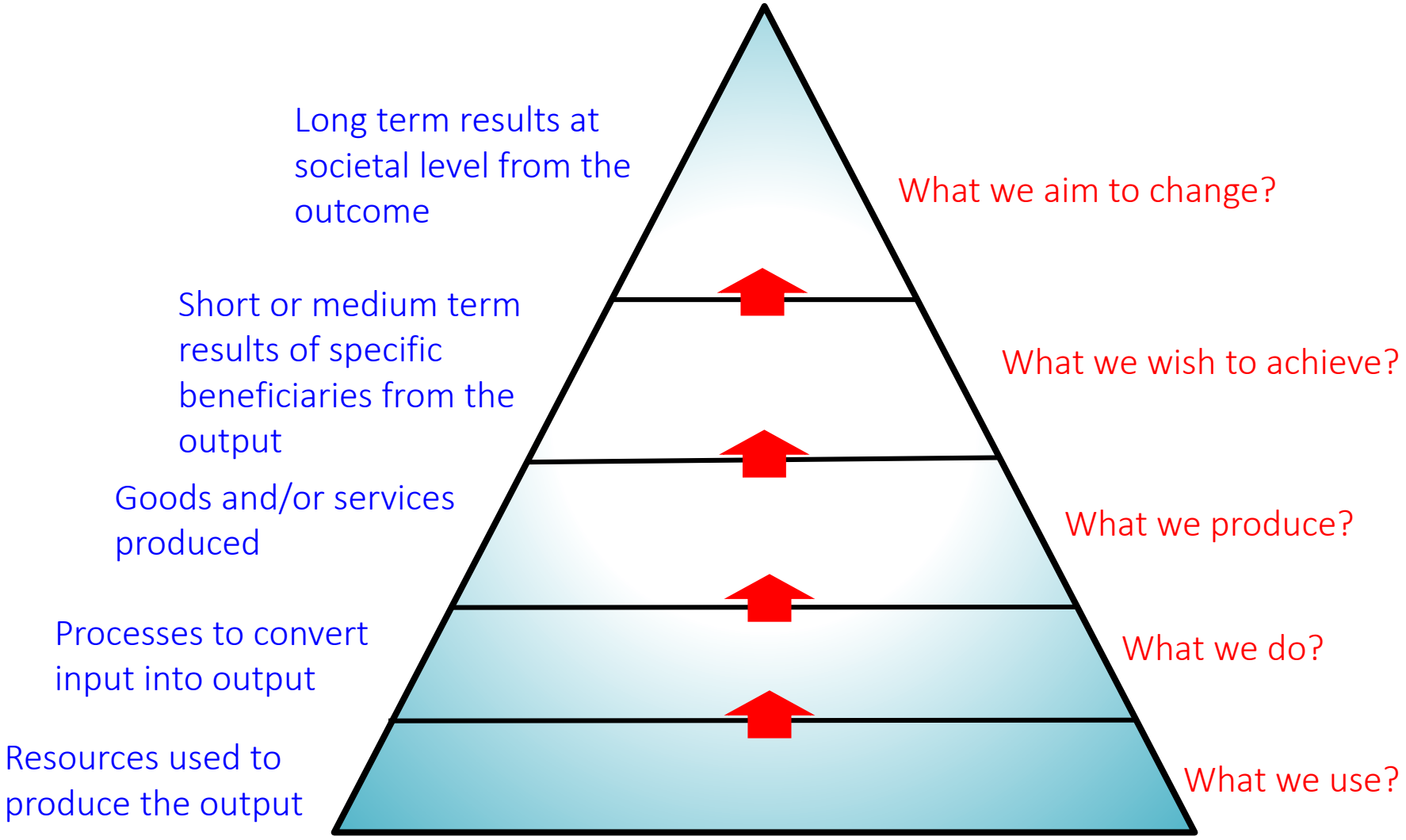
Outcomes-Based Concept



Outcomes-Based Concept

output	outcome
What is produced at the end of a process?	What is produced after using or consuming the output?
Does not address the benefits or impact gained from the output	Address the benefits or impact gained from the output
Result is measured at the time or end of production	Result is measured after production or some time in the future
Easy to quantify	Difficult to quantify
Absolute control over quality	Limited control over quality

Outcomes-Based Concept



Source: Adapted from http://www.gov.za/issues/outcomes-approach

Outcomes-Based Concept

Level	Output	Outcome	Impact
Lecture	Lesson delivered.	Students acquired the attitude, skills and knowledge (learning outcomes) of the lesson.	Students used the acquired attitude, skills and knowledge to solve real life problems.
Study Programme	Number of graduates.	Graduates with relevant attitude, skills and knowledge are employed and able to perform as expected.	Graduates contributed to the improvement of the organisations and society.
University	Number of graduates and postgraduates.	High employability of graduates and quality workforce for the labour markets.	Graduates contributed to the betterment of society and the country.

Outcome-based Education (OBE)

- An approach to education in which decisions about the curriculum are driven by the exit learning outcomes.
  - Product define process.
  - Resulted- oriented thinking.

(Harden, etc., 1999)

Four Basic Principles of OBE (Killen, 2000 & Spady, 1994)

Clarity of focus (having specific outcomes gives a strong sense of purpose to everything teachers and students do).

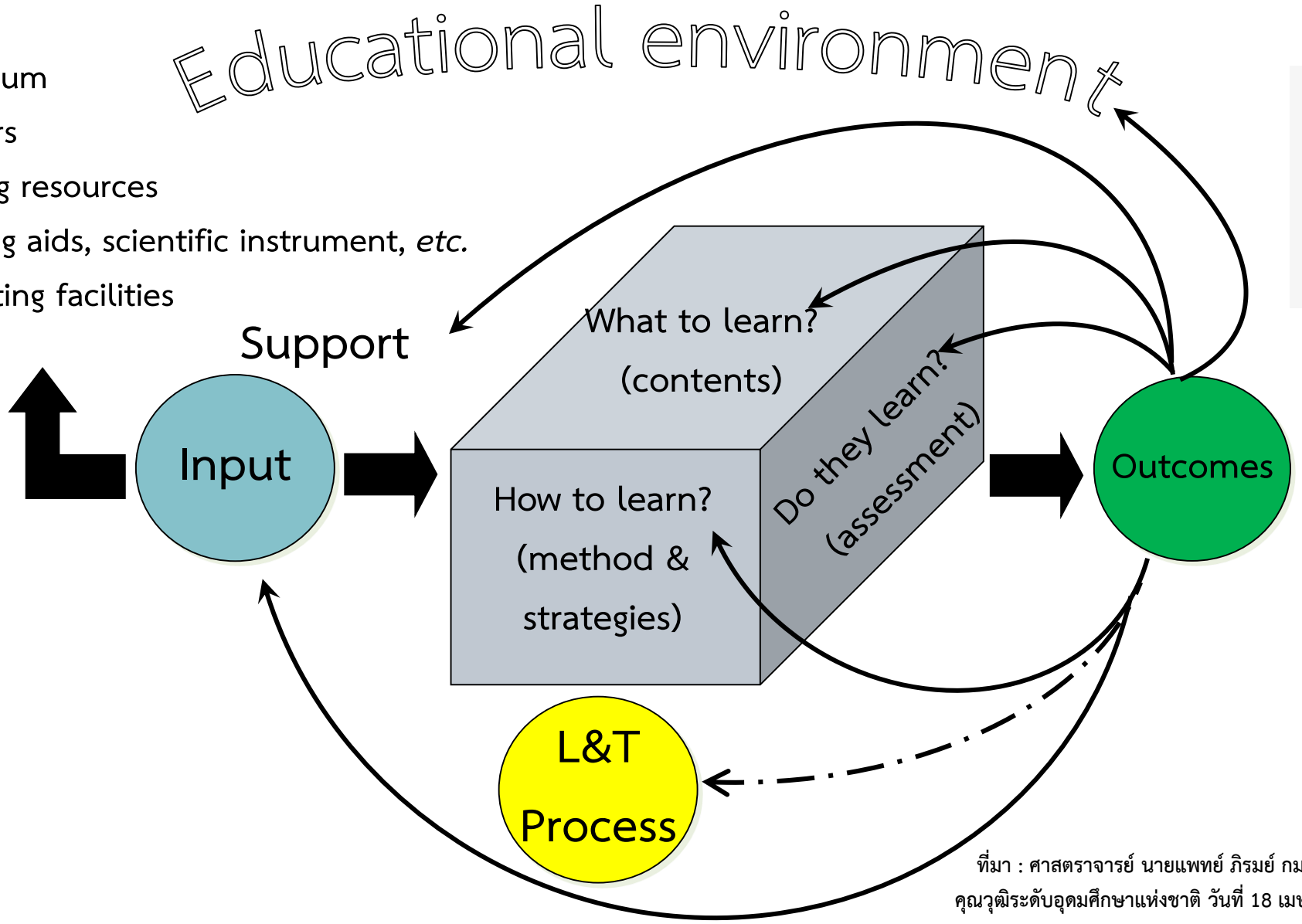
Design down, deliver up (when planning curriculum, educators start with the outcomes and work backwards; when planning instruction, teachers teach what students need to learn to demonstrate the outcomes).

High expectations (OBE departs from traditional education in its assumption that all students can learn well—although not in the same way and not necessarily on the same day), an.

Expanded opportunities (students must be permitted to demonstrate their learning in different ways, and they must have numerous opportunities to demonstrate the outcomes, not just one. Spady calls this “grading in pencil”).

OUTCOME BASED EDUCATION

- Curriculum
- Teachers
- Learning resources
- Teaching aids, scientific instrument, *etc.*
- Supporting facilities



