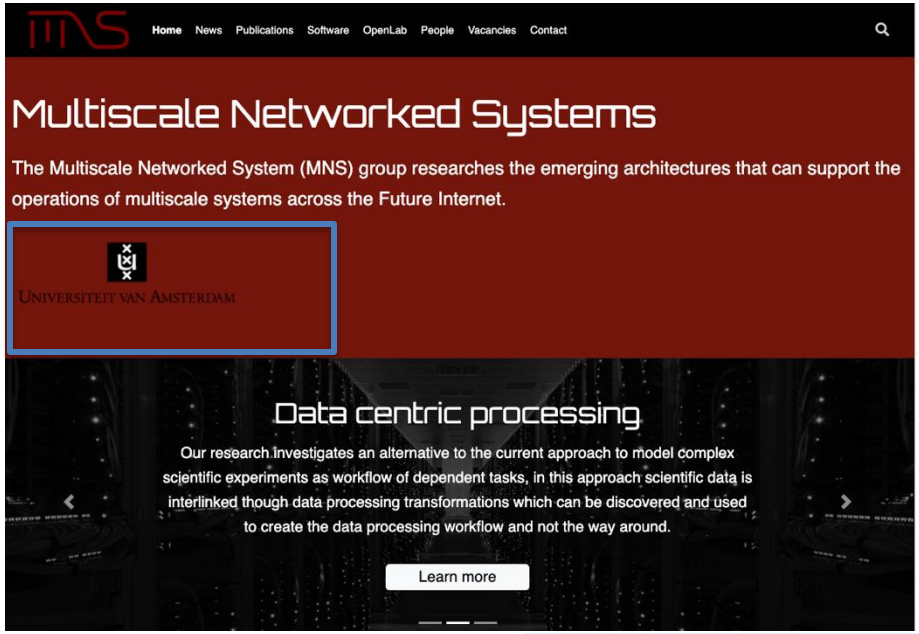
One Approach to Teach

STechnology**EM Subjects**

Adam Belloum

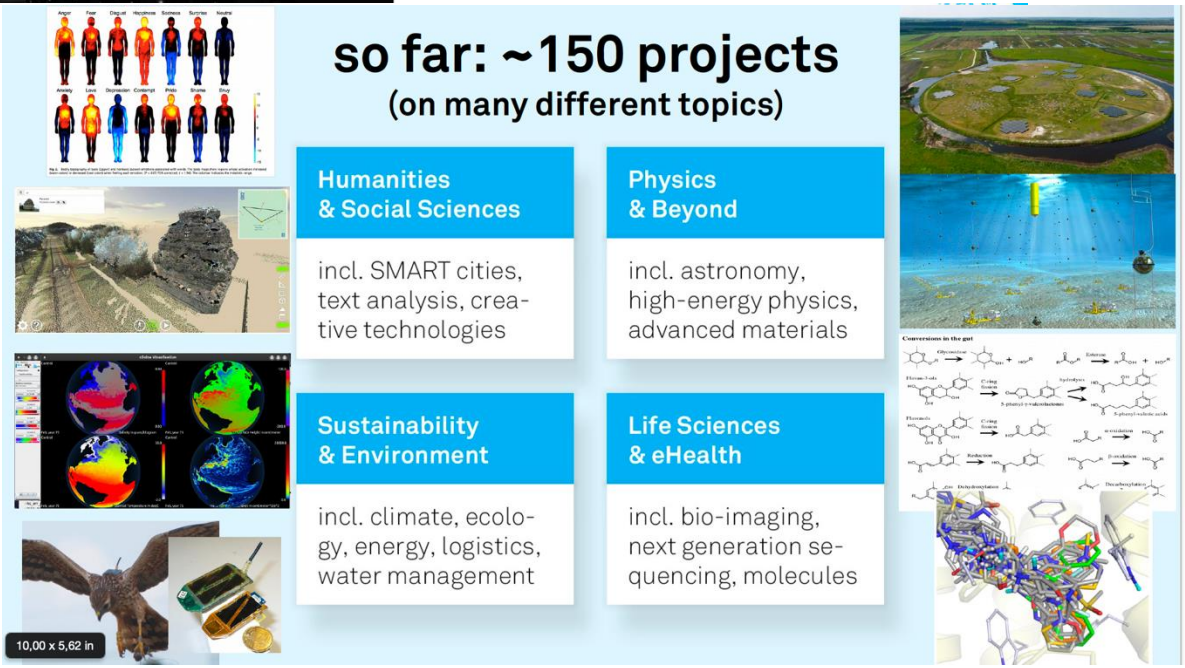
From Constantine to Amsterdam via Compiegne



