Radiation protection training for master students :
From formulation of competences to design of learning activities and evaluation of the learning outcomes

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content

Part 1 : general context from QA to constructive alignment in practical competence building at uhasselt

Part 2 : example for applied radiochemistry master course

Part 3 : short exercise using AI support starting from RPE roles

Quality assurance of an educational program

At all levels

- From institution to program and individual course

With internal and external stakeholders

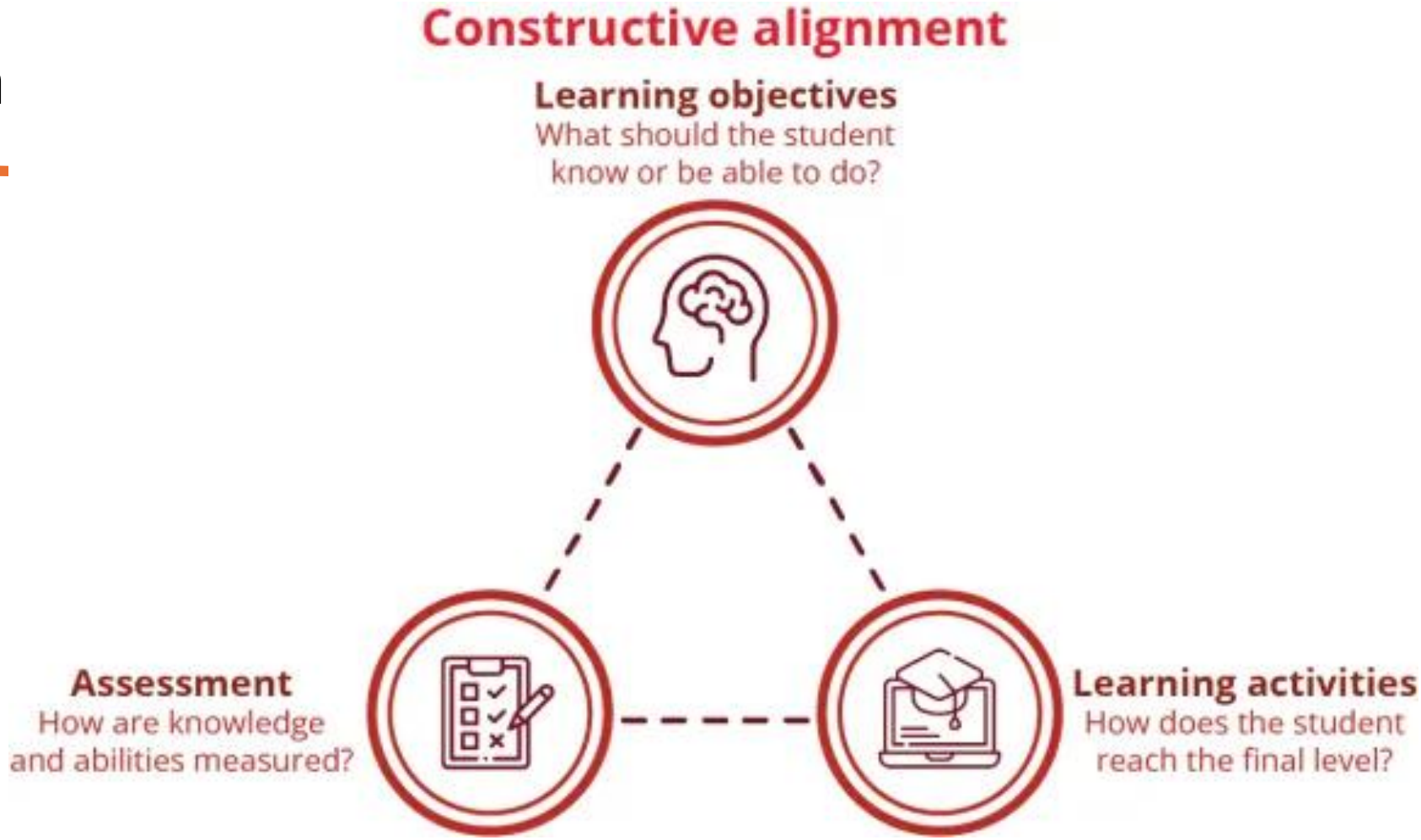
- Professors, students, alumni, workfield and experts

Continuous monitoring and adjustment

Educational policy : institutional strategic plan and program strategic plan

- **Innovative education**
- **Competences are built throughout a curriculum, repeated but at different levels**