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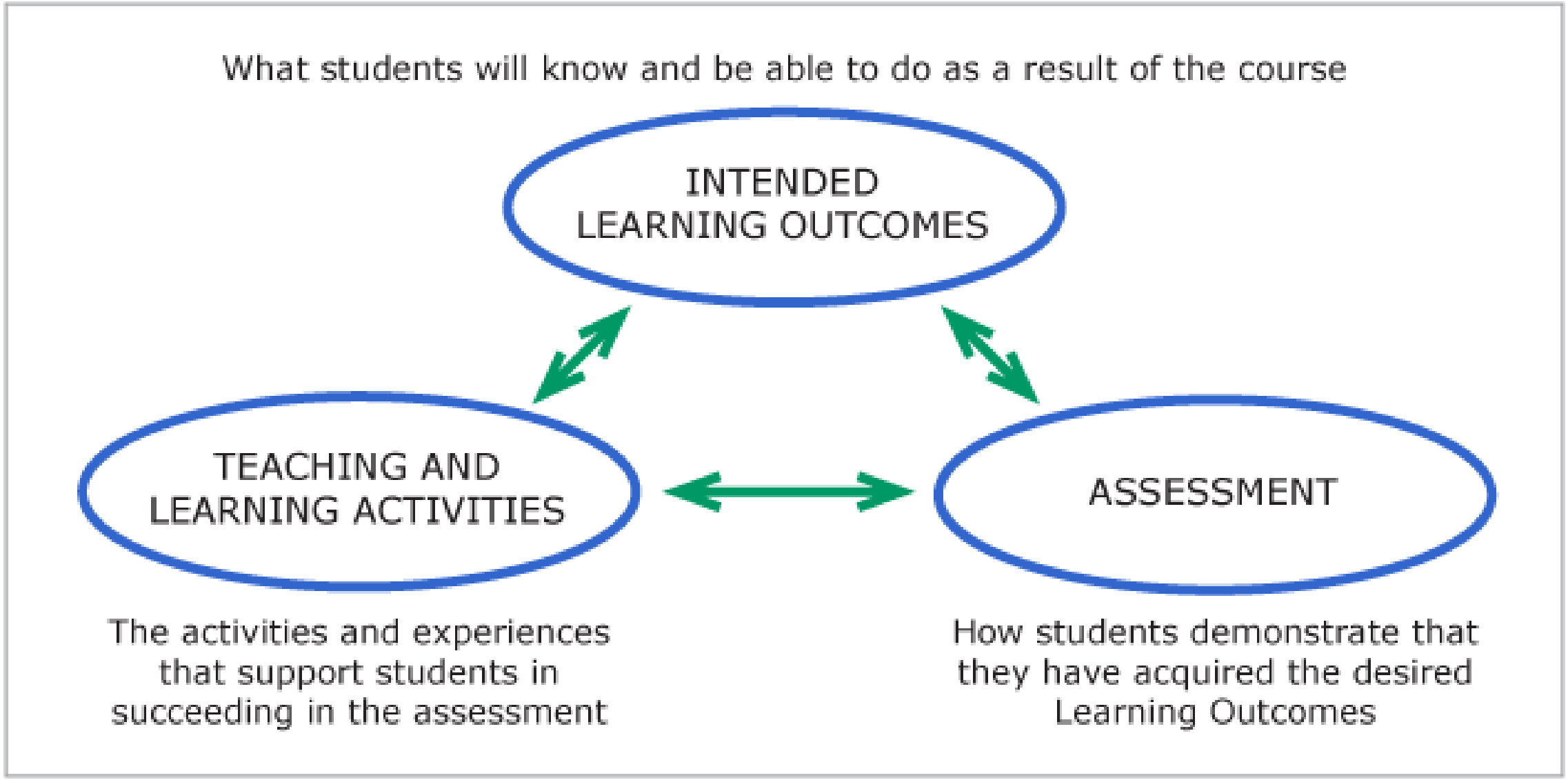
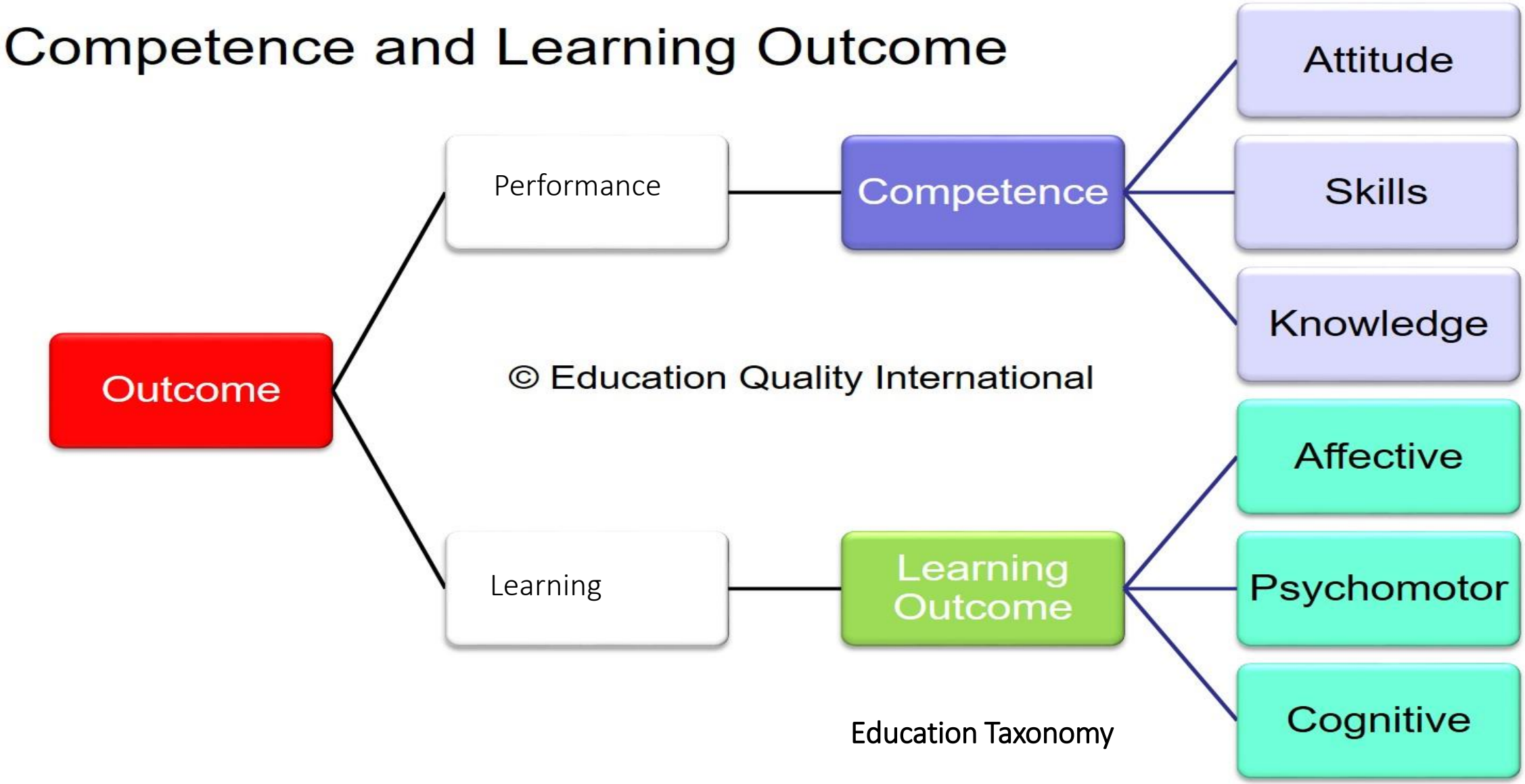
Constructive Alignment



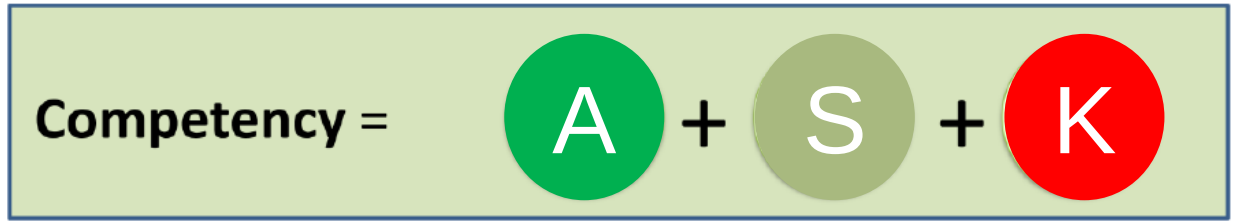
Outcomes-Based Education (OBE)



Competence

What is Competency?

- A competency is a measurable set of attitudes, skills and knowledge (ASK) that a person needs to perform a task effectively
- A competency is not an entire job
- In most cases, several competencies are required for a job
- Often used by employers to describe the desired characteristics of a graduate.



Source: Singapore Workforce Development Agency – Quality Assurance Division Develop Competency-Based Assessment Plans Version 1.1 (14 October 2012)

What are Leaning Outcomes?

- Learning outcomes are statements of what is expected that the **students will be able to Do as a result of learning activity** ….(Jenkins and Unwin).

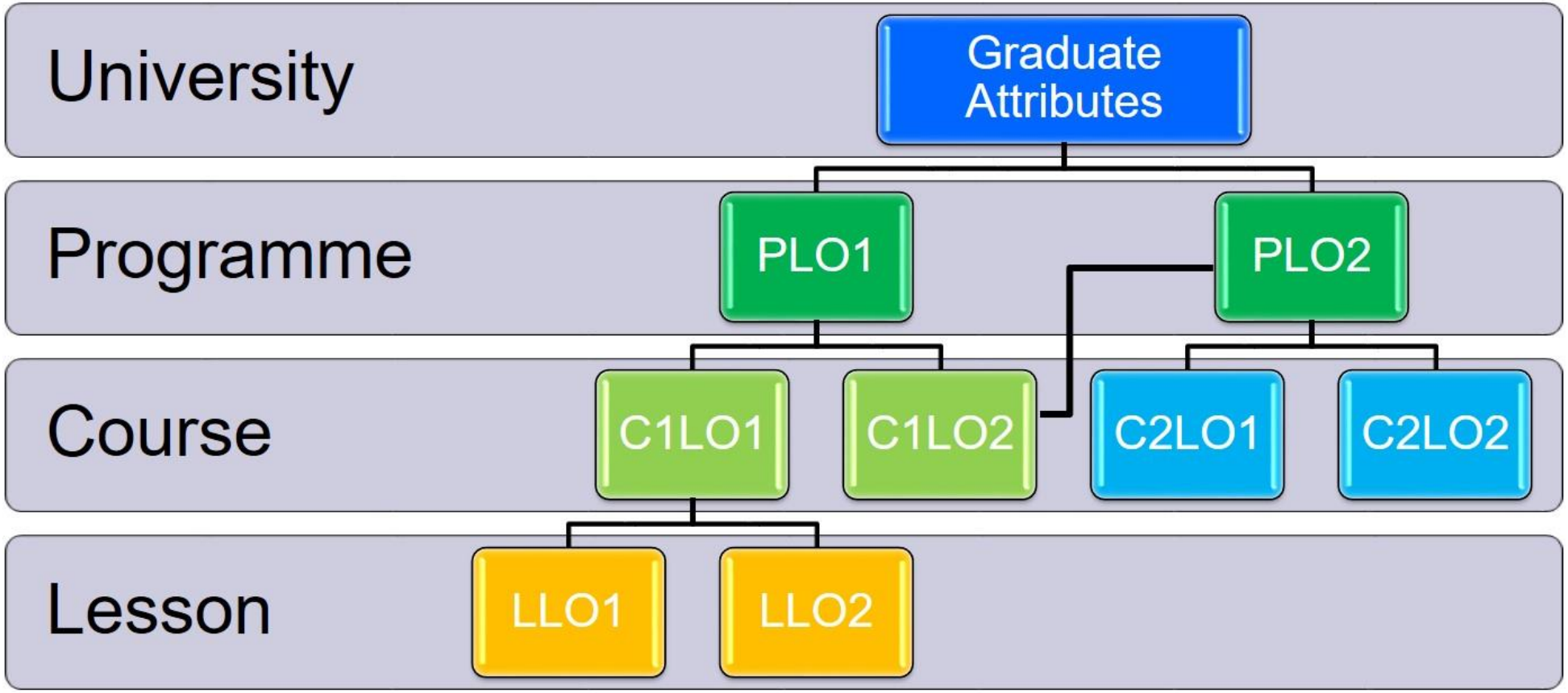
- Learning outcomes are explicit statements of **what we want our students to know, understand or to be able to do** as a result of completing our courses. (Univ. New South Wales, Australia)

- "Learning outcomes are statements that specify what learners will know or be able to do as a result of a learning activity. Outcomes are usually **expressed as knowledge, skills or attitudes**". (American Association of Law Libraries).

- Learning outcomes are an explicit description of what a learner should know, understand and be able to do as a result of learning. (Learning and Teaching Institute, Sheffield Hallam University)