netherlands eScience center

Technology Lead, Data Processing

Dr. Adam Belloum



Content

- Goals of this talk
- Classic teaching vs Active learning
- Discussing online videos
  - Teaching & Understanding Understanding
- Constructive Alignment
  - Learning objectives
  - Students' Assessment and feedback
- Example of course design

The goals of this talk …

Objectives

- **Raise awareness** of different methods to teaching

Takeaways

- Everyone attending this talk should be apply these techniques

- ❑ does not take much
- ❑ or need much

Just the will of the teacher to change his/her mindset.

- ❑ **No** need **to change the content**

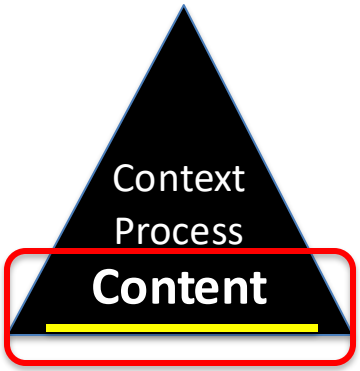
Just change the way to convey the message to the target audience

Personnel-Opinion - Classical teaching

(the way I was taught …) with all respect to my teachers

- Focus on the **content** of the course

Start teaching the content from the very first minute



- Often there is no clear **context** or **process**
  - Teachers do not explain the structure of the course
  - Teachers do not introduce themselves to the students
  - Teachers sees the students as a homogenous population
  - Teachers often neglect the “why” (context) and “how” (teaching activities)

As a consequence, the students are just interested in the GRADE – they want to pass the course

About the speaker

- 1999 – 2002 TA in the course ***computer organization,*** Ba Course
- 2002 – 2004 ***Grid computing /eScience infrastructure***, Ba Courses
- 2005 – 2010 ***Essential skills for administrator***, MSc course
- 2010 – 2017 ***Concurrency and Parallel Programming***, Ba Course
- 2013 – now ***HPC & Big Data / Cloud systems and Service Oriented architecture,*** MSc Courses
- 2016 – now

- 2005 – 2007 Grid Computing course
- 2008 – 2012 ***eScience Infrastructure***
- 2013-present ***Cloud systems and Service Oriented architecture***

Designed courses from scratch

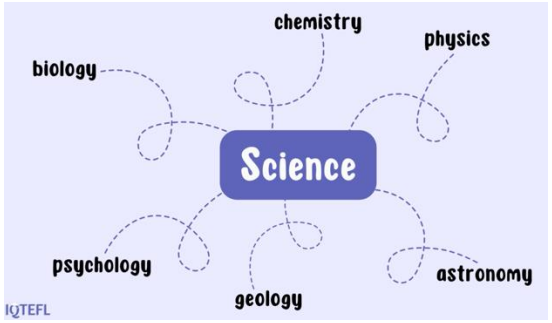
- 2004 - 2007 MSc Grid Computing program, university of Amsterdam
- 2008 - 2012 MSc computer Science Program, joined program VU-UvA

Involved in design MSc programme

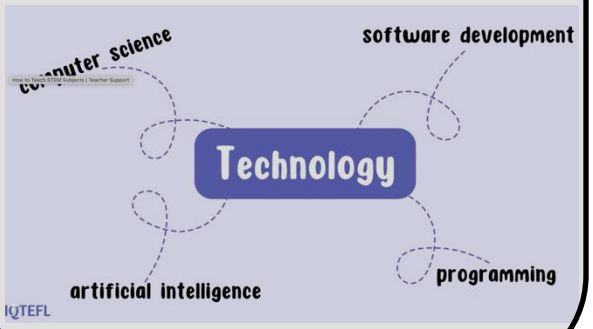
- 2017 Senior Teaching Qualification
- **2011 University Teaching Qualification**