Competency based education



Constructive alignment steps

Societal and regulatory needs, professional roles

Define core competences and sub-competences

Mapping across the courses of a curriculum/module/…: matrix

Develop learning activities : teach as you preach, by competent teachers

Evaluation criteria related to activity and competence level

Continuous quality improvement and adjustment to new challenges

Aim of this presentation

@UHasselt

Master students industrial engineering in nuclear technology

competent to work as

future **RPE**s

Radiation Protection in EU outlined in the Council Directive 2013/59/Euratom (BSSD)

Defines **role of RPE** –

an individual or a group of individuals having the **knowledge, training, and experience** needed

to **give radiation protection advice**

whose **competence to do so is recognised** by the Competent Authority

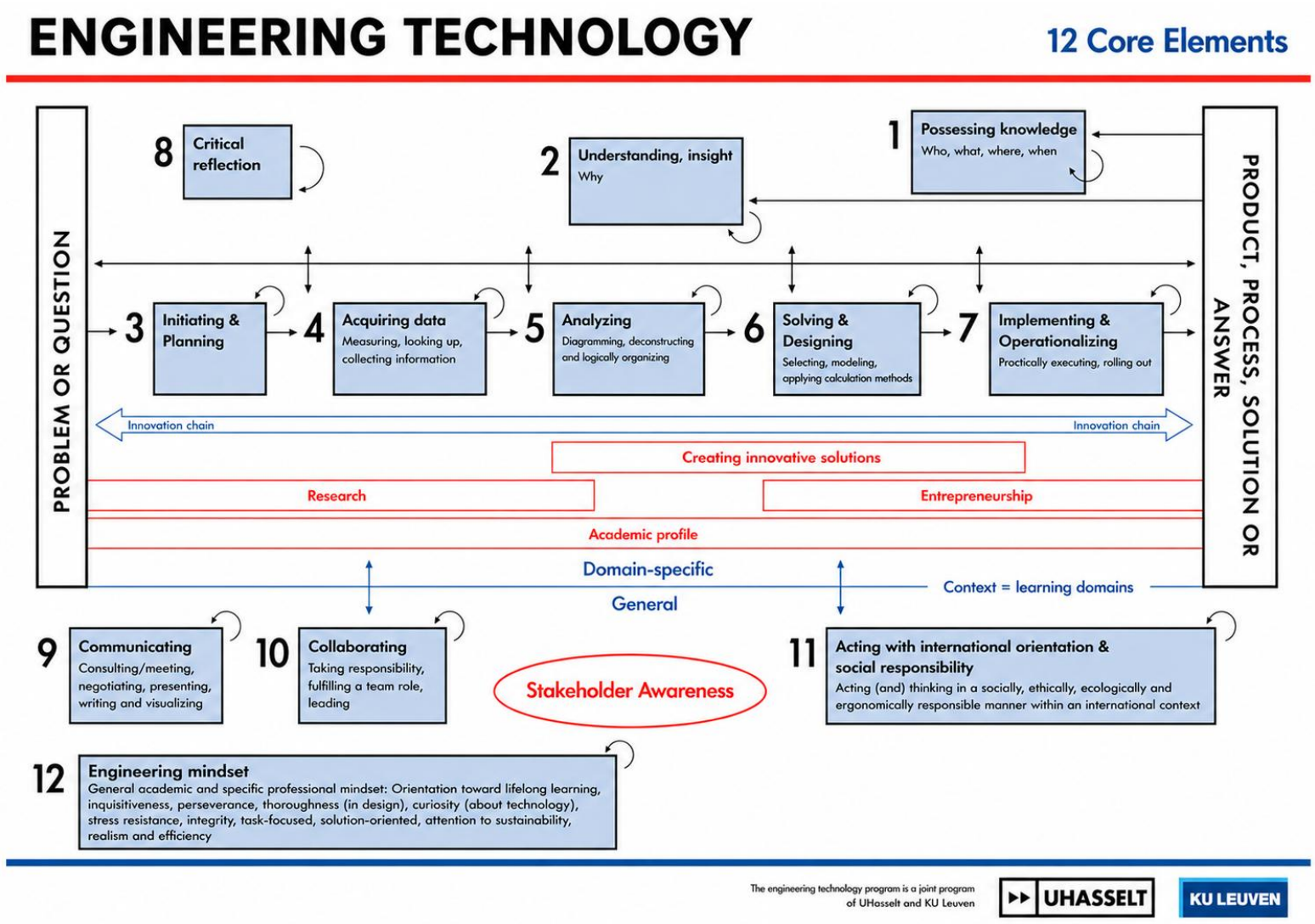
NT educational program starts at 2Ba sem 2

Bachelor programs

universal **12 core elements** model for the profile of an industrial engineer (end competences)

divided in sub-competences and related to the learning domains for specific programs like NT

The level is increased in a learning path or learning domain of courses which are connected.