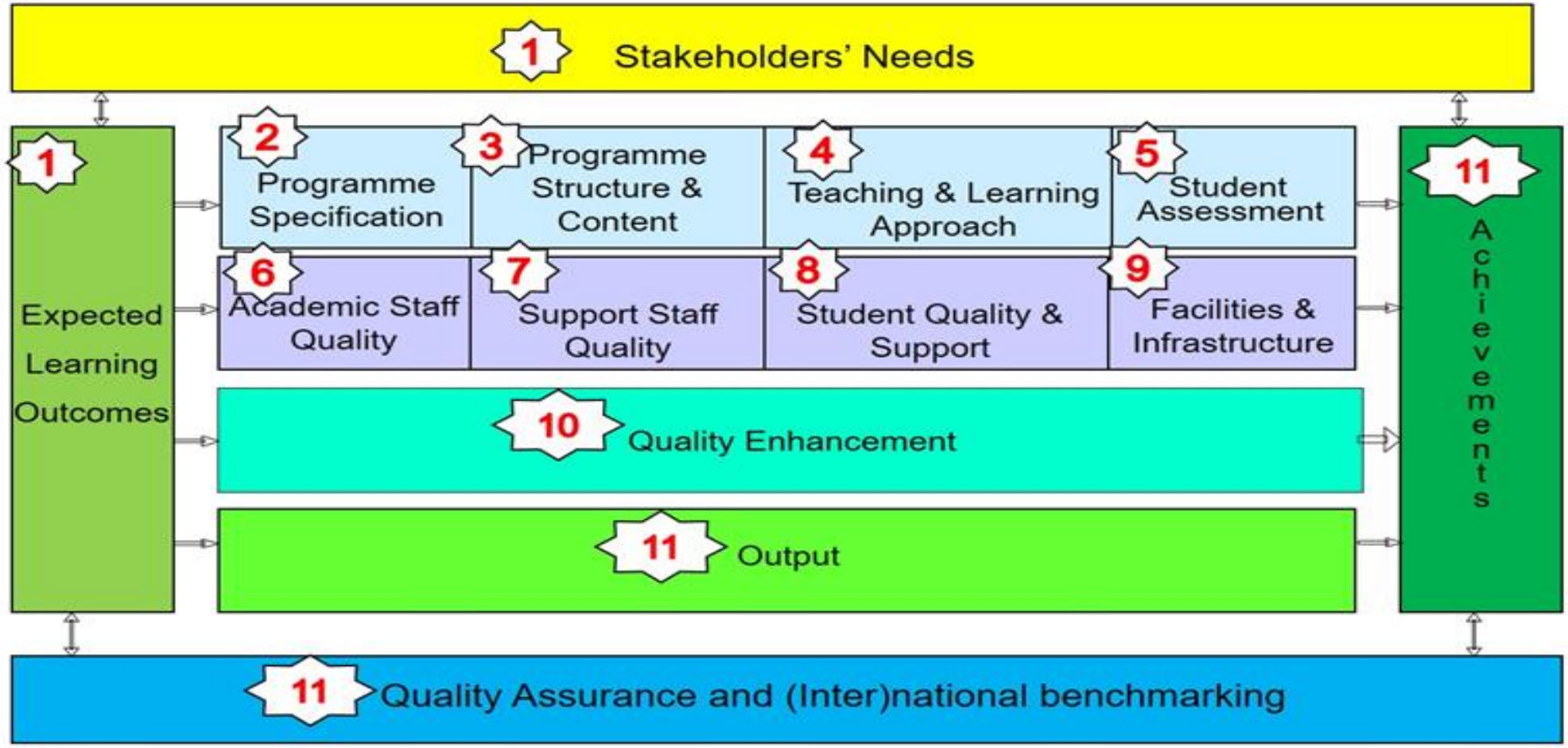
Hierarchy of Learning Outcomes

Hierarchy of Learning Outcomes



Learning Outcomes Tree

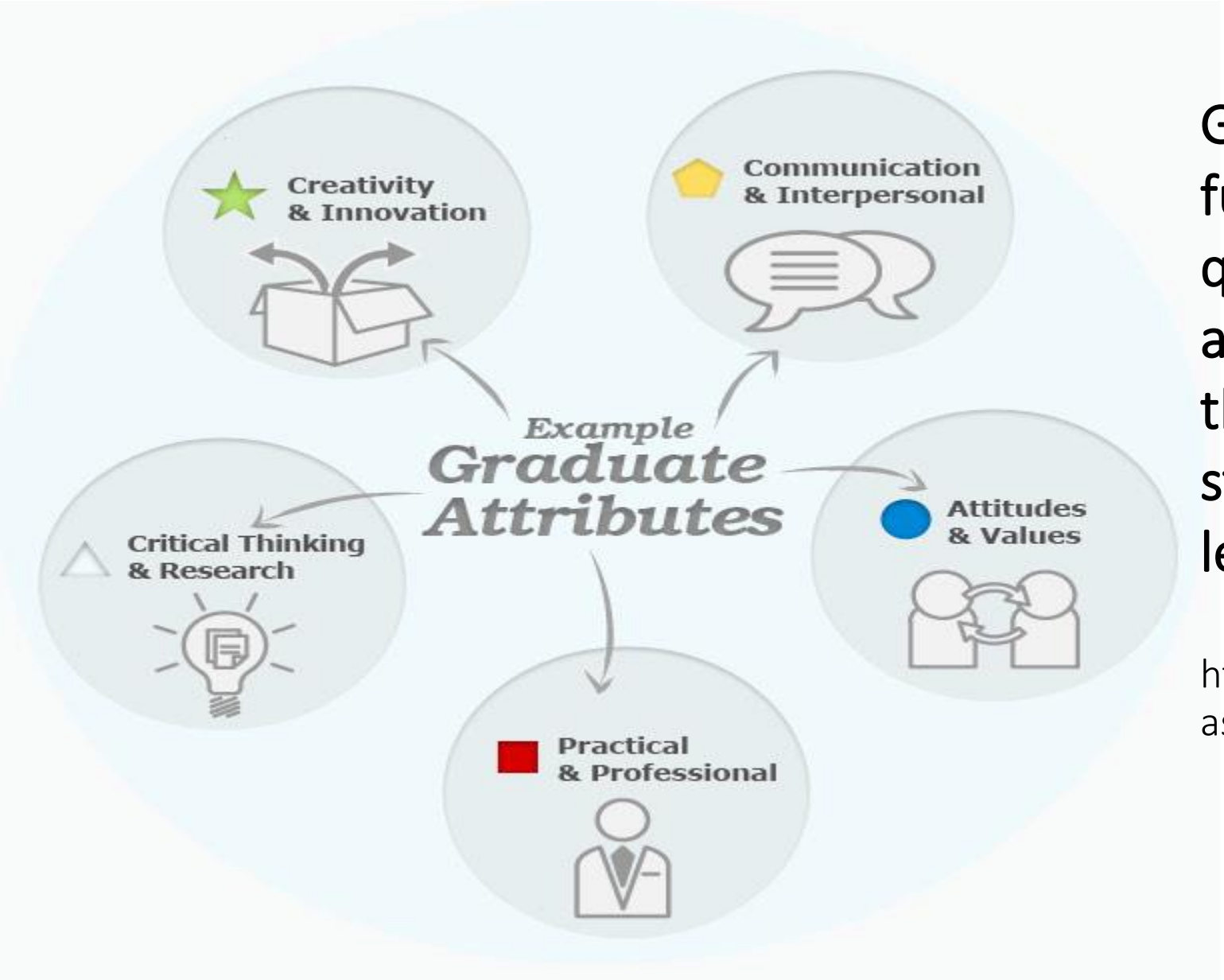
How do we develop Learning Outcomes?



Graduate Attributes

These statements detail the qualities and skills that the provider believes graduates should develop through the course of their study and engagement in student life.

The lists of attributes typically include outcomes that range from simple technical skills to complex intellectual abilities and ethical values. They are often written as nouns or adjectives.



Graduate attributes are fundamental skills and qualities, knowledge literacy and conceptual frameworks that are imperative to a student's development in learning.

http://academ.com.au/review-assessment-tools/

Trinity Graduate Attributes

To **Act** Responsibly

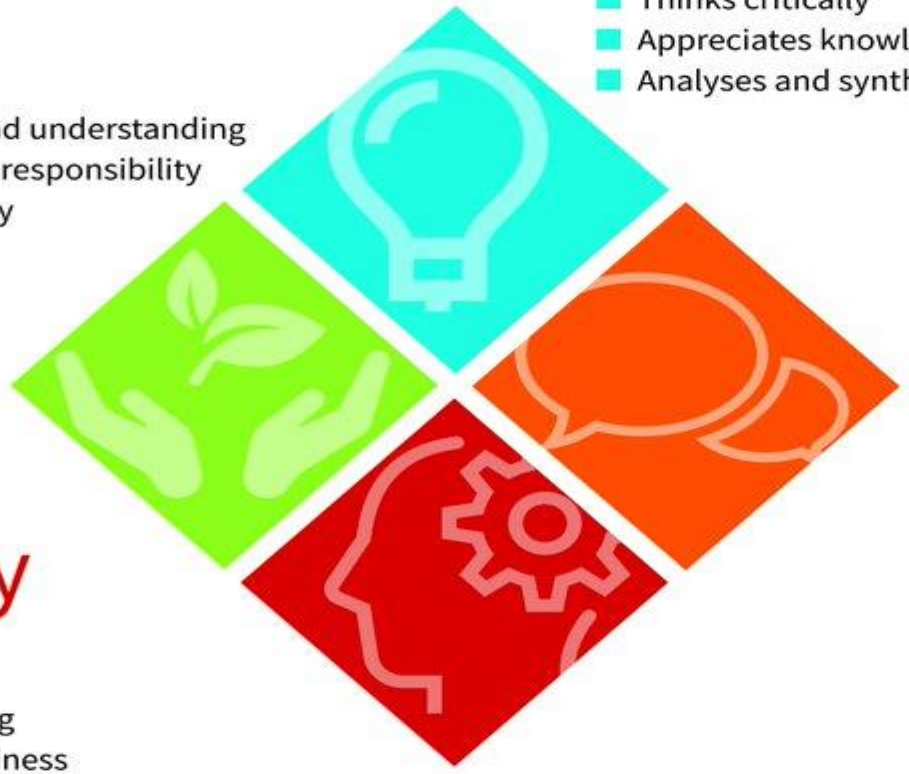
A Trinity Graduate

- Acts on the basis of knowledge and understanding
- Is self-motivated and able to take responsibility
- Knows how to deal with ambiguity
- Has a global perspective
- Is ethically aware

To **Think** Independently

A Trinity Graduate

- Has a deep knowledge of an academic discipline
- Can do independent research
- Thinks creatively
- Thinks critically
- Appreciates knowledge beyond their chosen field
- Analyses and synthesises evidence



To **Develop** Continuously

A Trinity Graduate

- Has a passion to continue learning
- Builds and maintains career readiness
- Commits to personal development through reflection
- Has the confidence to take measured risks
- Is capable of adapting to change

To **Communicate** Effectively

A Trinity Graduate

- Can present work through all media
- Is expert in the communication tools of a discipline
- Connects with people
- Listens, persuades and collaborates
- Has digital skills
- Has language skills

https://twitter.com/tcdtep/status/996675730879721472

GRADUATE ATTRIBUTES AND COMPETENCIES

https://www.nie.edu.sg/higher-degrees/graduate-attributes-and-competencies/

Those who complete NIE graduate programmes have:

Expanded knowledge of their disciplines and beyond. This means that they have:

- demonstrated mastery, creation and application of knowledge.

-grown in their understanding of the structure and nature of knowledge

-developed an understanding and appreciation of the evolving nature of knowledge

-shown appreciation for multiple ways of knowing

Developed the habit of mind of critical inquiry. This means that they:

- are open-minded, able to question assumptions

- are critically reflective; that is, able to recognise potential for on-going individual and collaborative growth

- do not take things for granted

- are able to understand problems in time and space

- are able to grasp literal and symbolic meanings (metaphorical)

- are able to see issues in social contexts

- are able to derive implications and/or applications for a wider purpose or community

https://www.nie.edu.sg/higher-degrees/graduate-attributes-and-competencies/

Those who complete NIE graduate programmes have:

Enhanced their communication competencies. This means that they are able to:

- develop points of view and defend arguments with evidence

- listen open-mindedly to arguments of others

- engage in critique, collaboration and consensus building

- communicate through multi-modalities in diverse contexts

Enhanced their leadership competencies. This means that they are able to:

- motivate knowledge manipulation and generation through provision of the necessary supportive conditions

- enable change and innovation by encouraging new ways of knowing and doing

- facilitate and support the work of others with empathy and care

https://www.nie.edu.sg/higher-degrees/graduate-attributes-and-competencies/

Those who complete NIE graduate programmes have:

Demonstrated values and dispositions consistent with the broad mission of NIE graduate programmes. This means that they have demonstrated willingness to:

- maintain an attitude of humility regarding their own knowledge
- be sensitive to multiple contexts (maintain perspective consciousness)
- hold critical perspectives (maintain tentativeness and open-mindedness)
- value diversity and differences
- develop a pro-active sense of social responsibility and justice
- act with ethical sensitivity

https://www.nie.edu.sg/higher-degrees/graduate-attributes-and-competencies/

KMUTT

Student QF

"Social Change Agent"