STEM

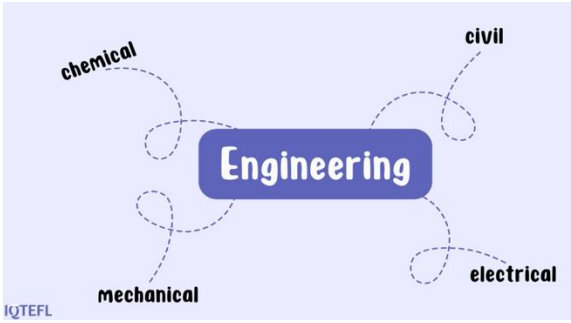
Science



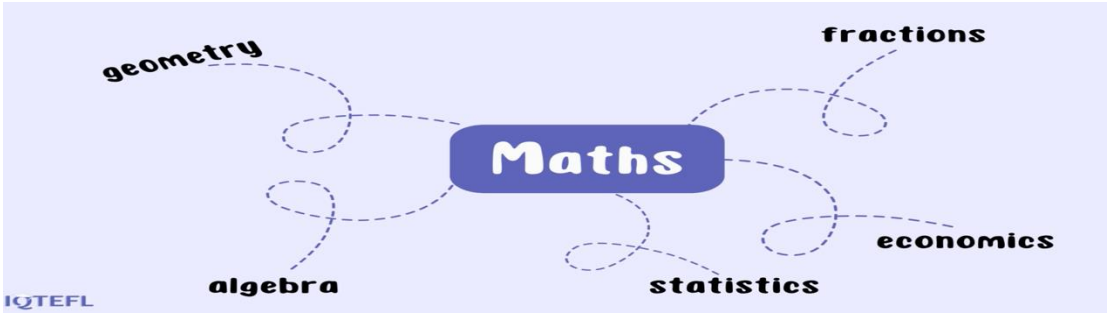
Technology



Engineering



Mathematics



STEM Education- beyond the content

STEM education should help students to

- Develop soft skills
  - creativity, Problem-solving, collaboration

- Increase engagement and Motivation
- personalise the learning experience

STEM Teaching Techniques

Project-based learning

Students Learn skill and apply them by taking part to projects.