Master: broadens and deepens KSA in Nuclear technology

- 4 End competences + 1extra specialization
- The **core elements** are still linked in the **sub-competences**
- Matrix mapping of sub-competences to individual courses

	Master NT - gemeenschappelijk										Master NT - Milieu					Master NT - Nucleair en medisch				
Competentieprofiel opleiding Academiejaar 2023-2024 Master NT	2655 ITC: Duits	2909 ITC: Engels	2908 ITC: Frans	3209 Bedrijfsmanagement	2801 Stralingsbescherming & dosimetrie	4276 Nuclear materials	4277 Fuel cycle, waste and decommissioning	4481 Toegepaste radiochemie	4278 Internationaal leren	2169 Image processing	4280 Radio-ecologie	4281 Circulaire milieutechnologie	4282 Milieuanalyse: chemisch & radiologisch	4670 Milieuchemie	3642 Masterproef - Nucleaire technologie: milieu	4843 Stralingsfysica 2	4285 Reactorfysica	4286 Nucleaire en medische elektronica	4842 Radiotherapy and dosimetry	2784 Masterproef - Nucleaire technologie: nucleair en medisch
	3	3	3	3	3	3	3	5	3	3	3	4	6	4	20	4	5	3	5	20
	K	K	K	V	V	V	V	V	K	K	V	V	V	V	V	V	V	V	V	V
EC1 - Professioneel denken en handelen	**x**	**x**	**x**	**x**	**x**		**x**	**x**	**x**	**x**			**x**	**x**	**x**		**x**	**x**	**x**	**x**
DC8 - Kritisch reflecteren	X	X	X	X	X		X		X					X	X		X			X
DC9 - Communiceren	X	X	X		X		X	X	X				X	X	X		X	X	X	X
DC10 - Samenwerken								X	X				X		X			X	X	X
DC11 - Internationaal en maatschappelijk	X	X	X				X		X					X	X			X		X
DC12 - Ingenieursattitude	X	X	X	X			X	X	X				X	X	X		X	X	X	X
EC2 - Onderzoeken en innoveren binnen multidisciplinair project	**x**	**x**	**x**	**x**											**x**		**x**			**x**
DC1 - Kennis bezitten	X	X	X	X											X		X			X
DC2 - Begrijpen	X	X	X	X											X		X			X
DC3 - Initiëren en plannen	X	X	X												X		X			X
DC4 - Data verwerven	X	X	X												X		X			X
DC5 - Analyseren	X	X	X	X											X		X			X
DC6 - Oplossen en ontwerpen				X											X		X			X
DC7 - Implementeren en operationaliseren	X	X	X												X		X			X
DC8 - Kritisch reflecteren				X											X		X			X
EC3 - Deskundigheid in stralingsbescherming en stralingshygiëne					**x**						**x**					**x**				
DC1 - Kennis bezitten					X						X					X				
DC2 - Begrijpen					X						X					X				
DC3 - Initiëren en plannen					X						X					X				
DC4 - Data verwerven					X						X					X				
DC5 - Analyseren					X						X					X				
DC6 - Oplossen en ontwerpen					X											X				
DC7 - Implementeren en operationaliseren					X						X					X				
DC8 - Kritisch reflecteren					X						X					X				
EC4 - Deskundigheid in nucleair technologische domeinen						**x**	**x**	**x**		**x**						**x**	**x**	**x**		
DC1 - Kennis bezitten						X	X	X								X	X	X		
DC2 - Begrijpen						X	X	X								X	X	X		
DC3 - Initiëren en plannen						X	X	X								X	X	X		
DC4 - Data verwerven						X		X								X	X	X		
DC5 - Analyseren						X	X	X								X	X	X		
DC6 - Oplossen en ontwerpen						X		X								X	X	X		
DC7 - Implementeren en operationaliseren						X		X								X	X	X		
DC8 - Kritisch reflecteren						X	X	X								X	X	X		

