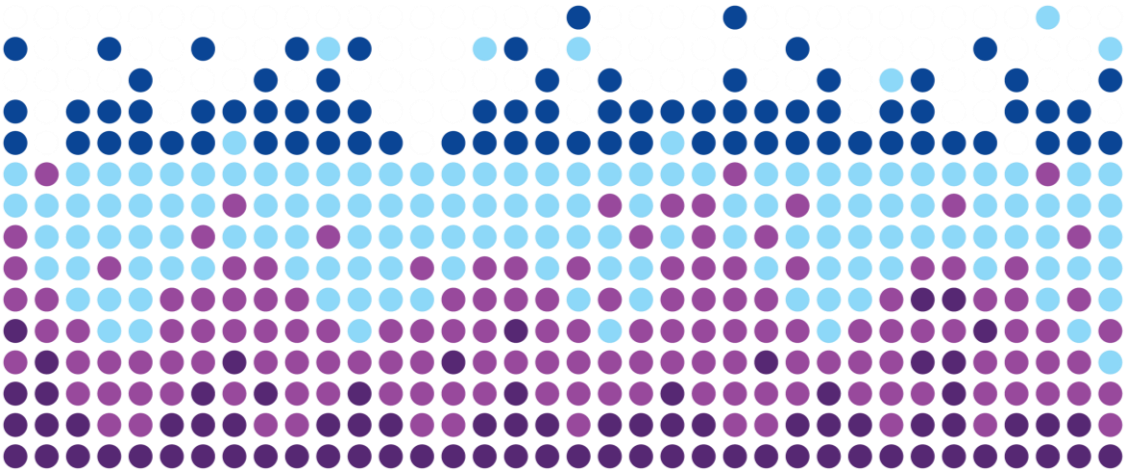

sck cen Academy

Systematic approach to training

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What is a systematic approach to training?

- SAT = logical progression from the identification of the competences to the development and implementation of training towards achieving these competences
- 5 phases

- 'ADDIE approach'

Why do we use a systematic approach?

- Logical process – can be tweaked over time
- To communicate with others who are not learning specialists
- To establish milestones and targets
- Sound basis for external review

Analysis

- Analysis = Analysis of the needs
- Result:
  - Knowledge
  - Skills
  - Attitude

  } K+S+A = Competence

(EC approach)
- Knowledge
- Skills
- Competences (autonomy & responsibility)

- Critical component for
  - Starting a new training
  - Revising an existing training
  - Identify the gaps in one's competences

Analysis

- Competences can be derived from
  - the missions and goals at organizational level
  - tasks and job expectations

- Mainly two levels:
  - **Core competences** (broad, applies to all staff in the organization, linked to the values and behavior)
    - E.g. communication, reporting, analytical and strategic thinking, decision making, knowledge management, teamwork.
  - **Functional/specific competencies** (necessary for the specific job/function)

→ Competence mapping and management

Analysis

- Different approaches
  - Job/task/competency analysis
  - Content analysis
  - Goal-approached analysis
- Use references!
  - IAEA (UPNET, Safety reports)
  - EC (e.g. ENETRAP, MEDRAPET, MPE)

- Techniques
  - Verification analysis (based on similar tasks, existing training materials) - document analysis (based on existing procedures and job related documents)
  - Topical analysis (based on content)
  - Functional analysis (based on a broad spectrum of tasks)

Analysis
Topical analysis

- Example for **radiation protection officers**
  - Radiation sources and associated risks
  - Personal protection of the workers
  - Behavior on the workfloor
  - Communication within the company

- Example for **radiation protection experts**
  - Radiation sources and associated risks
  - Worker, public and environmental protection
  - Risk assessment and decision making
  - Interaction with RPO, MPE, license holder, competent authority

Analysis
Functional analysis

- Example for **radiation protection experts**
  - Advise on adequate dosimetric monitoring programme related to the type of exposure

- Example for **radiation protection officers**
  - Oversee practical implementation of dosimetric monitoring for workers