They work for an extensive period to find solution to a given problem

Problem-based learning

Students must analyse, evaluate, and solve a problem that is given to them

This requires high-level of thinking there is no clear answer to the problem

➔ creativity, teamwork, and leadership

Inquiry-based learning

Emphases the role of the students in the learning process, they are encouraged

➔ critical thinking, questioning and problem solving,

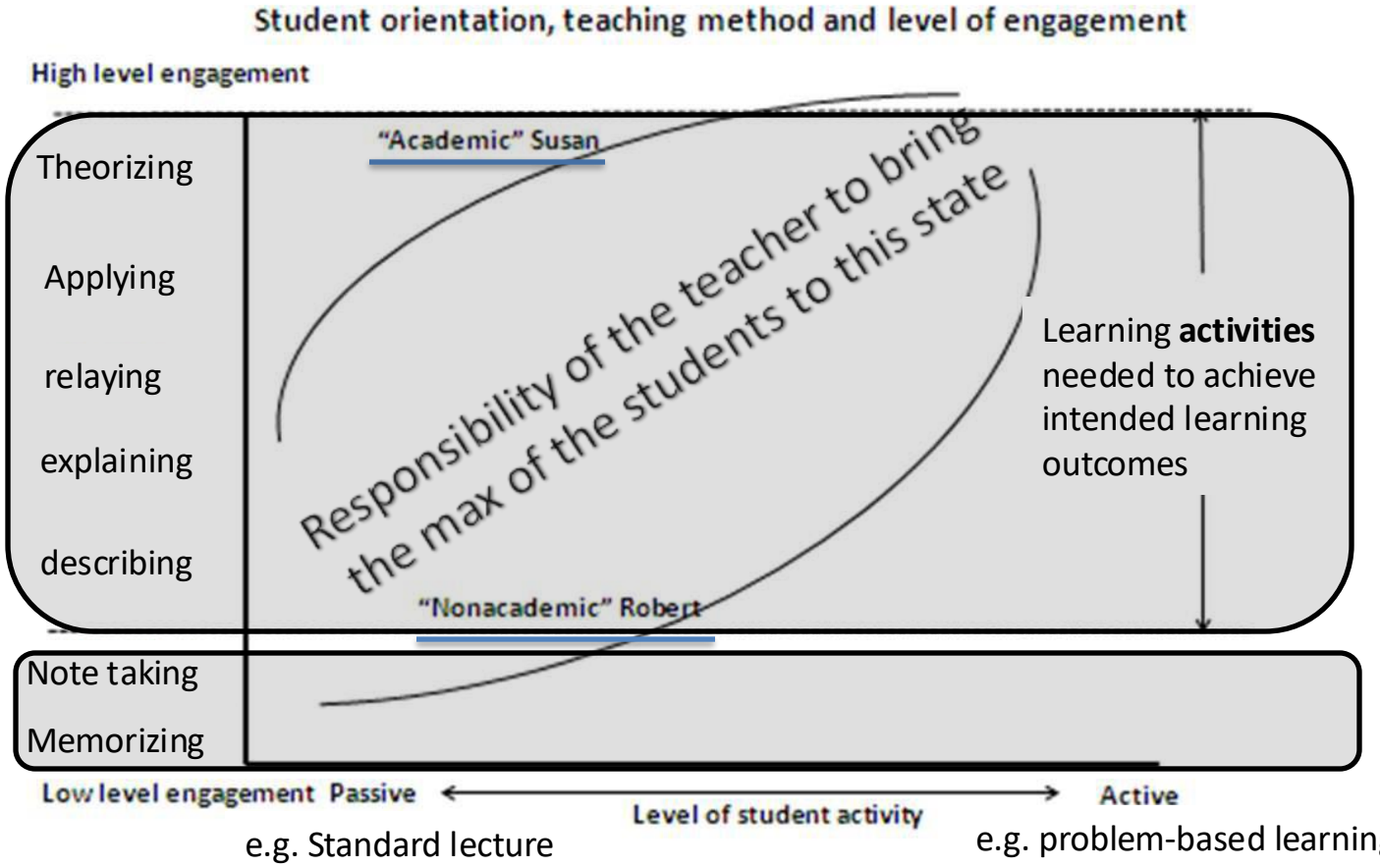
➔ the **students** need to decide what inquiries they want to make

➔ the **teacher's** role is to spark curiosity and prompt reflection

Active Learning

STEM Education: active learning

Why active learning

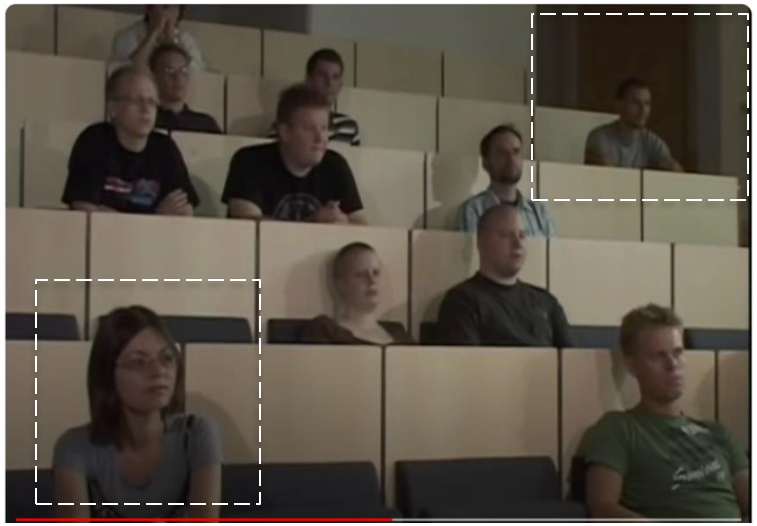


John Biggs, "Higher education and development , Vol 18, No 1, 1991 What the student does: Teaching for enhanced learning

STEM Education: active learning

Get to know your Class

“the story of Robert and Susan”. Or: “What the student does: teaching for enhanced learning” (Biggs, 1999).