End competences UHasselt: Master NT

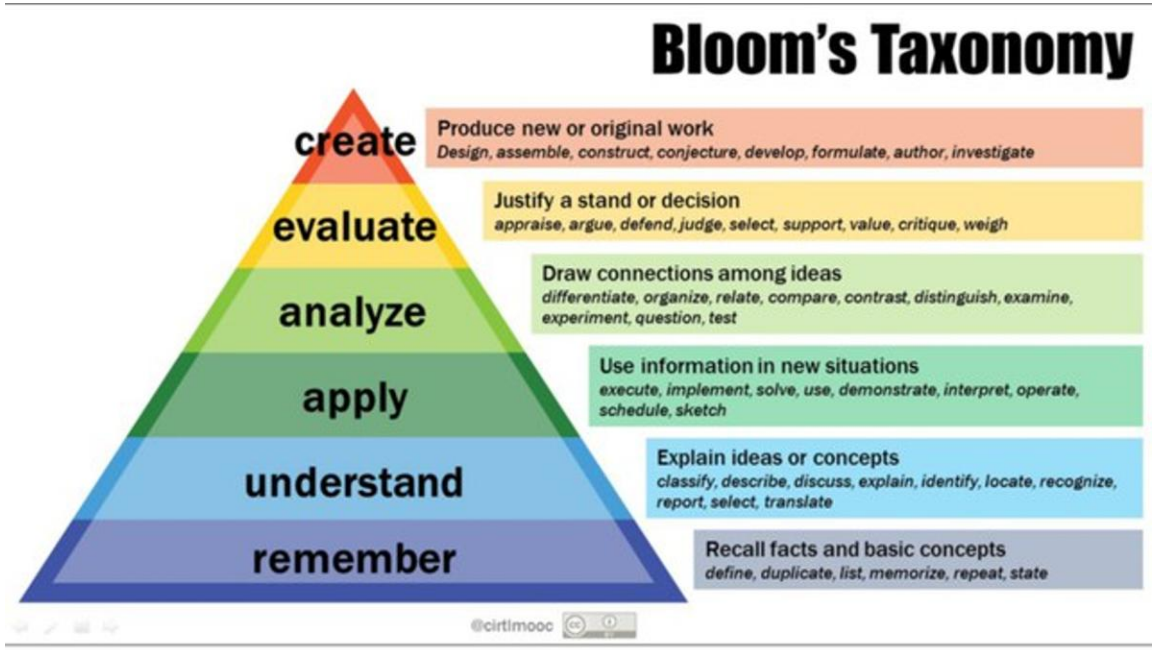
Small number (4+1) : integrating knowledge – skills - attitudes

- EC1 - The Master of Industrial Sciences: Nuclear Technology is able to think and act in one's own professional way -- with an appropriate engineering attitude and with continuous attention to one's own training -- adequately communicate, collaborate effectively, and take into account the economic, ethical, social and/or economic or international context and is aware of the impact on the environment.
- EC2 - The Master of Industrial Sciences: Nuclear Technology masters a set of nuclear techniques and technologies and can creatively conceive, plan and implement them as an integrated part of a methodologically and project-based sequence of actions within a multidisciplinary project with an important research and /or innovation component.
- EC3 - The Master of Industrial Sciences: Nuclear Technology has advanced application-oriented expertise in radiation protection and radiation hygiene.
- EC4 - The Master of Industrial Sciences: Nuclear Technology has acquired specialized and in-depth knowledge, understanding and skills in nuclear technological domains such as reactor technology, nuclear physics, **radiochemistry,** nuclear measurements, nuclear electronics and nuclear software applications of signal processing algorithms and systems.
- EC5 - The Master of Industrial Sciences: Nuclear Technology (main subject "Nuclear and Medical"), has acquired specialized and in-depth knowledge, insight and skills in medical nuclear domains such as medical dosimetry, application of radiation in medicine, technology of radiology and radiotherapy.
- EC6 - The Master of Industrial Sciences: Nuclear Technology (main subject "Environment") has acquired specialized and in-depth knowledge, insight and skills in environmental technology domains such as environmental analysis, the approach and prevention of environmental problems, environmental process technology, environmental regulation and sustainable materials and energy management.

Why defining evaluation criteria alongside end competences?