- Example for **exposed worker**
  - Wear dosimeter appropriately

Analysis

- Output:
  - Target audience
  - Needs
    - Learning outcomes
    - Tasks and topics (meta)

- Pitfalls:
  - too broad (too much resources)
  - too narrow (training deficiencies and costly personnel errors)

"If you don't know where you are going, you'll end up someplace else"

Prompts

- *What are the critical task performed by …*
- *Which competencies lack among … when dealing with …*
- *What are the most common errors made by… when doing …*
- *Which knowledge, skills and attitudes are required for a … to …*

Also:

- *Generate a survey to assess the training needs of … in the context of …*

Text mining (incident reports, job descriptions, SOPs…)

- *Summarize the most common errors related to… from…*

- Determine training approach: efficient and (cost-)effective

- Input from analysis phase
  - Information on knowledge, skills and attitudes
  - (unstructured) content topics

- Result:
  - **Learning outcomes**
  - Sequence of content
  - Instructional and delivery strategy (cfr teaching and learning styles)
    - Could be enhanced by modern learning techniques such as AR, VR, etc.
  - Evaluation strategy

What is a learning outcome?

- **Statement** of what a learner knows, understands and should able to do on completion of a learning process, and which are defined in terms of knowledge, skills and attitude.

- Example

Upon completion of this training course, participants should be able to explain the mechanism of DNA damage to a non-specialist public.

Why do we use learning outcomes?

1) To align the expectations of the trainers vs trainees
   → what they need to know/do vs what you want to tell?
   → what will be the focus of your training course?
   → what's in it for them?

2) To prepare the content of our training course
   → focus on the end goals (how to employ knowledge and skills) not on the content
   → helps to outline and structure (important) content
   → helps to avoid overlap within a training programme

2) To prepare the assessment and evaluation
   → good learning outcomes are easy to assess

How to write a learning outcome?

- In different domains (knowledge, skills and attitude), you can describe in one learning outcome

1. Target public (= WHO)
2. Element of the learning path after which learning outcomes aimed to be achieved (= WHEN)
3. The action that must be made and the content to which it refers (= WHAT, cfr. performance)
4. Situations, circumstances, the conditions in which this action must be made (= HOW, cfr. input)
5. Expected performance level (= HOW ++, cfr. standards)

- Upon completion of this training course, participants should be able to explain the mechanism of DNA damage to a non-specialist public.

How to write a learning outcome?

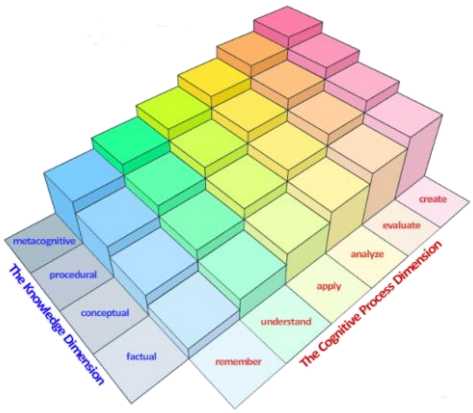
- Best approach to start:
  - *Upon completion of this training course, participants should be able to…*
- Real learning outcome
  - = **action verb + specific content**
- Knowledge vs skills vs attitude (competences)
  → taxonomy of Bloom and successors
- Write them SMART
- Link to evaluation

Different level descriptors when using learning outcomes

EQF level	Knowledge	Skills	Competence
	Described as **theoretical and/or factual**	Described as **cognitive** (involving the use of logical, intuitive and creative thinking), and **practical** (involving manual dexterity and the use of methods, materials, tools and instruments)	Described in terms of **responsibility and autonomy**
Level 1	Basic general knowledge	Basic skills required to carry out simple tasks	Work or study under direct supervision in a structured context
Level 2 - 7	Hierarchy of knowledge: factual – comprehensive, specialized, awareness, advanced, highly specialised	Hierarchy of solving problems: Routine – specific – abstract – complex and unpredictable - critical	Hierarchy of contexts: Usually predictable – unpredictable – complex
Level 8	Knowledge at the most advanced frontier of a field or at the interface between fields	The most advanced and specialised skills and techniques required to solve critical problems in research and/or innovation	Demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment

