B. Sc. Physics studies Student-Centered Learning Competences & Learning Outcomes

Support to strengthening the higher education system in Azerbaijan

Twinning project ENI/2018/395-401

Competences and Learning Outcomes

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https://serc.carleton.edu/integrate/programs/workforceprep/competencies_and_LO.html

- **Competency:** A *general* statement that describes the desired knowledge, skills, and behaviors of a student graduating from a program (or completing a course). Competencies commonly define the applied skills and knowledge that enable people to successfully perform in professional, educational, and other life contexts.

- **Outcome:** A very *specific* statement that describes exactly what a student will be able to do in some measurable way. There may be more than one measurable outcome defined for a given competency.

Ref. Exploring the assessment of twenty-first century professional competencies of undergraduate students in environmental studies through a business—academic partnership, Dave Gosselin, Sara Cooper, Ronald J. Bonnstetter, Bill J. Bonnstetter, Journal of Environmental Studies and Sciences, June 2013.

Definition by Declan Kennedy, in *Writing and Using, Learning Outcomes. A Practical Guide*, Quality Promotion Unit, UCC, 2007

- Learning outcomes focus on what the student has achieved rather than merely focussing on the content of what has been taught.
- Learning outcomes focus on what the student can demonstrate at the end of a learning activity.

→ A good working definition:

Learning outcomes are statements of what a student is expected to know, understand and/or be able to demonstrate after completion of a process of learning.

https://ec.europa.eu/education/ects/users-guide/docs/ects-users-guide_en.pdf

The programme learning outcomes

→ are based on the programme profile and describe what a student knows, understands and is able to do on completion of the programme.

Formulating programme learning outcomes

Considerable care needs to be taken in formulating learning outcomes. The following non-exhaustive list provides a set of guidelines which has proved to be helpful.

- The learning outcomes should adequately reflect the context, level, scope and content of the programme.
- The statements of learning outcomes have to be succinct and not too detailed.
- The learning outcomes have to be mutually consistent.
- The learning outcomes should be easily understandable and verifiable in terms of what the student has actually achieved at the end of the programme.
- The learning outcomes have to be achievable within the specified workload.
- The learning outcomes have to be linked with appropriate learning activities, assessment methods and assessment criteria.
- There are no rules on the ideal number of learning outcomes at programme level. Experience suggests that between 10 and 12 is appropriate.

Formulating programme learning outcomes

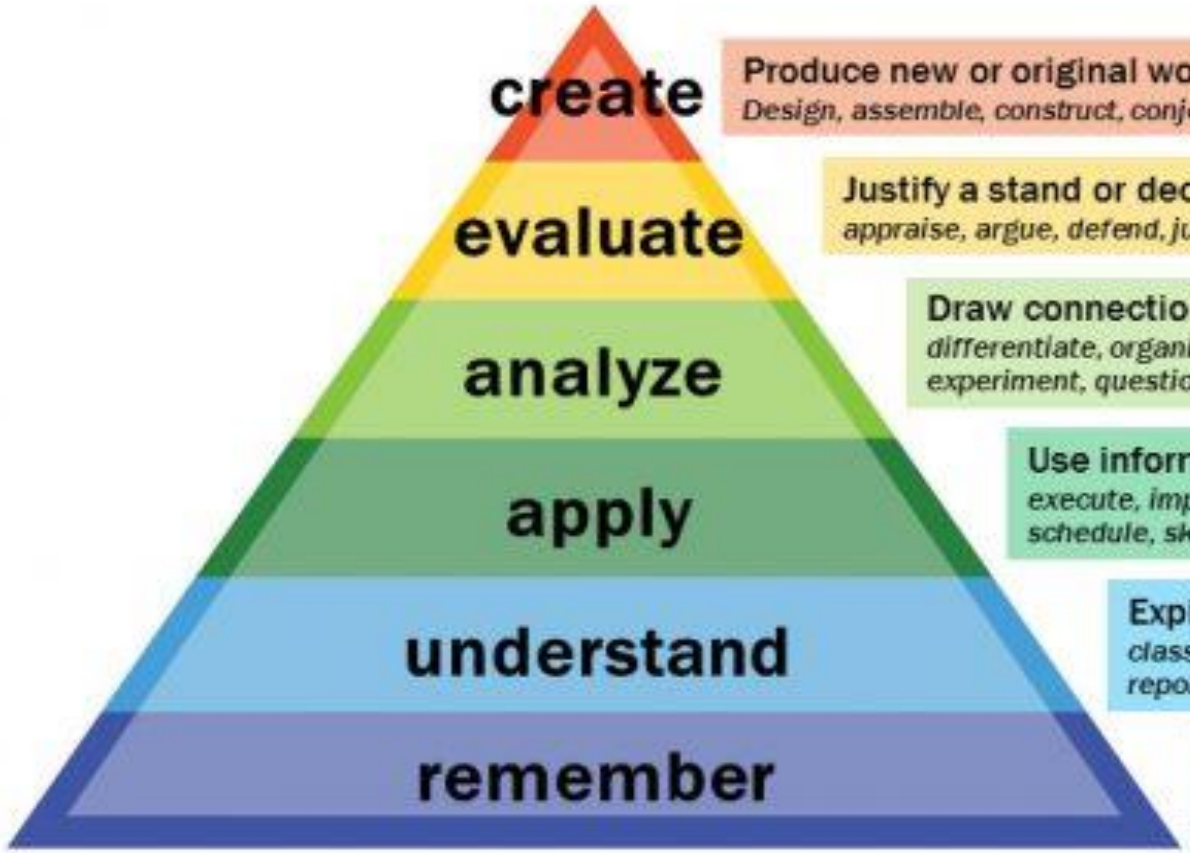
A widely accepted way of formulating learning outcomes is based on three essential elements.