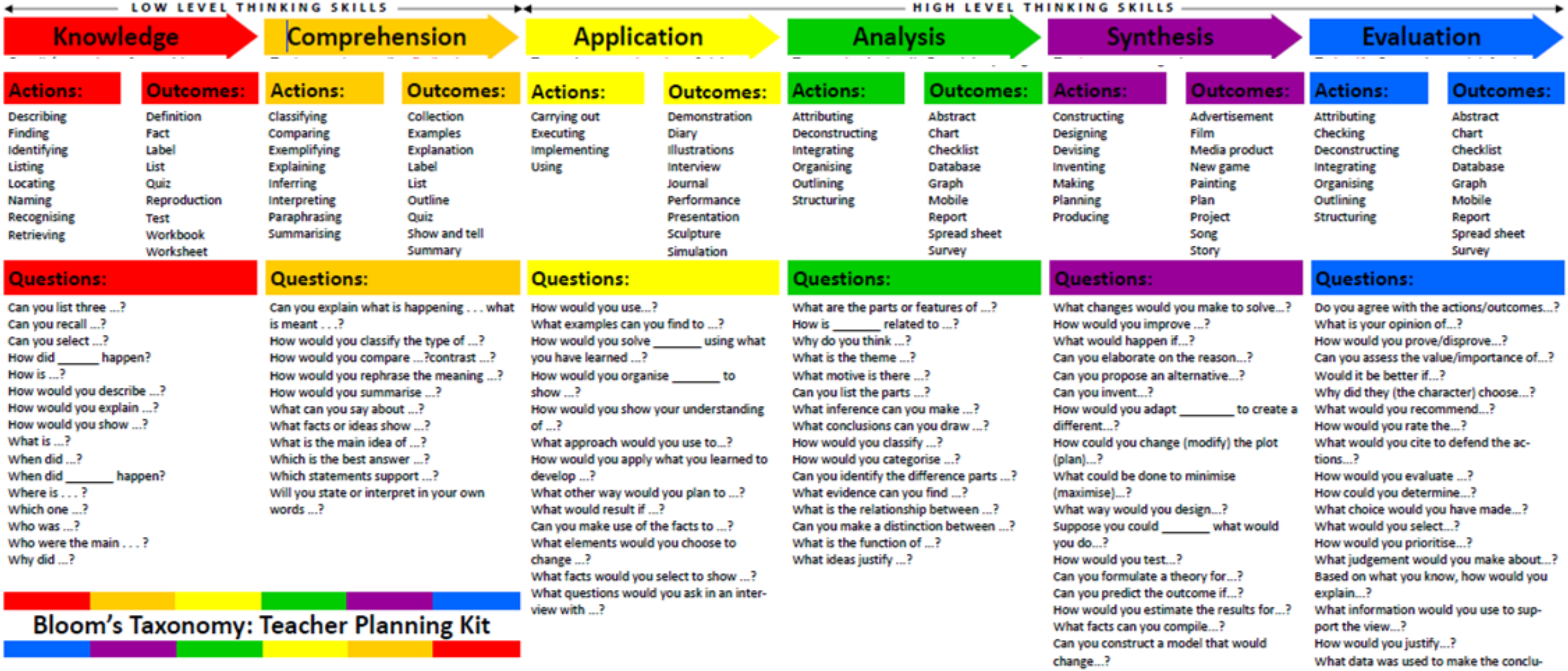
- Support the quality of evaluation within constructive alignment
  - ✓ between assessment and learning activity
  - ✓ between assessment and learning outcomes (sub-competences of a course linked to the learning domain)
- translation using active verbs and outcomes (blooms taxonomy!)
- Help to evaluate
  - Objectively
  - Reliable
  - Transparent (ECTS fiche-studyguide)

Verb table helps to formulate criteria which can be **quantified**



Center for Teaching. (n.d.). Retrieved August 22, 2016, from https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/

Verbs tables related to levels of Bloom Taxonomy



Applied Radiochemistry

Studyguide : complete description of course

contract with the student

5 ECTS sem 2 master

1 ECTS : introduction to LSC, lab waste management and tracers

4 ECTS : Practical sessions (40h)

Attendance is obliged

Evaluation

20% written exam with MCQ and open questions

80% permanent evaluation : lab work, lab report, lab attitude

End Competence 1 - The Master of Industrial Sciences: Nuclear technology is able **to think and act in one's own professional way --** with an appropriate engineering **attitude** and with continuous attention to one's own training -- adequately communicate, collaborate effectively, and take into account the economic, ethical, social and/or international context and is aware of the impact on the environment.

End Competence 4 - The Master of Industrial Sciences: Nuclear Technology has acquired **specialized and in-depth knowledge**, **understanding and skills** in nuclear technological domains such as reactor technology, nuclear physics, **radiochemistry, nuclear measurements**, nuclear electronics and nuclear software applications of signal processing algorithms and systems.

Learning activities

How does the student reach the final level?

- Theoretical course prior to labs
- Labs (by 2) on detection of radioactive sources, preparation of radioactive tracers, quantitative analyses on/with radionuclides, determination and removal radioactive contamination, statistically processing of measurement results, manipulation, waste management produced during the laboratory.
- Through company visits/guest lectures, students come into contact with the latest technologies in the field of radioactive waste management.
- In a team, an assignment is carried out involving the collection of information regarding a specific analysis: writing a laboratory procedure (experiment, waste management, and analysis) and performing the analysis to evaluate the developed material.

Sub EC: The student possesses oral and written (graphical) communication skills.

Evaluation Criteria :

1. The student is able to write a correct and complete **lab report** of the practica: fully **describe** the performed test, display analysis results with correct units, significant figures, and any margin of error, complete presentation of **calculations and graphs**, results and **interpretation and conclusion**. Level 4

2. During the **theory test**, the student can **formulate** his answers in a structured, fluent and correct manner. Level 2

Sub-EC: The student can function constructively and responsibly as a member of a (multidisciplinary) team.