Value

Potential and Competent

Leadership

KMUTT-STUDENT QF

Value

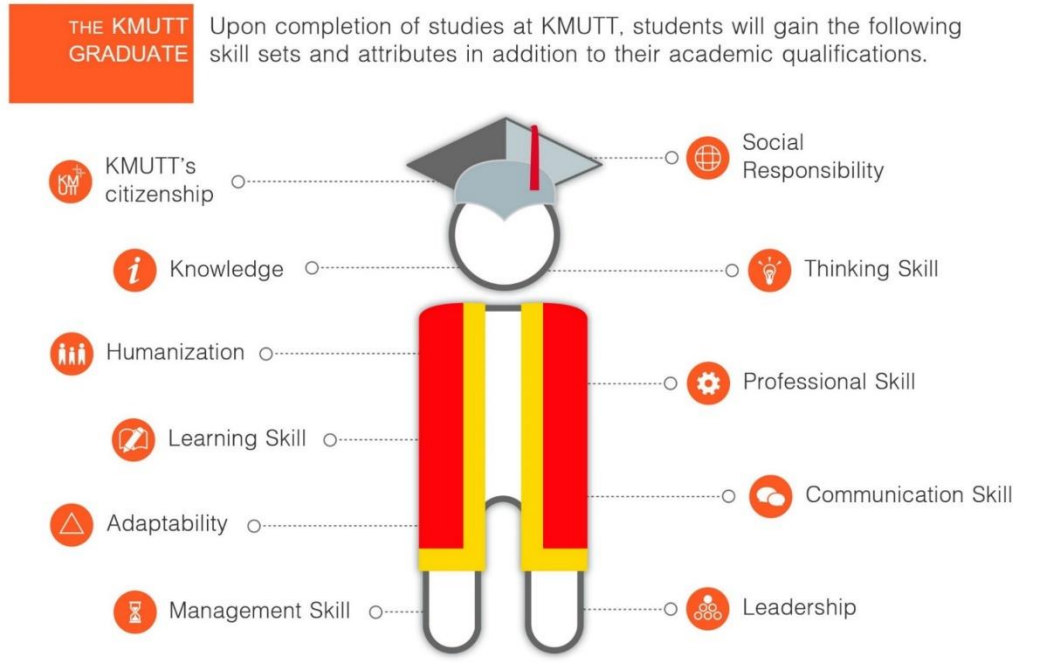
- KMUTT's citizenship
- Social Responsibility

Potential and Competent

- Knowledge
- Thinking Skill
- Learning Skill
- Professional Skill
- Communication Skill
- Humanization

Leadership

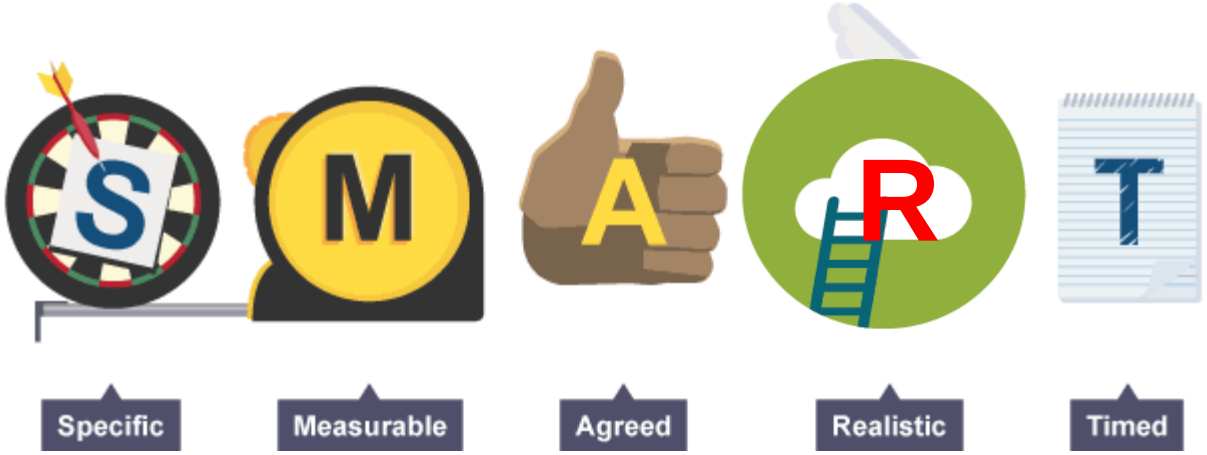
- Adaptability
- Leadership
- Management Skill



ที่มา : KMUTT C4ED (http://www.c4ed.kmutt.ac.th/?q=node/18)

Programme Objectives

Programme objectives are the intended results (i.e. outputs, outcomes and/or impact) of what a study programme aims to achieve within a certain timeframe. They typically form the basis for evaluating the performance of the study programme.



Programme Learning Outcomes

- Programme learning outcomes describe what the learner will be able to do at the end of the study programme.
- The programme learning outcomes should be aligned with the needs of the stakeholders as well as the vision and mission of the university.
- They also contribute to the achievement of the graduate attributes and programme objectives.

Biomedical Engineering

Program Educational Objectives

PEO 1:

Graduates apply systemic approach and principles of engineering, science, and mathematics to design, produce, and evaluate products, prototypes, or systems for applications in biomedical engineering.

PEO 2:

Graduates compete effectively, provide leadership and communicate effectively within industrial, academic, entrepreneurial, or governmental environments in the broad context of biomedical engineering.

PEO 3:

Graduates keep well-informed regarding state-of-art technologies and apply such novelties in biomedical engineering through self-study or acquire new knowledge as needed, using appropriate learning strategies through advanced graduate studies and beyond.

PEO 4:

Graduates apply ethical codes of professional and research conducts according to professional occupations.

PEO 5:

Graduates work both independently and collaboratively in diverse fields and interdisciplinary environments in either industries or academia.

Mahidol University
Faculty of Engineering

Biomedical Engineering

Student Outcomes

1. Identify, formulate, and solve complex biomedical engineering problems by applying principles of engineering, science, and mathematics.
2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. Communicate effectively with a range of audiences.
4. Recognize ethical and professional responsibilities in biomedical engineering situations and make informed judgments, which must consider the impact of biomedical engineering solutions on global, economic, environmental, and societal contexts.
5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. Develop and conduct appropriate experimentation, analyze and interpret data from living and non-living system, and use engineering judgment to draw conclusions.
7. Acquire and apply new knowledge as needed, using appropriate learning strategies.

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Mahidol University Faculty of Engineering
www.eg.mahidol.ac.th
Tel (66) 2889 2138 FAX (66) 2441 9731

Tips for Developing Effective, Measurable Program Learning Outcomes

- Learning outcomes should have two parts: an action verb and a content area.
- Keep statements short and focused on a single outcome.
- Use active verbs that describe what a student will be able to do once learning has occurred.
- Learning outcomes should be student-focused and target the expected student outcome.
- Learning outcomes should be SMART (specific, measurable, acceptable to the instructor, realistic to achieve, and time-bound with a deadline).
- Include complex or higher-order learning outcomes when they are appropriate.
- Utilize learning outcomes as a basis for course preparation.
- Learning outcomes should match instructional strategies and assessment requirements.

Source: https://academicprograms.calpoly.edu/program-learning-outcomes

Examples: Using the Best Action Verbs for Program Learning Outcomes

VERY HARD TO MEASURE	STILL TOO HARD TO MEASURE	RELATIVELY EASY TO MEASURE
Students will be able to	Students will be able to	Students will be able to
appreciate *the benefits of exercise.*	***value*** *exercise as a stress reduction tool*	***explain*** *how exercise affects stress.*
access *resources in the college library database.*	***recognize*** *problem solving skills that would enable one to adequately navigate through the proper resources within the college.*	***evaluate*** *the most appropriate resource that is pertinent to their college concern.*
develop *problem-solving skills and conflict resolution.*	***understand*** *how to resolve personal conflicts and assist others in resolving conflicts.*	***demonstrate*** *to classmates how to resolve conflicts by helping them negotiate agreements.*
have more confidence *in their abilities.*	***identify*** *critical thinking skills, such as problem solving as it relates to social issues.*	***demonstrate*** *the ability to analyze and respond to arguments about racial discrimination.*

Source: https://academicprograms.calpoly.edu/program-learning-outcomes

The Three Domains of Learning

Depending on the course goals, learning outcomes may target a range of skills or cognitive processes. Bloom's (1956) taxonomy of educational objectives differentiates between three domains of learning: cognitive, affective, and psychomotor.

DOMAIN	TARGET	FOCUS
Cognitive	Knowledge, intellectual skills	Mind
Affective	Attitudes, interests, feelings, values, adjustments	Spirit
Psychomotor	Motor and manipulations skills	Body

Revised Bloom's Taxonomy

Two Dimensions: Knowledge Levels and Cognitive Skills (Learning Outcomes)

Levels	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual Knowledge	List primary and secondary colours	Summarise features of a new product	Respond to FAQs	Select the most complete list of activities	Check for consistency among sources	Generate a log of daily activities
Conceptual Knowledge	Recognise symptoms of exhaustion	Classify adhesive by toxicity	Provide advice to novices	Differentiate high and low culture	Determine relevance of results	Assemble a team of experts
Procedural Knowledge	Recall how to perform CPR	Clarify assembly instructions	Carry out PH test of water samples	Integrate compliance with regulations	Judge efficiency of sampling techniques	Design efficient procedural workflow
Meta-cognitive Knowledge	Identify strategies for retaining information	Predict one's response to culture shock	Use techniques that match one's strengths	Deconstruct one's biases	Reflect on one's progress	Create a learning portfolio

Source: http://www.celt.iastate.edu/teaching/effective-teaching-practices/revised-blooms-taxonomy

Bloom's Taxonomy
Psychomotor Domain

Psychomotor Domain	Behavior
1. Imitation	Observes a skill and attempts to repeat it
2. Manipulation	Performs skill according to instruction rather than observation
3. Precision	Reproduces a skill with accuracy, proportion and exactness
4. Articulation	Combines more than one skill in sequence with harmony and consistency
5. Naturalization	Completes one or more skills with ease and becomes automatic with limited physical or mental exertion

Bloom's Taxonomy - Affective

Higher Order

5. Internalising

Behaviour: Adopt belief system or philosophy

Verbs: Internalise, Acts, Displays, Influence, Practice, Believe, Ingrain, Immerse, Consistently, Incorporate, Acquire

4. Organising

Behaviour: Reconcile disparate elements or conflicts, develop value system

Verbs: Organise, Develop, Build, Relate, Prioritise, Reconcile, Contrast, Compare, Arrange, Integrate, Synthesise, Adhere, Alter, Modify, Formulate

3. Valuing

Behaviour: Attach values and express personal opinions

Verbs: Argue, Challenge, Debate, Refute, Justify, Persuade, Critique, Explains, Invites, Forms, Proposes, Joins, Demonstrates

2. Responding

Behaviour: Get involved in or participate actively

Verbs: Respond, React, Clarify, Contribute, Question, Cite, Perform, Write, Assists, Aids, Recites, Presents, Answers, Reports, Discusses

1. Receiving

Behaviour: Open to experience or idea, willing to hear

Verbs: Hear, Listen, Be Open To, Ask, Focus, Attend, Take Part In, Acknowledge, Concentrate, Do, Feel, Follow, Read, Uses

Lower Order

Designed by Ivan Teh Runningman, September 2016

Programme Learning Outcomes

Mapping of Graduate Attributes and Programme Learning Outcomes

Graduate Attributes (GA)	Programme Learning Outcomes (PLO)						
	PLO1	PLO2	PLO4	PLO5	PLO6	PLO7	PLO8
GA1							
GA2							
GA3							
GA4							
GA5							

Share KMUTT GE Learning outcomes

Example: PLO1: Intellectual and Practical Skills

Sub-PLO: a. Critical Inquiry, Analysis, and Problem Solving

General Goal (1): Students will be able to develop the disposition and skills to gather, organize, refine, analyze, and evaluate critically information and ideas.

1. Identify and follow through on personally and socially relevant problems and reasonable solutions to those problems.

2. Identify relevant information sources, make reasoned choices among those sources, and open-mindedly follow where those sources lead.

3. Justify conclusions reached in the analysis of information.

4. Analyze evidence, statements, alternative viewpoints, graphics, and other forms of information.

Sub-PLO: b. Creative Thinking and Expression

General Goal (2): Students will be able to develop new ideas, products, or solutions and explore novel perspectives and approaches.

1. Develop creative and novel solutions to personally and socially relevant problems.

2. Take account of novel, alternative, contradictory, and even radical viewpoints in creating new ideas, products, or solutions appropriate to the domain or subject matter.