Teaching Teaching & Understanding Understanding (1/3)

– https://www.youtube.com/watch?v=iMZA80XpP6Y

STEM Education: active learning

Get to know your Class

Student Perspective

Expectations/goals vary from student to student

- **From** deep learning.
  to surface learning

Reaction of the students

- **From** it is interesting
  to when is the break

There are more Roberts than Susan in the class

Teacher Perspective

Level 1: **focus** on what students are?

- Teacher label the student (Blame the student)

➔ cannot do much, this is how the students are!!!!

Level 2: **focus** on what the teacher do?

- blame the teacher: good/bad teachers

➔ Good level2 Teachers can prepare themselves with tips and tricks

Level 3: Teacher is concerned by what the student does

➔ during and after teaching

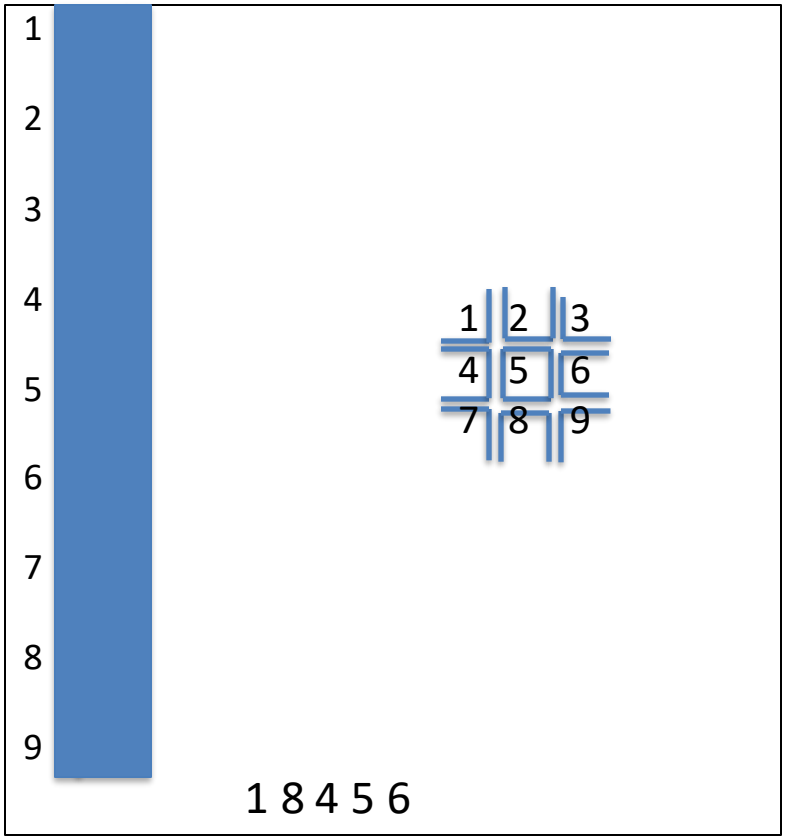
Teaching Teaching & Understanding Understanding (1/3)

– https://www.youtube.com/watch?v=iMZA80XpP6Y

STEM Education: active learning

Knowledge perspective Understanding

Student Structured vs non-structured information Perspective



Knowledge is constructed as a result of a **Learning activity**

- **Old Idea**: Knowledge is transmitted to a passive learner

> Learning takes place through the active behavior of the student: it is what he does that he learns, not what the teacher does
>
> Ralph W. Tyler (1949)

- **BUT**: Activation is not enough, we need a theory of understanding

Teaching & Understanding: knowledge perspective (2/3)

https://www.youtube.com/watch?v=SfloUd3eO_M

STEM Education: active learning

Knowledge perspective Understanding

Job Biggs has a theory of how Students are activated

John Bigg's **solo** taxonomy

Structure of the
Observed **L**earning
Outcome

solo taxonomy

Solo 5: extended abstract	deep learning	• to generalize • to hypothesis • to theorize
Solo 4: relational		• to relate • to compare • to analyse
Solo 3: Multi-structural	Surface learning	• to classify • to combine • to enumerate
Solo 2: uni-structural		• to identify • to do a procedure • to recite
Solo 1: pre-structural		• No understanding • Uses irrelevant inf • Misses the point