Evaluation Criteria :

4. He/she can collaborate **constructively** in a group and take **responsibility** for the elaboration, execution of tasks and safety regulations. Level 3-5

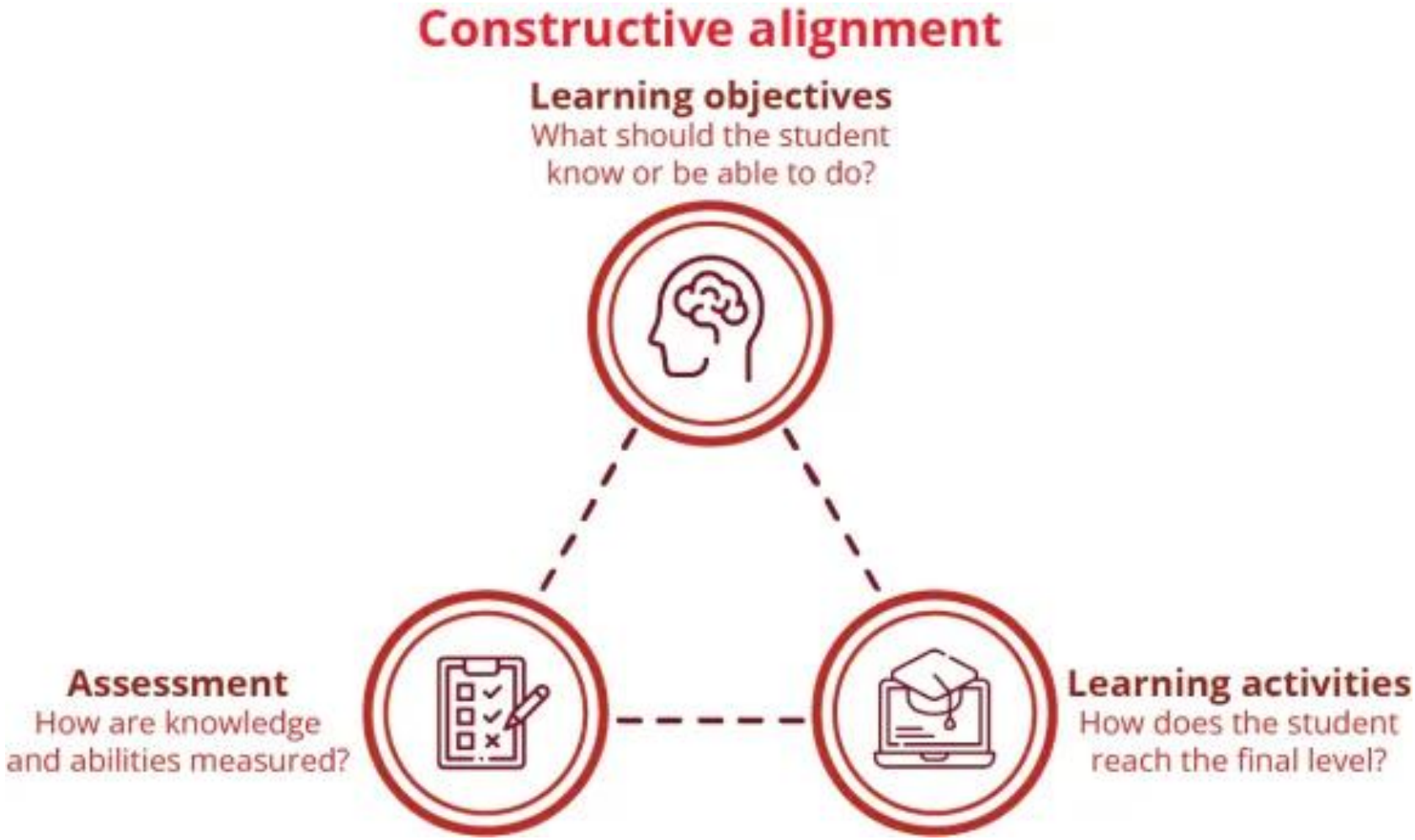
=> labs attitude

Sub-EC: The student demonstrates an appropriate engineering attitude.