Example:
PLO1: Intellectual and Practical Skills

Sub-PLO: c. Written Communication

General Goal (3): Students will be able to develop and express themselves clearly and appropriately in writing for a range of social, academic, and professional contexts and use appropriate writing technologies.

1. Demonstrate consideration of context, audience, and purpose with a clear focus on the assigned tasks (e.g., the writing aligns with audience, purpose, and context).

2. Demonstrate consistent use of important conventions particular to specific disciplines and writing tasks, including organization, content, presentation, and stylistic choices.

3. Correctly use language that conveys meaning to readers.

4. Use writing for inquiry, learning, and thinking to find, evaluate, analyze, and synthesize appropriate primary and secondary sources and integrate their own ideas with those of others.

Sub-PLO: d. Oral Communication

General Goal (4): Students will be able to listen critically and speak thoughtfully, clearly, and appropriately to a variety of social, academic, and professional audiences.

1. Convey the central message clearly and consistently, using supporting material.

2. Demonstrate clearly and consistently an organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) within the presentation.

3. Demonstrate language choices that support the effectiveness of the communication and are appropriate to the intended audience(s).

4. Employ interesting and effective delivery techniques (e.g., posture, gesture, eye contact, and vocal expressiveness).

5. Employ supporting materials (e.g., explanations, examples, illustrations, statistics, analogies, and quotations from relevant authorities) in a manner that establishes the speaker’s credibility/authority on the topic.

Example:
PLO1: Intellectual and Practical Skills

Sub-PLO: e. Quantitative Literacy

General Goal (5): Students will be able to reason and solve quantitative problems from a wide array of contexts and everyday life situations; understand and create logical arguments supported by quantitative evidence; and clearly communicate those arguments in a variety of formats (e.g., words, tables, and mathematical equations) as appropriate.

1. Interpret and communicate information presented in mathematical forms (e.g., equations, functions, graphs, diagrams, tables, or words).

2. Convert relevant information into various mathematical forms (e.g., equations, functions, graphs, diagrams, tables, or words).

3. Calculate numerically and symbolically to solve a problem.

4. Analyze data quantitatively as the basis for competent, valid, and reliable inferences in order to draw reasonable and appropriate conclusions.

5. Use appropriate mathematical tools to explicitly describe assumptions, mathematical relationships, and conclusions.

6. Express evidence in support of an argument by employing an appropriate form of presentation (e.g., equations, functions, graphs, diagrams, tables, or words).

Sub-PLO: f. Information Literacy

General Goal (6): Students will be able to know when there is a need for information and then be able to identify, locate, evaluate, and effectively and responsibly use and share that information for a particular problem.

1. Completely define the scope of research questions or theses. Select information sources needed to answer these research questions.

2. Access information using a variety of search strategies and relevant sources.

3. Evaluate critically the accuracy and validity of information sources and the relevant contexts in which they are presented.

4. Organize, synthesize, and communicate information from sources so the intended purpose is achieved.

5. Distinguish between common knowledge and ideas requiring attribution. Correctly choose between paraphrasing, summarizing, or quoting when incorporating citations.

6. Demonstrate a full understanding of the ethical and legal restrictions on the use of published, confidential, and/or proprietary information.

Example:
PLO1: Intellectual and Practical Skills

Sub-PLO: g. Collaboration

General Goal (7): Students will be able to understand the collaborative process and work collaboratively with others to solve problems and make informed decisions.

1. Demonstrate understanding of the roles, skills, and behaviors required for effective teamwork and goal attainment.

2. Demonstrate values, knowledge, and skills, such as building upon the ideas of others and treating team members with respect, which support a collaborative culture.

3. Understand conflict and employ responses that strengthen collaboration; formulate productive responses to criticism and conflict.

4. Appraise alternative solutions or courses of action that build on the ideas of others.

sub-PLOs

Sub-PLO1	Sub-PLO2
Knowledge (Cognitive Learning outcomes: CL):	Knowledge (Cognitive Learning outcomes: CL):
Skills: (Psychomotor Learning outcomes: PL):	Skills: (Psychomotor Learning outcomes: PL):
Attitude: (Affective Learning outcomes: AL):	Attitude: (Affective Learning outcomes: AL):

PLOs Matrix

PLOs	Sub-PLOs
PLO1	1A ..... 1B ..... 1C ..... 1D.....
PLO2	2A ..... 2B ..... 2C ..... 2D.....
PLO3	3A ..... 3B ..... 3C ..... 3D.....

Programme Learning Outcomes

Mapping of Programme Learning Outcomes and Taxonomy's Domains

Programme Learning Outcomes (PLO)	Cognitive (Knowledge)					Affective (Attitude)					Psychomotor (skill)					Type
	CL1	CL2	CL3	CL4	CL5	AL1	AL2	AL3	AL4	AL5	PL1	PL2	PL3	PL4	PL5	
PLO1																Subject-Specific
PLO2																
PLO3																
PLO4																
PLO5																Generic
PLO6																
PLO7																

Design Course Learning Outcomes

Course Learning Outcomes

- Course learning outcomes describe clearly what learners will know and be able to do at the end of the course.

- They are aligned with one or more of the programme learning outcomes and they contribute to the achievement of the programme learning outcomes (PLOs).

Course *Objective*	Course *Learning Outcome*
What **THE TEACHER** expects students to know and be able to do (as a whole) at the end of instruction	What **THE STUDENTS** are be able to do (specific) at the end of instruction
Not behavioral in nature - Verbs: *Know, Understand*	Stated in behavioral terms - Verbs: Identify, Discuss, Evaluate
One course objective may generate several learning outcomes	Several learning outcomes are derived from one course objective
Objectives are **intended** results or consequences of instruction, curricula, programmes, or activities.	Outcomes are **achieved** results or consequences of what was learned – evidence that some learning took place.

https://www.slideshare.net/alwynlau/outcomebased-education

Categories of Learning Outcomes

Categories of Learning outcomes:

- Subject specific outcomes that relate to the subject discipline and the knowledge and/or skills particular to it;

- Generic (sometimes called transferable skills) outcomes that relate to any and all disciplines e.g. written, oral, problem-solving, information technology, and team working skills, etc.

Example: Course Learning Outcomes

At the completion of the course, student will be able to :

1. Determine the parameters in kinetic rate expressions for both elementary and non-elementary reactions;
2. Apply the design equations for the three ideal reactor models (batch, CSTR, and plug flow), in the presence of both single and multiple reactions;
3. Apply the energy balance equation to the three ideal reactor models and determine required heating and cooling loads, in the presence of both single and multiple reactions;
4. Apply the design equations and rate laws for catalytic reactors;
5. Select the appropriate reactor type for a given chemical conversion and size it to meet operational goals; and
6. Employ a computer algebra program (i.e. MatLab) to numerical solve systems of algebraic and differential equations.

Source: Adapted from Chemical Reaction Engineering (CHS310804), Chemical Engineering, Universitas Indonesia

Examples of CLOs for different PLOs

Course Learning Outcomes (CLO) *At the end of the course the student should be able to:*	Learning Outcomes Domain (MOE LO)
• explain the principles of ..... • analyse a given text based on the concept of.....	knowledge (LO1)
• display the procedure to ..... • demonstrate how to perform	technical skill (LO2)
• propose a solution to management problems using principles of..... • describe a solution to thermodynamic problems using	critical thinking problem solving (LO3)
• explain and present the principles of	LO1 and communication (LO4)
• organise in teams to ..... • explain ..... in groups	teamwork (LO5)

Course……

CLOs	Knowledge (K)	Skill (S)	Attitude (A)
CLO1	K1 K2 K3 K……	S1 S2 S3 S……	A1 A2 A3 A……
CLO2	K1 K2 K3 K……	S1 S2 S3 S……	A1 A2 A3 A……
CLO3	K1 K2 K3 K……	S1 S2 S3 S……	A1 A2 A3 A……

Course Learning Outcomes

Mapping of Courses and Programme Learning Outcomes

Courses (C)	Programme Learning Outcomes (PLO)						
	PLO1	PLO2	PLO4	PLO5	PLO6	PLO7	PLO8
C1……							
C2……							
C3……							
C4……..							
C^n……							

Course Learning Outcomes

Table 1.2 Relationship between Courses and Expected Learning Outcomes (Continued)

No	Code	Course	Credit	Expected Learning Outcome (ELO)						
				ELO 1	ELO 2	ELO 3	ELO 4	ELO 5	ELO 6	ELO 7
27	CHS220802	Analytical Chemistry Lab.	1	5	5	1	1	1	5	1
28	CHS210801	Mass and Energy Balance	3	5	1	1	1	1	5	1
29	CHS210802	Transport Phenomena	3	5	1	3	5	1	4	1
30	CHS220804	Fluid Mechanics	3	5	1	1	5	1	4	1
31	CHS220805	Material Construction and Corrosion	3	5	1	1	1	4	4	3
32	CHS220806	Thermodynamics	3	5	1	1	1	1	5	5
33	CHS220807	Heat Transfer	3	5	1	1	5	1	5	5
34	CHS220801	Chemical Engineering Mathematics	3	5	1	5	5	1	5	1
35	CHS310802	Mass Transfer	4	5	1	2	5	1	5	1
36	CHS310803	Unit Operation Lab. 1	2	5	5	1	5	1	5	1
37	CHS320803	Unit Operation Lab. 2	2	5	5	1	5	1	5	1
38	CHS310804	Chemical Reaction Engineering	4	5	1	1	1	1	5	5
39	CHS310806	Process Control	3	5	1	5	1	1	5	1
40	CHS320801	Chemical Process Simulation	3	5	1	5	5	1	5	1
41	CHS320802c	Natural Gas Processing	3	5	1	4	5	1	5	5
42	CHS120801	Communication Skill	2	3	1	1	1	1	5	5
43	CHS310805	Project Management	2	5	1	1	1	5	5	5
44	CHS320804	Research Methods	2	5	5	1	5	1	5	1
45	CHS400803	Capita Selecta	2	4	1	1	1	5	4	5
46	CHS410801	Process Equipment Design	4	5	1	5	1	1	5	5
47	CHS410802	Chemical Plant and Product Design	4	5	3	5	5	5	5	5
48	CHS300805	Seminar	1	3	5	1	5	4	5	5
49	CHS400801	On the Job Training	2	5	1	5	5	5	5	5
50	CHS400802	Final Project	4	5	5	4	5	4	5	5
51	CHF410801c	Composite Material	3	4	1	1	1	4	5	4
52	CHF410802	Applied Thermodynamics	3	5	1	1	1	1	4	4
53	CHF410803	Dynamic Systems	3	4	1	5	4	3	3	1

Note: The figures in the ELO column relate to:
1 Not directly related to ELO
2 Quite related to ELO
3 Related to ELO
4 Closely related to ELO
5 Specifically related to ELO

Source: Chemical Engineering, Universitas Indonesia

Lesson Learning Outcomes

Lesson learning outcomes describe clearly what learners will know and be able to do at the end of the lesson.

They are sub-sets of the course learning outcomes and they contribute to the achievement of the course learning outcomes.

Example: Lesson Learning Outcomes

After completing **Lesson 3 – Rate Laws,** the student will be able to:

- Write the relationship between the relative rates of reaction.
- Write a rate law to define reaction order and activation energy.
- Describe the Arrhenius Equation and how the rate of reaction varies with temperature.
- Describe homogeneous, heterogeneous, elementary, non-elementary and reversible reactions.