1. Use an active verb to express what students are expected to know and be able to do (e.g. graduates can ‘describe’, ‘implement’, ‘draw conclusions’, ‘assess’, ‘plan’).

2.Specify what this outcome refers to (object or skill e.g. can explain the ‘function of hardware-components’, or can present the ‘design of a living-room by hand’).

3.Specify the way of demonstrating the achievement of learning outcomes (e.g. ‘to give an overview of the materials most often used in electro-engineering’; ‘to develop a research design by applying up-to-date scientific methods’, etc.)

Bloom's Taxonomy



Produce new or original work
Design, assemble, construct, conjecture, develop, formulate, author, investigate

Justify a stand or decision
appraise, argue, defend, judge, select, support, value, critique, weigh

Draw connections among ideas
differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test

Use information in new situations
execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch

Explain ideas or concepts
classify, describe, discuss, explain, identify, locate, recognize, report, select, translate

Recall facts and basic concepts
define, duplicate, list, memorize, repeat, state

B. Sc. Physics – General competences / Ability to/for …	
Establish his role and mission within an organization to adapt and take initiatives.	GC1
Identify, select, analyse and summarize various specialized resources to document a subject	GC2
Respect the principles of ethics, ethical and environmental responsibility.	GC3
Abstract thinking, analysis and synthesis, and develop argumentation with critical mind.	GC4
Working as part of a team while being independent and responsible with respect to a project.	GC5
Identify the professional fields potentially in relation to the achievements of the bachelor curriculum.	GC6
Characterize and enhance his identity, his skills and his professional project according to a context.	GC7
Able to step back from a situation, self-evaluate and questioning himself in order to improve knowledge and skills	GC8
Use digital tools of reference and the rules of computer security to acquire, process, produce and disseminate information as well as to collaborate internally and externally.	GC9
Identify and select various specialized resources to document a subject.	GC10
Understand, speak and write currently in at least one foreign language.	GC11

B. Sc. Physics – Professional competences

Mobilize the basic concepts in order to: simulate, analyse and solve simple problems	PC1
Address a complex problem and solve it step by step	PC2
Identify the different steps of an experimental approach and perform it.	PC3
Use the measurement devices and measurement techniques commonly used in the lab and in different areas of physics.	PC4
Interpret the experimental data in order to be able to simulate them.	PC5
Probe a model upon comparing its predictions to experimental results and assess its validity range.	PC6
Identify the sources of errors for an experimental result in order to assess its uncertainty range.	PC7
Suggest analogies, estimate orders of magnitude, and be able to understand their meaning.	PC8
Use the main mathematical tools relevant for physics.	PC9
Handle the basic mechanisms at the microscopic scale, simulate the macroscopic phenomena, and make the bridge between macro and micro.	PC10
Make a sound use of some data acquisition and analysis software	PC11
Use an up-to-date programming language	PC12
Identify the currently used techniques in the areas of: fluid mechanics and solid state mechanics, materials science, chemistry, geosciences, thermodynamics and thermal engineering, computer sciences, astronomy	PC13
Identify the peculiar regulations and implement the main preventive measures regarding health and safety system.	PC14

GC1	GC2	GC3	GC4	GC5	GC6	GC7	GC8	GC9	GC10	GC11	
	1			2		3		4		5	Sumqait Tecno Park

PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10	PC11	PC12	PC13	PC14	
		1	2		3	4	5	6	7		8	9		Sumqait Techno Park

B. Sc. Physics
Proposal for a revised syllabus

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Goals of the proposal

- Introduce interdisciplinarity
- Improve modelisation tools (maths+computer science)
- Maintain the ratio of the physics corpus to the overall curriculum
- Target practical work as a leading tool for physics study (25 % wt)
- Clearly states the mandatory study of soft skills
- Mimics without copy/pasting the curriculum of the faculty of physics & engineering of the University of Strasbourg (reproduce the respective weight of each subject while maintaining the former NSHE structure)

Comparison between present standards & proposal