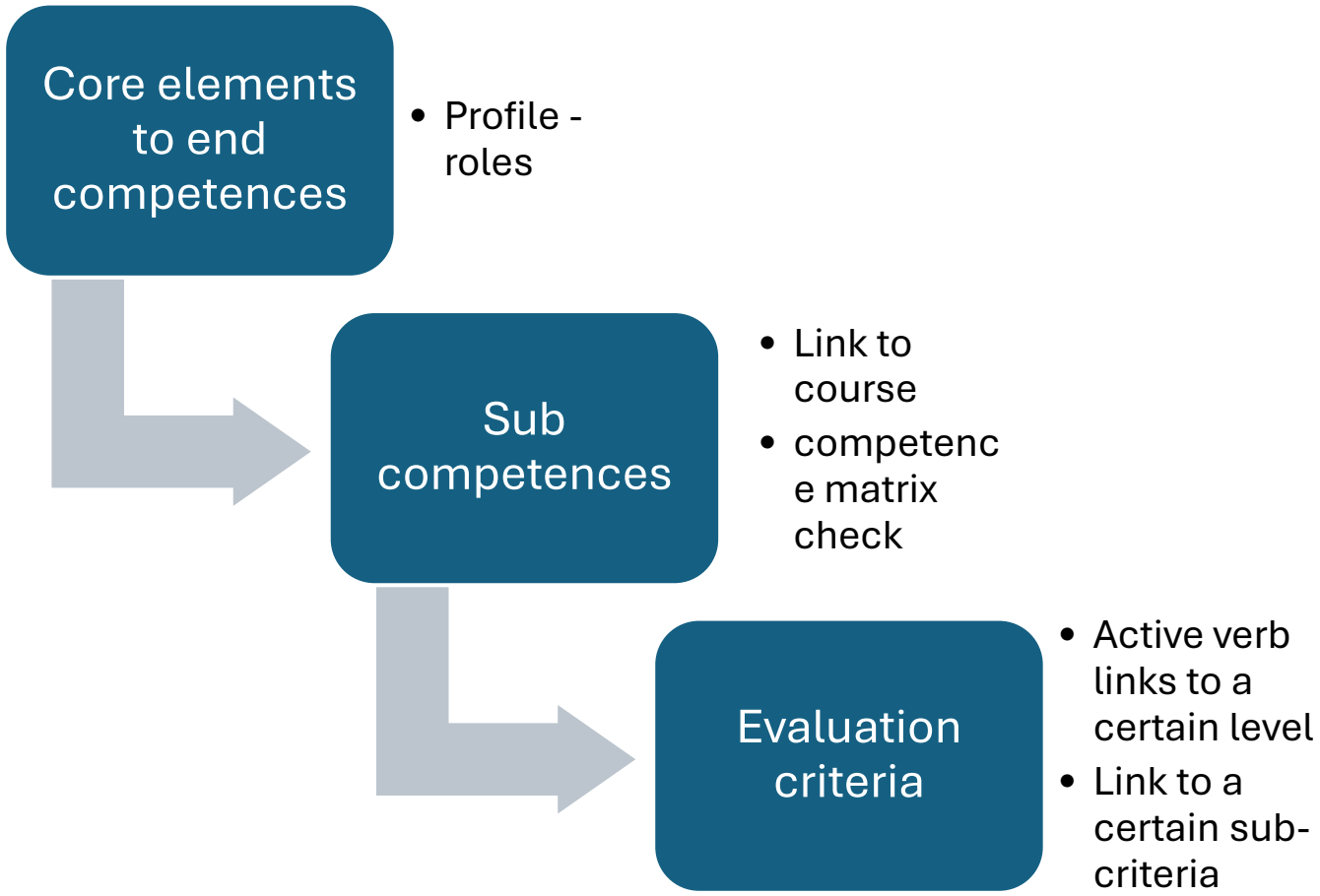
Evaluation Criteria :

7. When designing a group work, he/she takes into account technical and economic preconditions, implications for the environment and assessment of risks (radiation protection and radioactive and chemical waste) and the feasibility of the proposed solution. Level 6

Competency based education



EU-RPE example with help of AI? +>WS 3



NotebookLM
Gemini

Used sources

Final report on the EC study related to the transposition and implementation of the MPE-RPO-RPE in EU (2026...)