Lesson 3 – Rate Laws, Essentials of Chemical Reaction Engineering Course

Source: Adapted from http://www.umich.edu/~essen/html/03chap/frames.htm

Lesson Learning Outcomes

Mapping of Lessons and Course Learning Outcomes

Lessons (L)	Course Learning Outcomes (CLOs)						
	CLO1	CLO2	CLO4	CLO5	CLO6	CLO7	CLO8
L1							
L2							
L3							
L4							
L5							

Show & Share

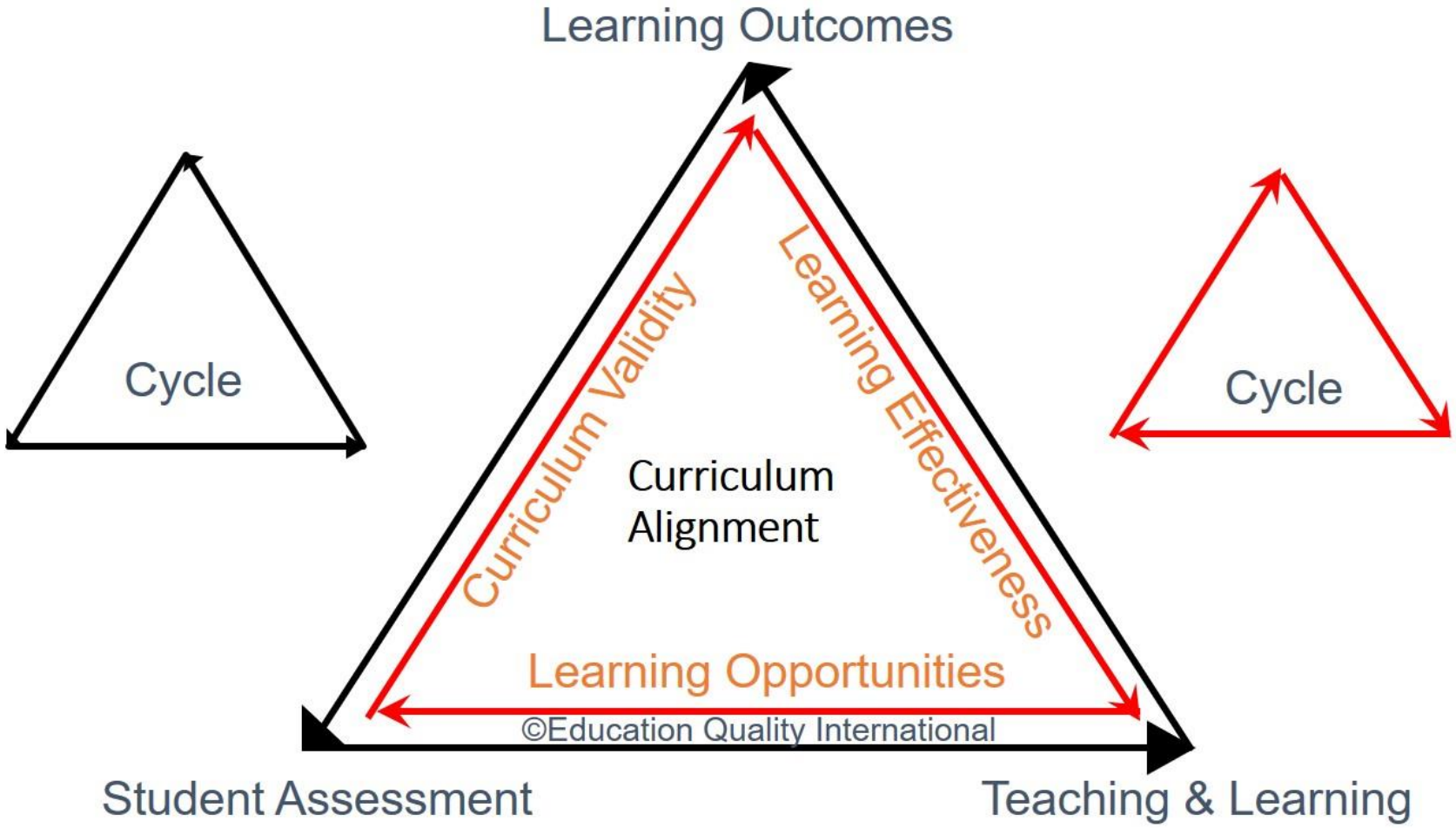
Design Learning Activities

Teaching and Learning

Learning activities are designed, grouped and sequenced to facilitate the achievement of learning outcomes.

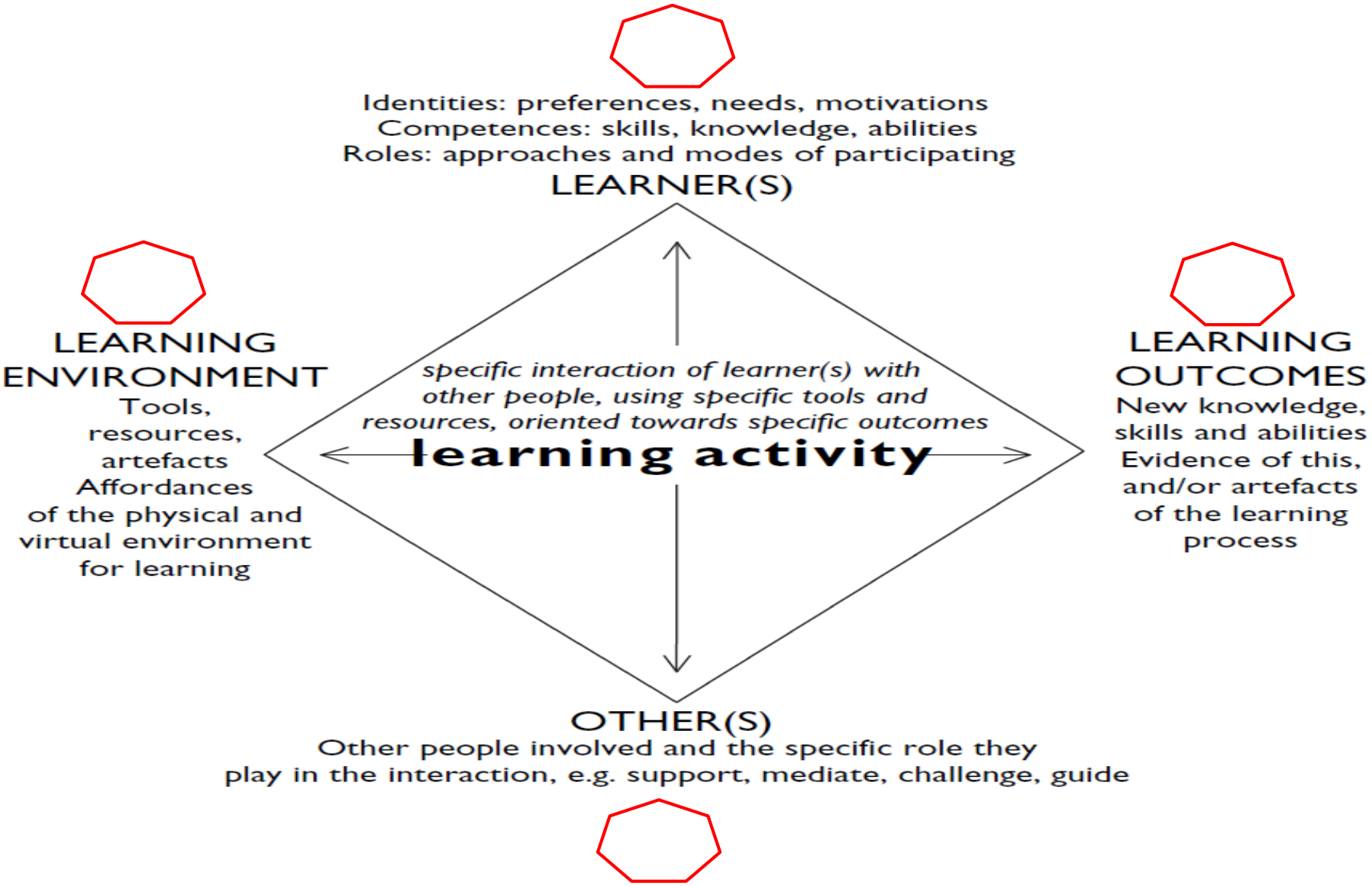
Through these learning activities, learners receive feedback about their progress and are prepared for assessment where they can demonstrate their achievement of the learning outcomes.

Constructive Alignment



Adapted from source: Lori W. Anderson, “Curricular Alignment: a Re-Examination

Design of Learning Activity



Source: Rethinking Pedagogy for a Digital Age, Edited by Helen Beetham and Rhona Sharpe

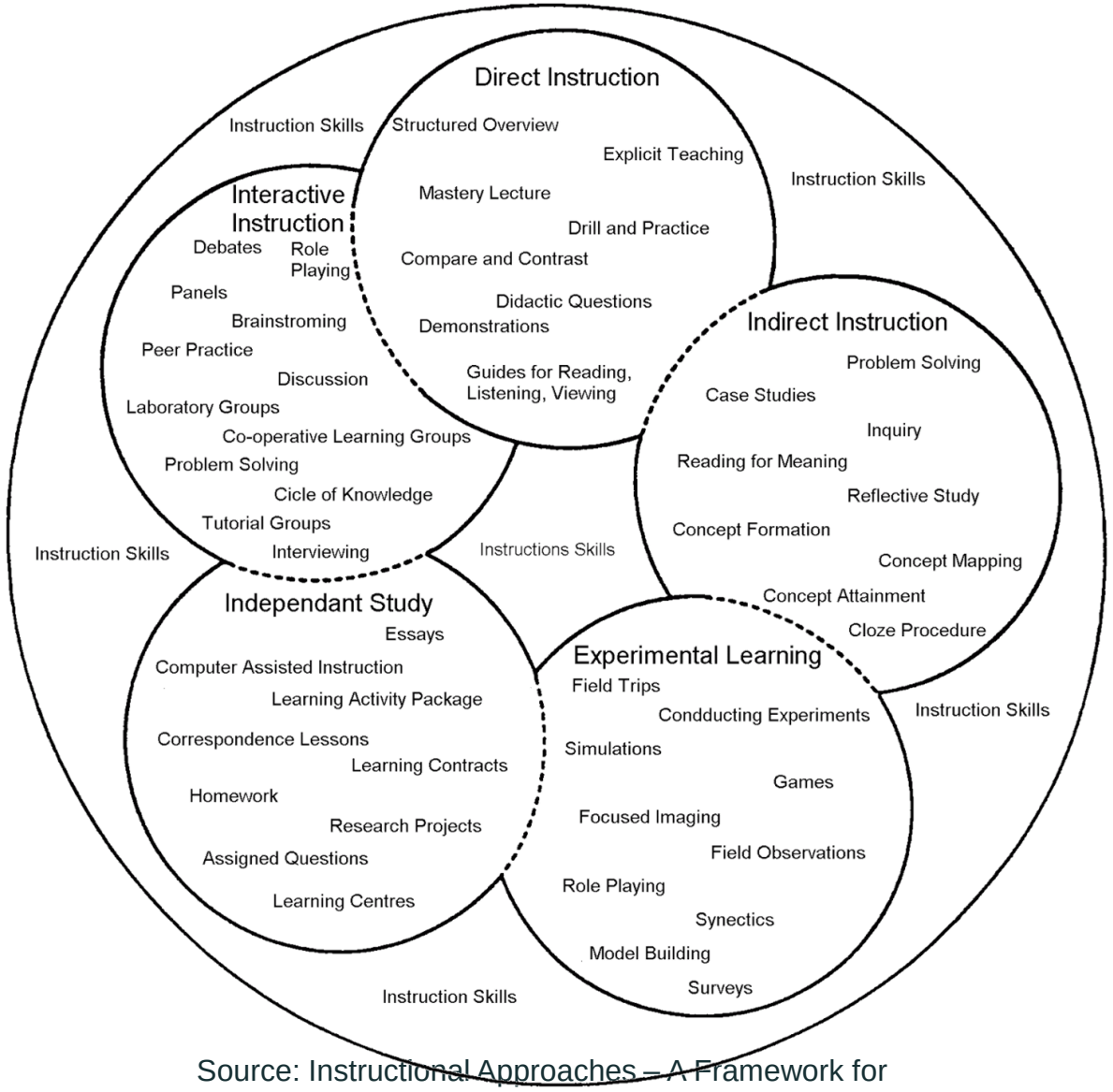
Example:
Course: Engineering project in community

Course/lesson learning outcomes	Learners	Learning Environment	Others-Teaching Activities (what teacher does)	Learning Activities (what the student do)
To solve problems using interdisciplinary approaches in an ethical and socially responsible way	Third year students from several disciplines or departments	• Communities • University	• Facilitators • Advisors	1. Group works (a lot of activities responsible by group members) 2. Do project serving communities