Teaching Teaching & Understanding Understanding (2/3)

https://www.youtube.com/watch?v=SfloUd3eO_M

STEM Education – active learning

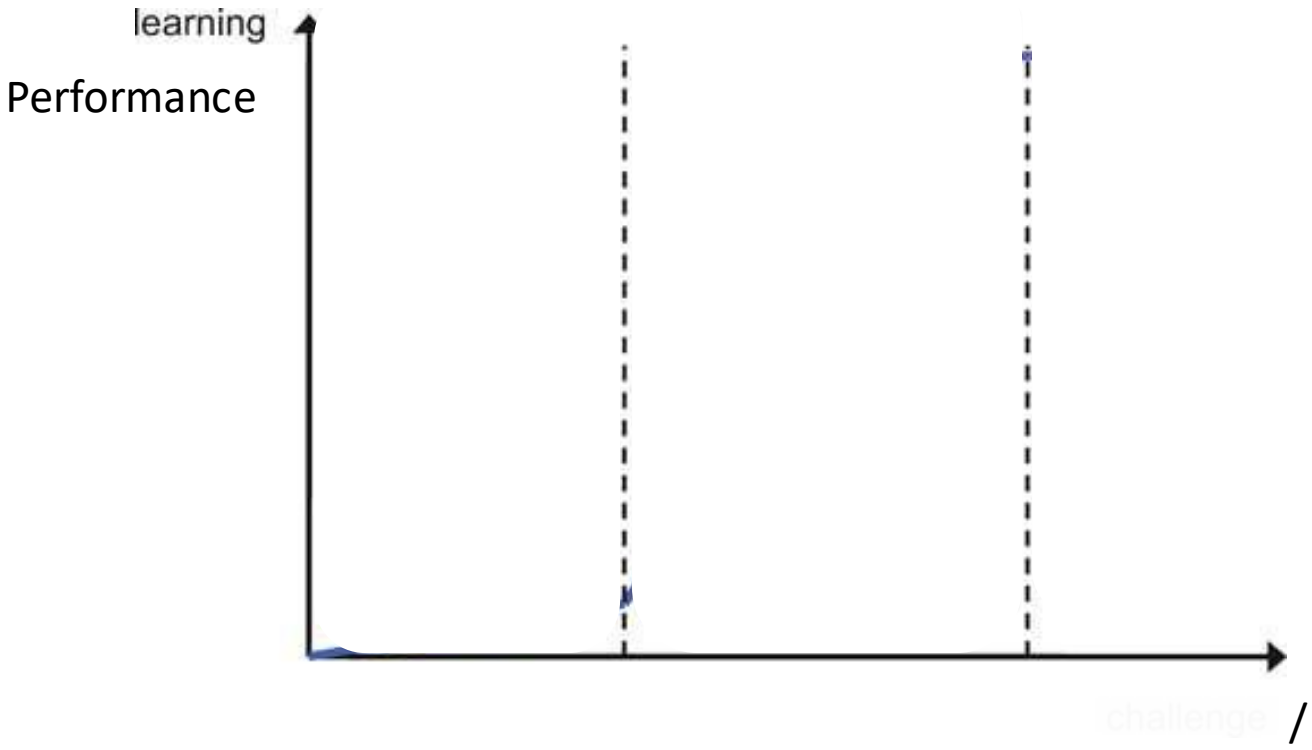
Why active learning

- **Shifts** the **focus** from the teacher to the student
- **Counters** passive/consumer-oriented attitude
- **stimulates** higher cognitive functions

The material to be learned is better retained when the student is **actively engaged** in the learning process!

STEM Education: active learning

When students learn better?



How can teacher bring the class to the stretch zone?
How can teacher assess that students have learned?

STEM Education: Designing a course

Depending on the topic of the course, the Teacher choose a **Textbook**, follow the **chapters of the book**

1. **often** the teacher follows the book learning objectives
2. Define the learning activities
3. Define the assessment of the course

Note:

- If there no textbook available: The teacher has to define the learning objectives

- The level of the course
  - Introductory-intermediate-advanced
  - Freshman-sophomore-junior-senior

Constructive alignment

STEM Education: learning objectives

Teacher

- learning objectives answer the question:

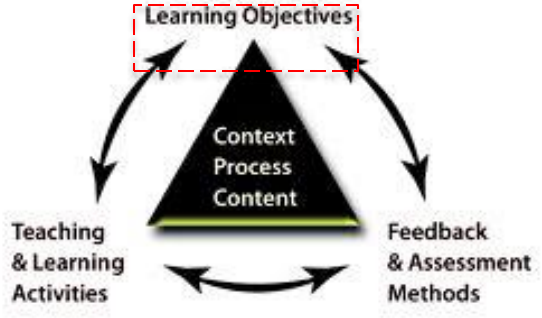
'What does the teacher want to achieve with the course?'