Herca Country fact sheets, May 2024

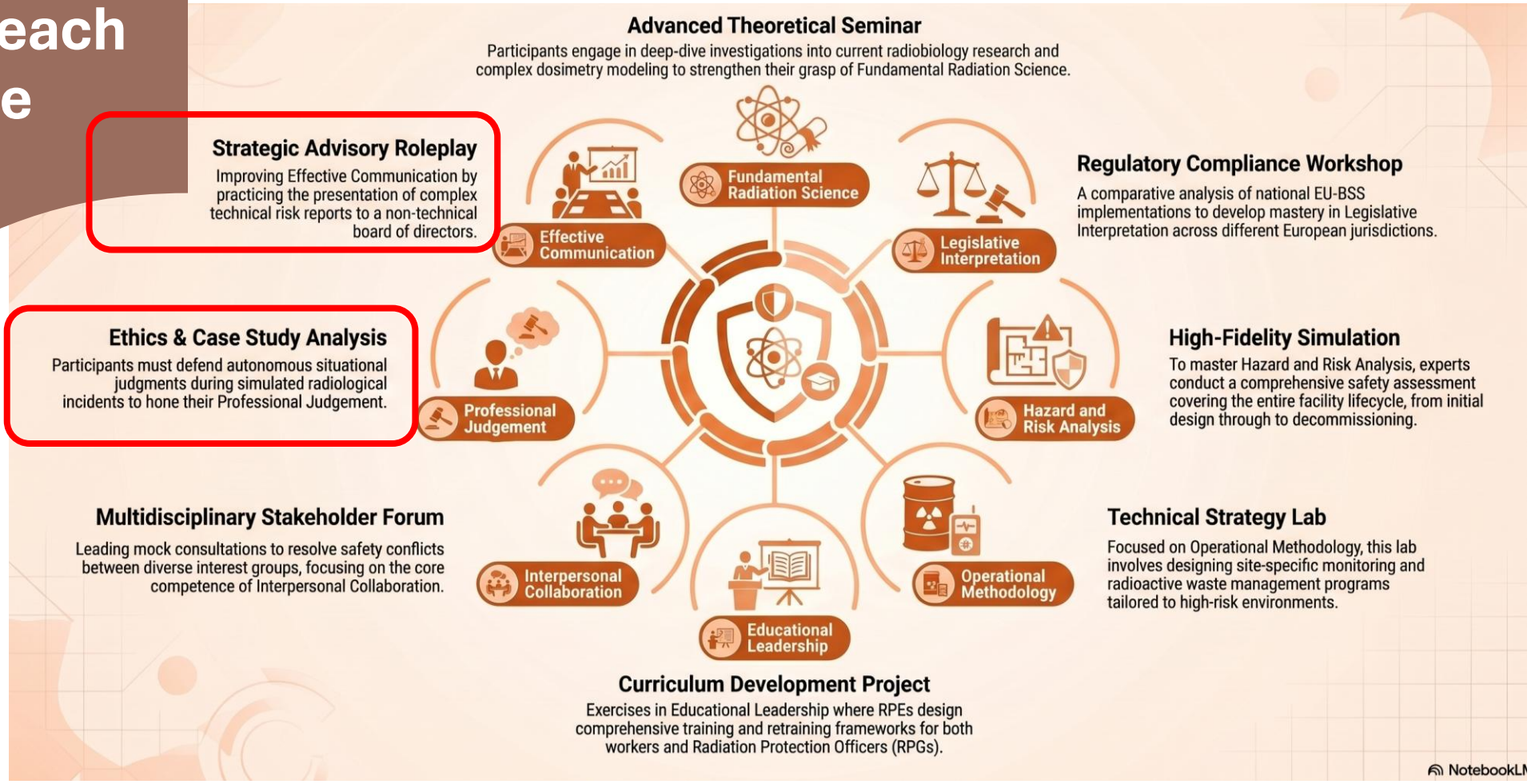
HERCA Guidance document, Nov 2017

BEROEPSKWALIFICATIEDOSSIER Milieucoördinator type A

End competences RPE divided in knowledge, skills and attitudes

use active verbs to translate end competences into levels of Blooms taxonomy		**The RPE is able to**
	Core elements?	
Knowledge	Fundamental Nuclear Science	Critically analyze and integrate complex principles of nuclear physics, (radio)chemistry, biology, and dosimetry to develop advanced safety strategies.
	Legislative Interpretation	Interpret and synthesize national and international radiation protection regulations to ensure organizational compliance in complex legal environments.
Skills	Hazard and Risk Analysis	Formulate comprehensive safety assessments by identifying radiological hazards in complex, novel, or high-risk situations.
	Operational Methodology	Design practical radiation protection methods and technical safety strategies tailored to specific workplace environments.
	Educational Leadership	Identify training needs and suggest education/retraining courses of exposed workers and RPOs (level 4)
	Interpersonal Collaboration	Coordinate a multi-disciplinary meeting with all stakeholders to ensure holistic safety.
Attitudes	Professional Judgement	Assess autonomous situational judgements to provide proportional advice in operational circumstances and to identify risks and take immediate action in imminent danger. (level 5?)
	Effective Communication	Translate complex technical radiological advice into strategic insights with diverse stakeholders (management, authorities,...)

Examples of learning activities supporting each competence



Conclusions Constructive alignment

- START: Describe competence profile related to roles and level required
- NEXT :
  - Keep training activities and assessment in line with the ECs and domains

QA needed to adapt to new challenges like digital competences and sustainability and new innovative educational approaches

Competent trainers needed : LLL

Competency-based curriculum design provides a transparent and transferable framework for educating future RPEs. AI may support future European harmonisation, provided expert validation remains central.

Questions?

- Thank you for your attention