Revision of Bloom's Taxonomy

- Cognitive process dimension
  - Remember
  - Understand
  - Apply
  - Analyze
  - Evaluate
  - Create
- Knowledge dimension
  - Factual (terms, elements,…)
  - Conceptual (conventions, criteria, classifications, stuctures,…)
  - Procedural (techniques, methods, algoritms,…)
  - Metacognitive (context, strategic, conditional,…)



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Pragmatic list of action verbs in the revised Bloom's Taxonomy

Evaluation	Rate, evaluate, assess, judge, justify
Synthesis	Create, compose, argue, design, plan, support, revise, formulate
Analysis	Analyze, question, differentiate, experiment, examine, test, categorize, distinguish, calculate, contrast, outline, infer, discriminate, compare
Application	Operate, apply, use, demonstrate, solve, produce, prepare, choose
Comprehension	Translate, paraphrase, discuss, report, locate, generalize, classify, summarize
Knowledge	List, define, recall, state, label, repeat, name

Avoid the use of vague qualifiers: 'very', 'completely', 'fully', 'totally', 'quickly'…

From: Newton et al. A pragmatic Master List of Action Verbs for Bloom's Taxonomy (2020) doi: 10.3389/feduc.2020.00107

Practical example working with learning outcomes

Example 1

- 2013/59/Euratom art 34: consultation with a radiation protection expert (RPE)
  - *The examination and testing of protective devices and measuring instruments*
  - *Regular checking of the effectiveness of protective devices and techniques*
- = tasks ➔ job description ➔ qualifications

➔ Describe the LO's in terms of KSC

Example 1

- The examination and testing of protective devices and measuring instruments
  - Requires **knowledge** of
    - Protective devices
      - Collective vs individual
      - Protection against radiation vs contamination
    - Measurement instruments
      - Contamination measurement
      - Dose rate measurement
    - Testing and examination methods
      - Statistics/mathematics
      - Methodological approach

Different training modules

Example 1

- *After successful completion of this training course, the participant should be able to...*
  - In terms of **knowledge**
    - Identify and describe individual and collective protective devices
    - Distinguish protection against radiation vs contamination
    - Name and recognize different radiation measurement instruments
    - Describe an approach for contamination measurement
    - Describe an approach for a dose rate measurement
    - List different testing and examination methods
    - Select the appropriate statistical tool for the testing method
    - Name a methodological approach for radiation measurements

Example 1

- The examination and testing of protective devices and measuring instruments
  - Requires **skills** of
    - Testing and examination
      - Valid measurement setup
      - Analysing results
      - Reporting to different target audience (end-user vs hierarchy vs purchase manager vs manufacturer)
  - Requires **attitude** of
    - Critical thinking

Example 1

- *After successful completion of this training course, the participant should be able to...*
  - In terms of **skills**
    - Compare different testing and examination methods
    - Create a valid measurement setup
    - Analyse different measurement results
    - Summarise test results to different target audience (end-user vs hierarchy vs purchase manager vs manufacturer)
  - In terms of **attitude**
    - Demonstrate critical thinking in a measurement scenario

Prompts

- **Learning outcome generation and improvement**
  - *Generate a set of learning outcomes for a training course on [Course Subject]. The course is designed for [Target Audience] and focuses on [Key Topics or Themes]. The learning goals should align with Bloom's Revised Taxonomy (and cover the following cognitive levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating).*
- **Course structure suggestions**
  - *Based on the following content topics…*
  - *Based on the following learning outcomes…*

- **Use references in your agent!**
  - IAEA (e.g. PGEC syllabus, Safety reports)
  - EC (e.g. ENETRAP, MEDRAPET, MPE)

Prompts

- **Course format suggestions**
  - *You're are an expert on learning design. Provide examples of suitable learning activities (such as acquisition, discussion, collaboration, inquiry, practice, and production) related to the following learning outcomes:… Ensure that these activities are aligned with the background of the participants:…*