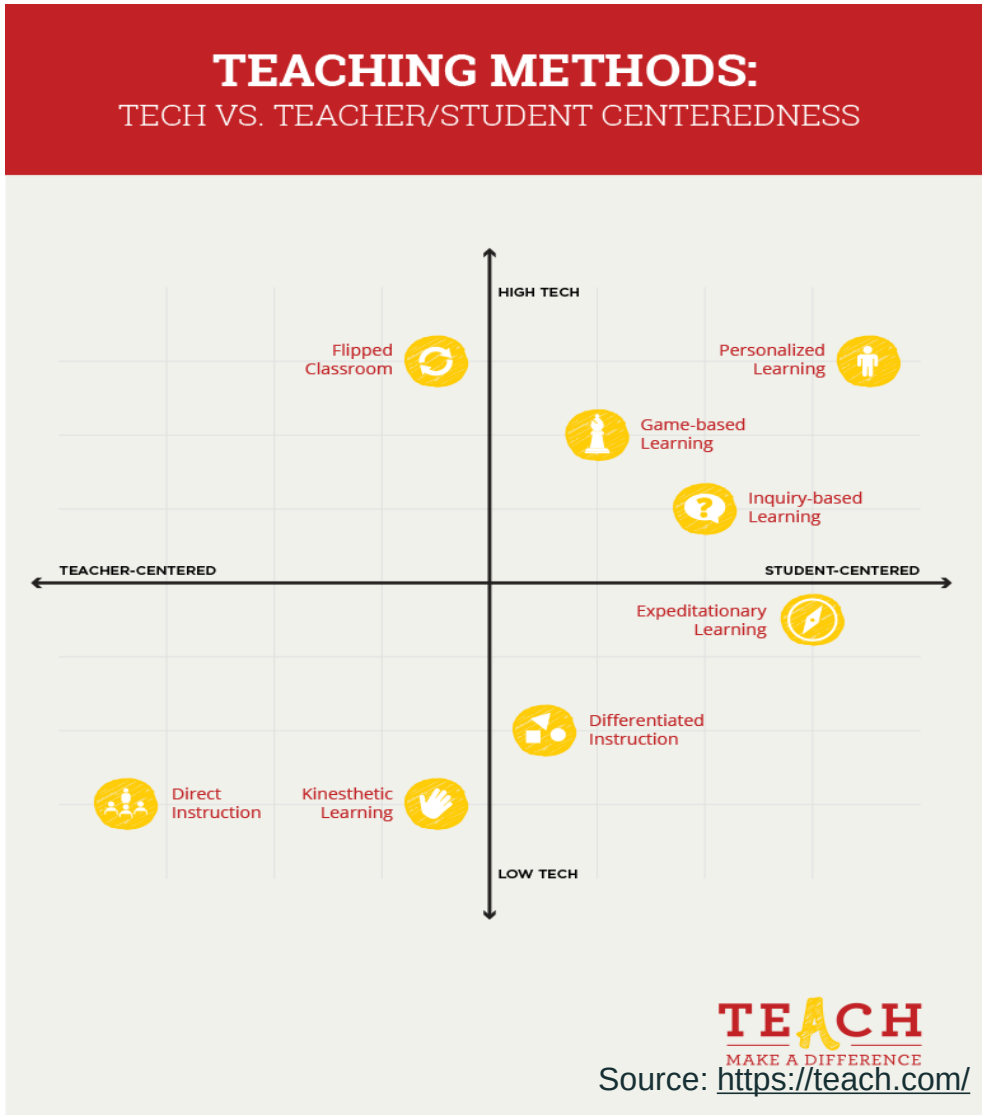
Course:.....

Course/lesson learning outcomes	Learners	Learning Environment	Others-Teaching Activities (what teacher does)	Learning Activities (what the student do)	Assessment Tools

Learning Activities (Instructional Methods)



Source: Instructional Approaches – A Framework for Professional Practice, Saskatchewan Education, 1991



Source: https://teach.com/

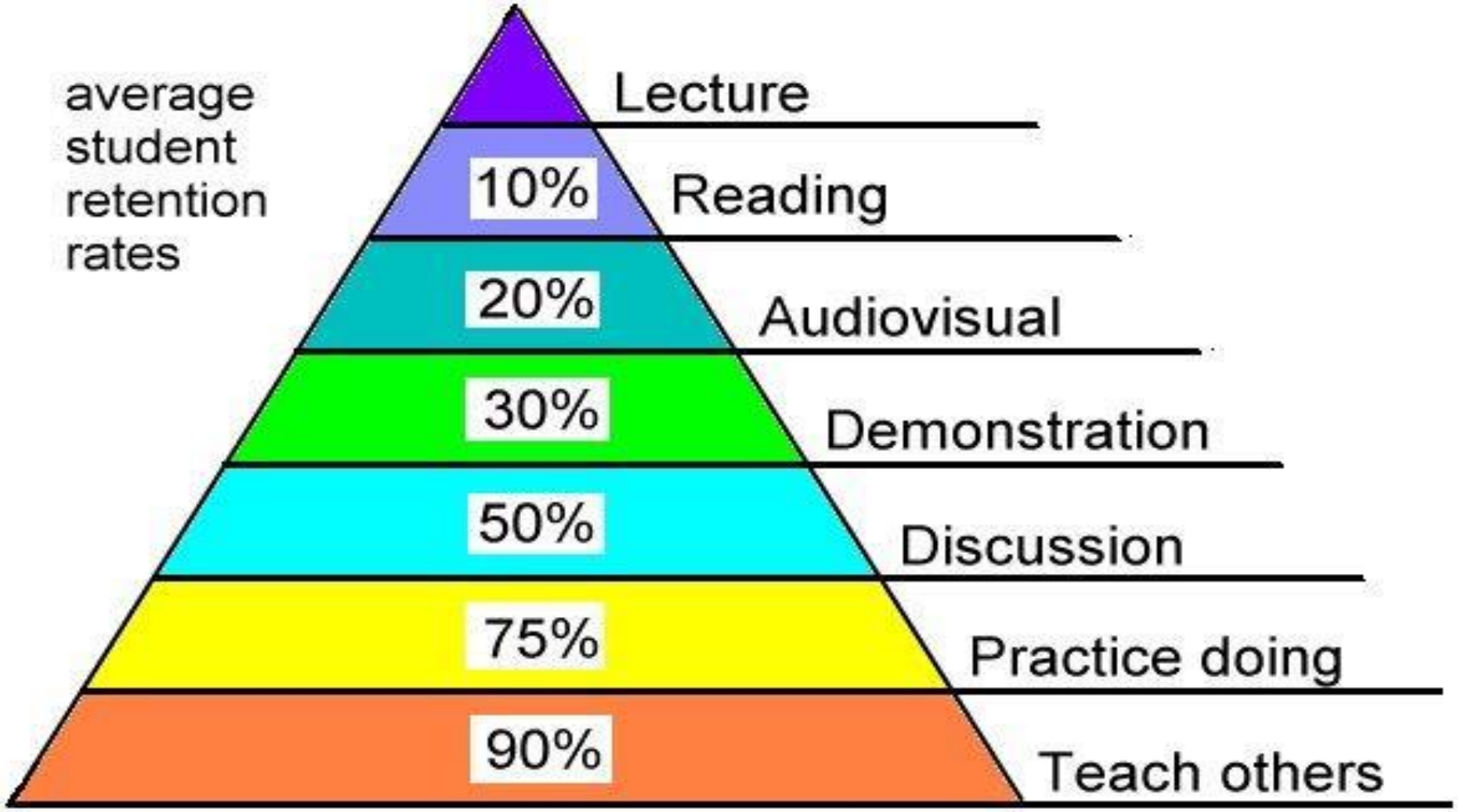
Table 11.1 Teaching Methods Found to Be Effective for Helping Students Achieve Different Learning Outcomes

Outcome Method	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Cognitive Development	Shift in Models
Lecture	X							
Interactive lecture	X	X	[a]	[a]	[a]	[a]	[a]	
Recitation	X	X						
Directed discussion		X	[a]	[a]	[a]	[a]	[a]	[a]
Writing/speaking exercises		X	X	X	X	X		
Classroom assessment techniques		X	X	X		X		
Group work or learning		X	[a]	[a]	[a]	[a]	[a]	
Student-peer feedback		X		X		X		
Cookbook science labs		X	X					
Just-in-time teaching	X	X						X
Case method			X	X	X	X	X	
Inquiry based or inquiry guided	X[b]	X	X	X	X	X	X	X
Problem-based learning	X[b]		X	X	X	X	X	
Project-based learning	X[b]	X	X	X	X	X		
Role plays and simulations		X	X	X		X		X
Service-learning with reflection			X	X	X	X		X
Fieldwork/clinicals	X		X	X	X	X	X	X

NOTE: An X indicates this method can help students achieve this learning outcome if the method is properly implemented to serve this outcome. Poor implementation or implementation for other ends may mitigate against students' achieving the outcome.
[a]Depends on the lecture-break tasks, the discussion questions, or the group tasks assigned.
[b]The knowledge acquired may be narrowly focused on the problem or project.