- **explicitly** indicates the outcomes of the course.

Student

- **provide** a framework where learning can take place.
- learning objectives guide the student's development

'If these are the learning objectives, how the students is going to achieve them?'



STEM Education: learning objectives

How to create clear learning objectives

1. Specify what you expect from the students

   (in terms of content: the subject matter).

2. Formulate this expectation actively,

   i.e., using a verb (see attachment of verbs).

3. Formulate the learning objective at the highest **mastery level***

   you expect (see Bloom's taxonomy)."

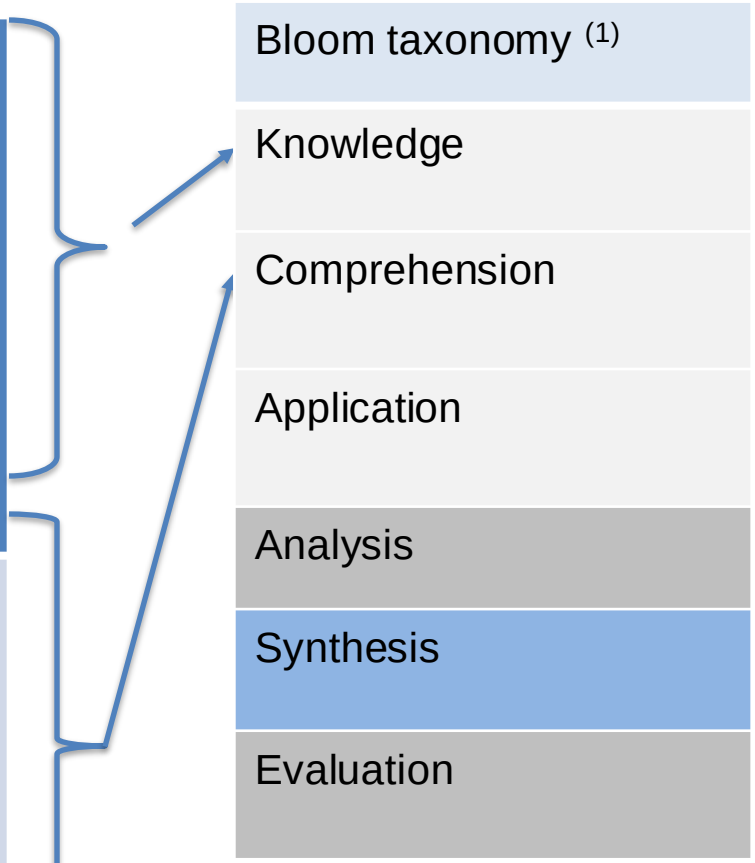
Bloom taxonomy (1)
Knowledge
Comprehension
Application
Analysis
Synthesis
Evaluation

A good **learning objective** links **content** to **mastery level** and is **formulated actively**!