  - *I have several modern teaching tools at my disposal related to radiation protection training, such as…<+context>. Provide possibilities how I could use these in a training course I am designing with the following topics and learning outcomes:…*

- Produce the material required to implement the training programme

- Result:
  - Course material
  - Demonstration models
  - Didactic material for practical exercises
  - Training scenario's and storyboards
  - (Technical framework for online/VR/AR/XR content)

- Do not forget:
  - Evaluation/assessment

Prompts

- **Content generation (theory, practice, evaluation,…)**
  - *Create a case study for RPO's on responding to a lost source incident.*
  - *Generate a quiz to assess the understanding of dose limits for exposed workers.*
  - *Design an infographic explaining the differences between tissue reactions and stochastic effects.*
  - *Provide 5 calculation exercises on radioactive decay linked to realistic examples of the use of radionuclides from the industry, medical and research, using the following resources as lookup material:…*
  - *Provide 10 different multiple-choice questions regarding the topic of…*

- **Multimedia support (symbols, pictures, video, audio, slides, e-learning)**

… lots of resources available, but still require input and processing from subject matter experts

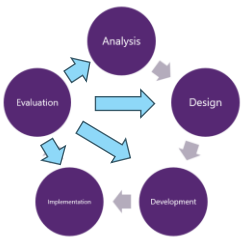
- Deliver the training programme in an **efficient** and **effective way**

- E.g.
  - Physical basis of radioactivity: classroom training or online
  - Personal protective equipment: hands-on demo and exercises *virtual, simulation or live*

- Evaluate stated objectives
  - Adequacy
  - Appropriateness
  - Effectiveness
  - Efficiency

- Evaluate on different levels

- Provide **feedback to other phases**



- According to the Kirkpatrick Evaluation Model
  - Level 1: Reaction *(did they like it?)*
  - Level 2: Learning *(did they learn it?)*
  - Level 3: Behavior *(do they use it?)*
  - Level 4: Results (impact) *(does it make a difference?)*

What do we assess? – Kirkpatrick Evaluation Model
Example: *Radioactive contamination awareness course*

- Level 1: Reaction e.g. *overall course rating: 4,6/5,0*
- Level 2: Learning e.g. (*online participation: 97%)*
  posttest average score: 87%
- Level 3: Behavior e.g. *percentage of contamination incidents*
  Oct (99%)-Nov (79%)-Dec (48%)
- Level 4: Results (impact) e.g. *cost savings that resulted from reductions in decontamination procedures Oct: 5 k€*
  Nov: 10 k€
  Dec: 20 k€

When do we assess? – Kirkpatrick Evaluation Model

Measure	Data collection tools
Reaction	Surveys, questionnaires, interview, focus group
Learning	Pre-post tests, surveys, interviews, control group
Behaviour	Impact surveys, interviews, observations by supervisors, focus group
Results	Impact surveys, observations, interviews

Prompts

- **Evaluation**
  - *Summarize, correct, clean data, analyse, identify gaps in student understanding, generate and evaluate using rubrics, …*
- **Also students know AI, and will probably use it for**
  - **Thesis**
  - **Assignments**
  - **Examinations**

Be ready… AI can also be used by you to anticipate on this ☺

Prompts

- **Optimisation**
  - *I would like to analyze and improve the constructive alignment between my intended learning outcomes, learning activities, and assessment. You are an expert in this. Below you will find the intended learning outcomes, the learning activities, and the evaluation methods. Now write a report on the degree of constructive alignment. Consider each of the three components separately, but also discuss their overall coherence. End with a list of concrete recommendations for improvement.*
  - *Identify areas for curriculum improvement, based on the outcome of the evaluation from the participants, trainers, and assessment of the participants.*