Source: "Teaching At Its Best" 3rd Edition, Linda Nilson,

Learning Pyramid

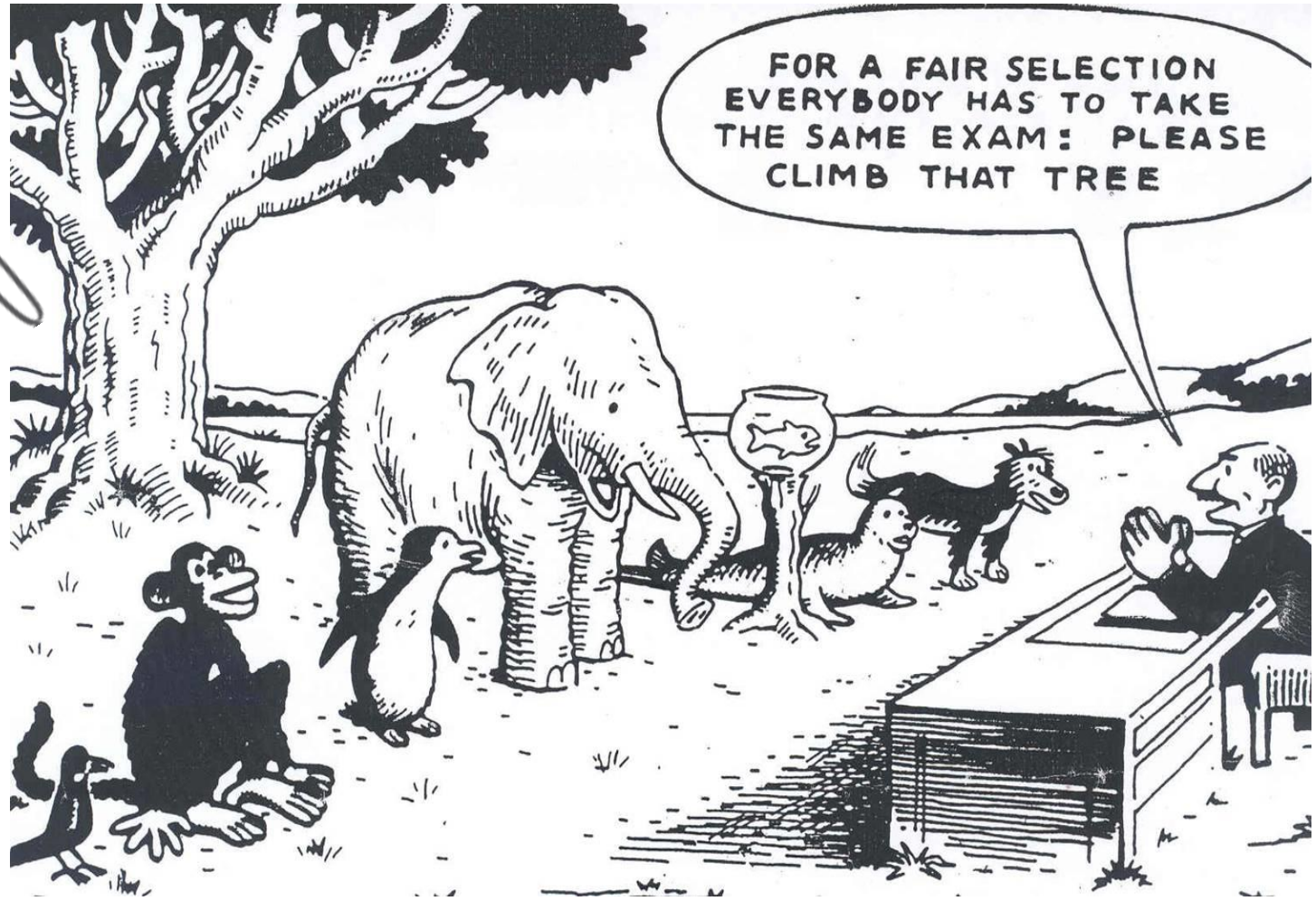


Source: National Training Laboratories, Bethel, Maine

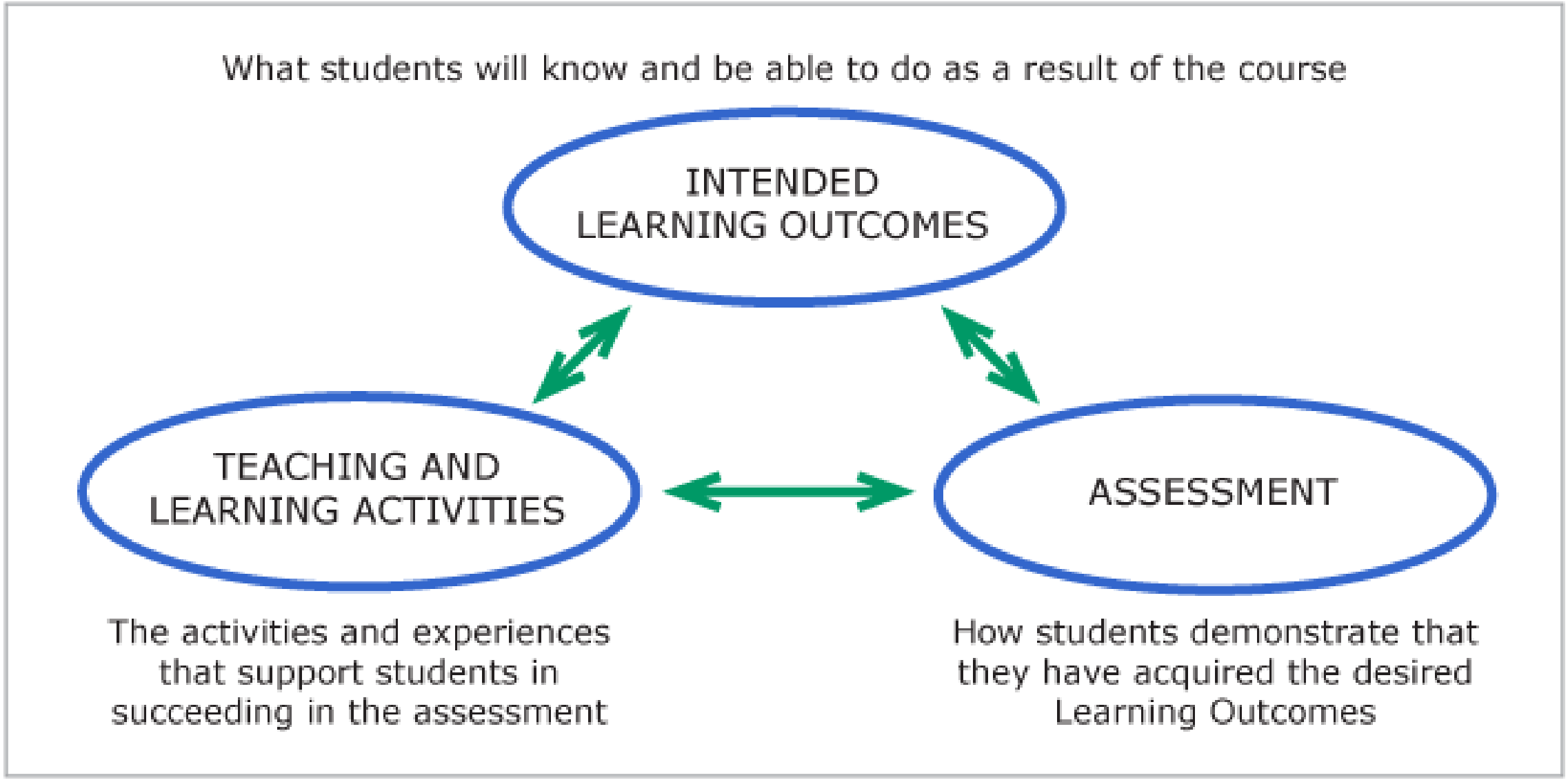
Do they learn?

Student Assessment

Do they learn?



Constructive Alignment



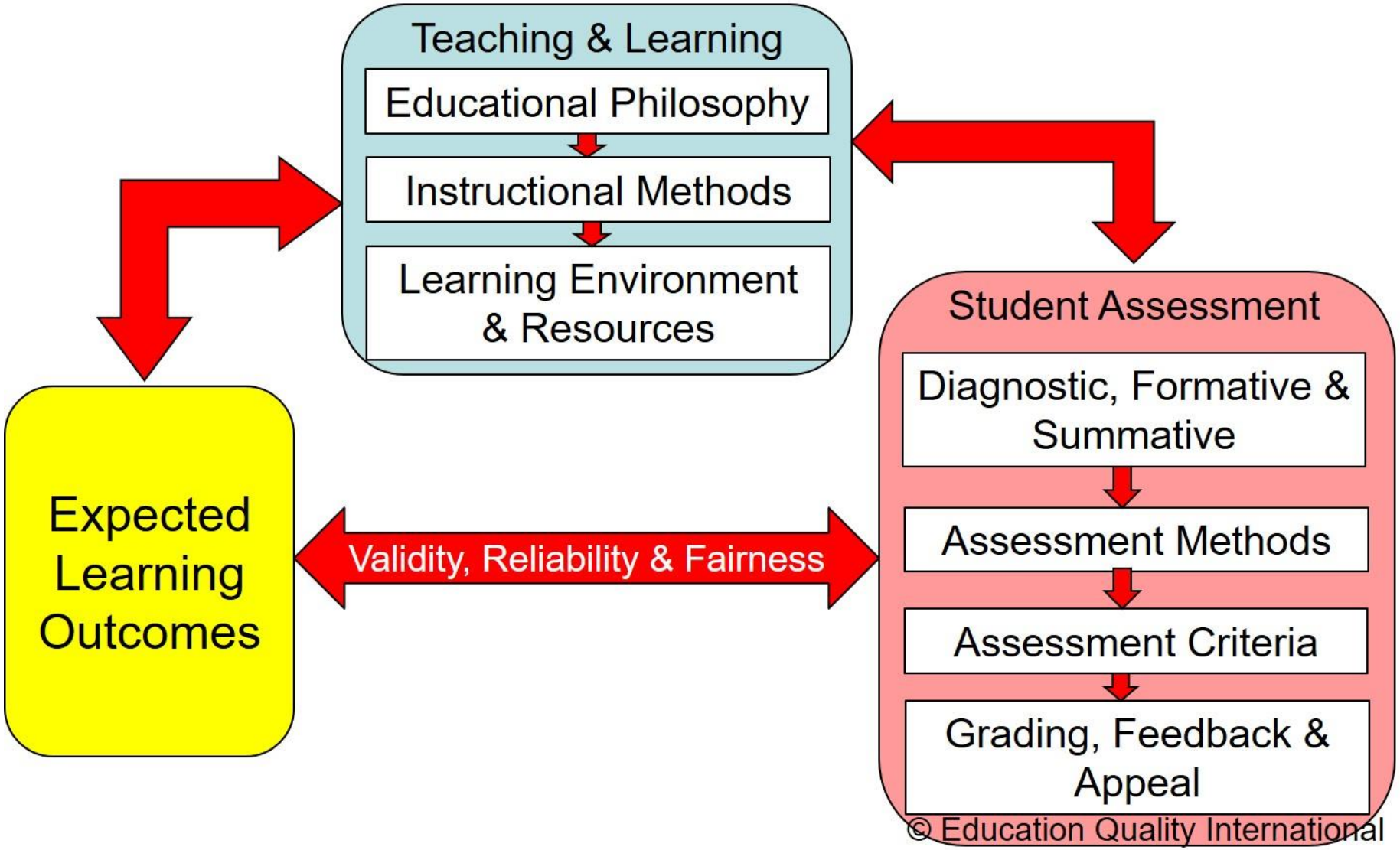
Student Assessment

It is also important that assessment aligns with learning outcomes. In an outcomes-based learning environment the focus is on helping a variety of learners achieve learning outcomes.

By definition, learning outcomes are performance-based. Learners must go beyond knowing to being able to *show what they know*.

In short, well planned assessments allow learners to demonstrate that they have achieved the learning outcome(s) or provide feedback that identifies the progress they are making towards their achievement.

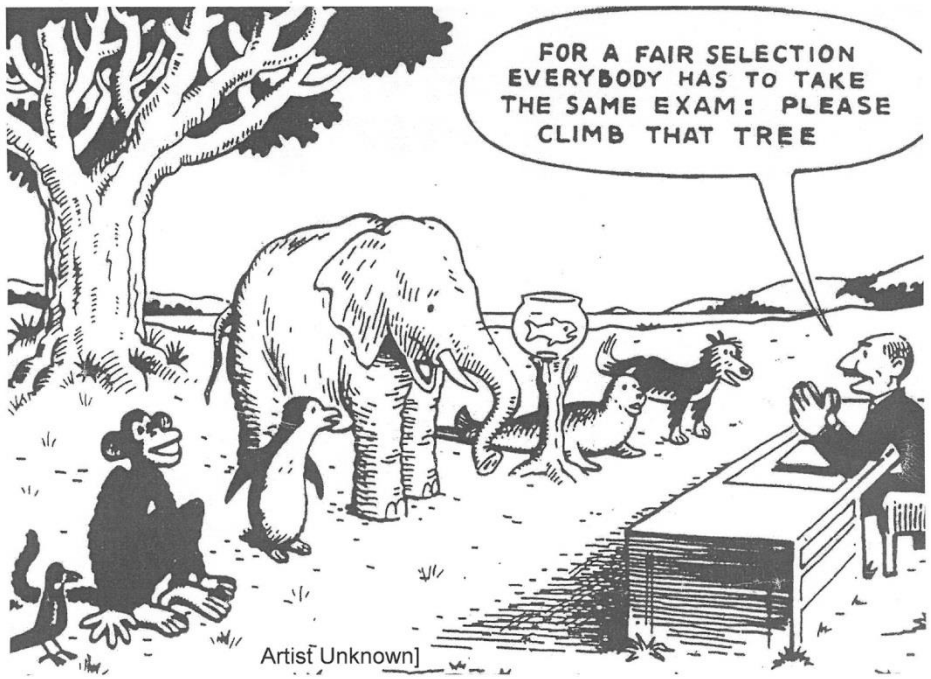
Student Assessment



Student Assessment

Principles of Assessment

- Validity
- Reliability
- Flexibility
- Fairness



Student Assessment

- **Diagnostic assessment** is used to help students identify areas of strengths and weaknesses, as well as potential abilities

- **Formative assessment** refers to constructive **feedback** given to the students while they are actually undergoing learning so as to effect improvement

- **Summative assessment** is used to measure the extent of learning that
- has taken place at the end of a course or a part of a course.

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Assessment Methods

- MCQs
- Short Answer Test
- Essay
- Performance Test
- Written Test
- Fieldwork/Practicum
- Projects
- Laboratory Test
- Thesis
- Presentation
- Portfolios
- Case Studies
- Posters
- Journals/Blogs

Learning outcomes assessment methods

Direct Assessment

- Standardize tests
- Licensure or professional exams
- Rubrics for evaluating
  - *Essays/Papers*
  - *Exam questions*
  - *Exhibits*
  - *Performance/Presentations*
  - *Portfolio of student work*
  - *Comprehensive exams*

Indirect Assessment

- Surveys
  - *Student*
  - *Alumni*
  - *Employer*
- Course Memos
- Focus group
- Exit interviews

Q & A