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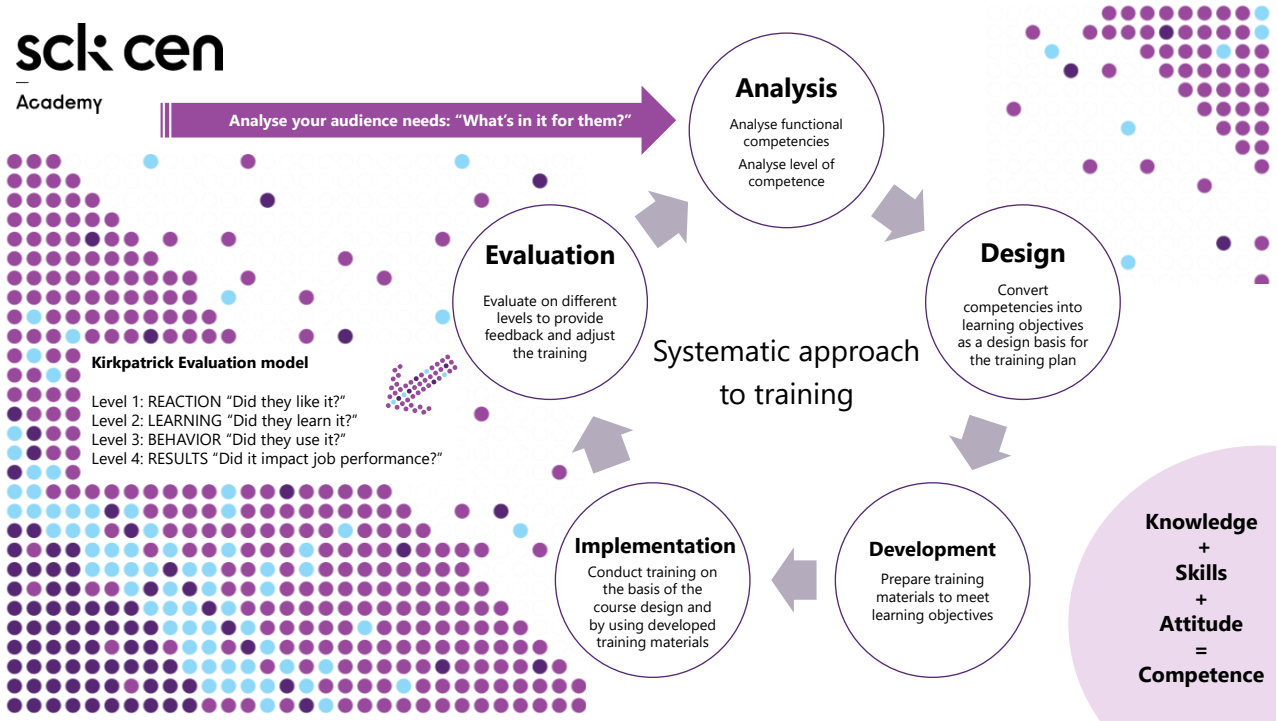

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References to SAT, as applied in nuclear and RP

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- Experience in the use of SAT, IAEA-TECDOC-1057 (1998)
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- Department of Energy (DOE) Handbook, DOE-HDBK-1078-94 (2014), Training Program Handbook: A Systematic Approach to Training
- **IAEA upcoming publications (safety reports) on RPE-RPO and competence building for medical professionals**

References to learning outcomes in radiation protection

- ENETRAP Requirements for RPE Training Scheme and Reference Syllabus
- EC Radiation protection 174: MPE Guidance
- EC Radiation Protection 175: Guidelines on Radiation Protection Education and Training of Medical Professionals in the European Union
- IAEA Revised syllabus Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources, 2019

Learning outcomes

Upon completion of this training module, participants should be able to:

- In terms of knowledge
  - Explain the process and steps of designing a training action
  - Identify the main points of the analysis of training needs

- In terms of skills
  - Analyze the need for training
  - Identify and write learning outcomes using Bloom's taxonomy
  - Define training strategy/pedagogical scenario the learning activities to be implemented in terms of time, means and resources (material/human), content, teaching methods, proceeding of activities; taking into account the possible constraints
  - Use generative AI to assist in SAT

- In terms of competences
  - Conceptualize a training course according to the systematic approach to training

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