The Bloom Taxonomy - Cognitive Level

Examples of verbs that can be used in actively formulating learning objectives

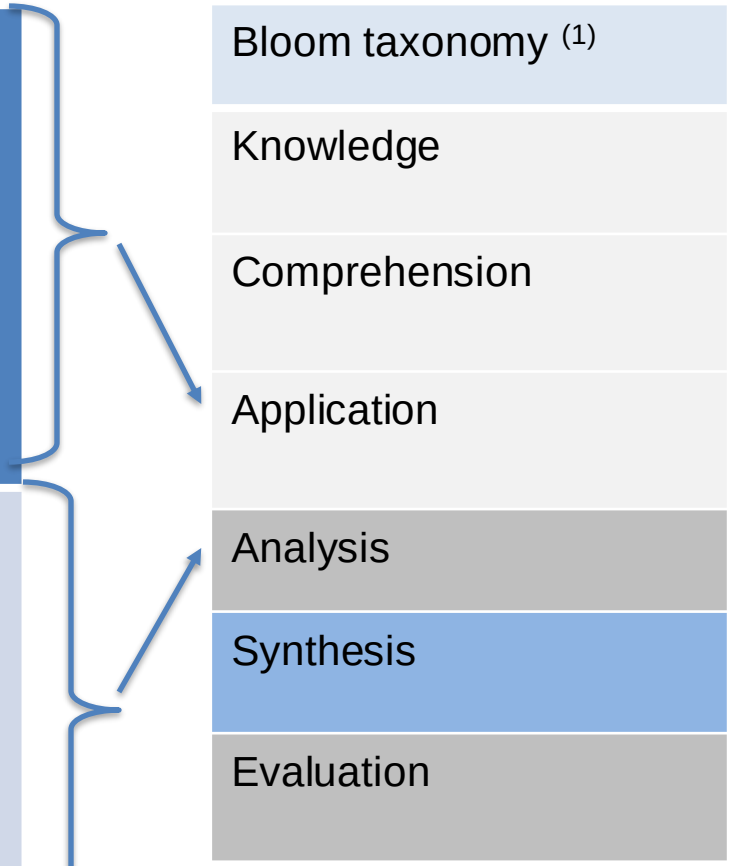
1. Knowledge Select List Name Define Describe Memorize	Identify Place Present Communicate Recognize Label …
2. **Comprehension** Correspond Characterize Paraphrase Rewrite examples Express Illustrate	Explain Defend Distinguish Summarize Relate Interpret Broaden …



The Bloom Taxonomy - Cognitive Level

Examples of verbs that can be used in actively formulating learning objectives

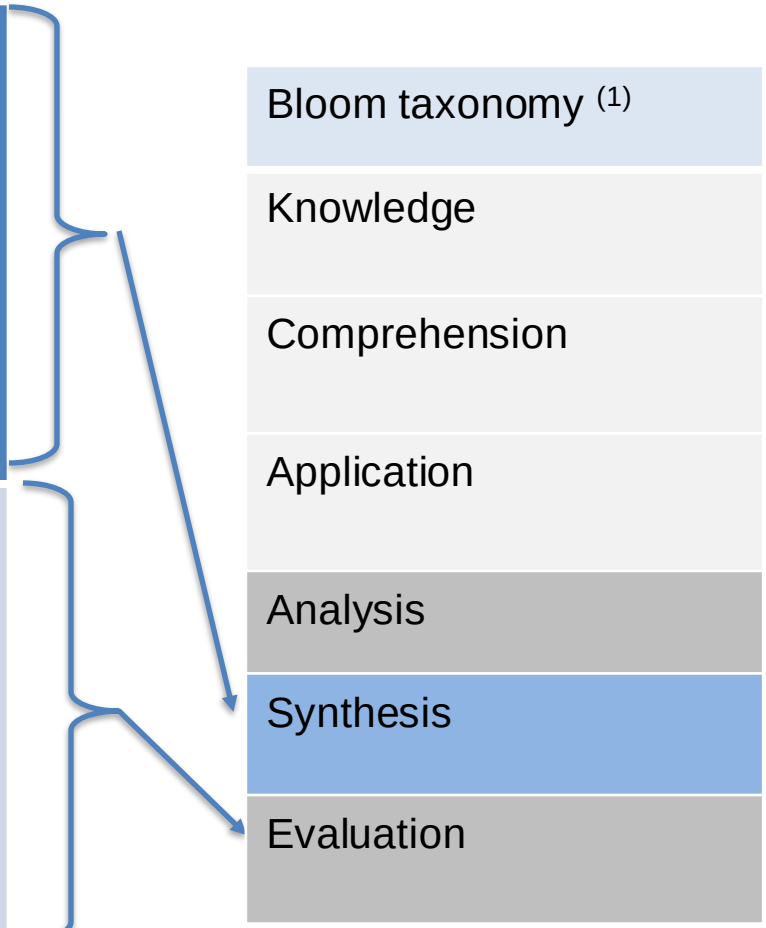
3. Application	
Organize	Sketch
Generalize	Apply
Stage	Solve
Prepare	Characterize
Produce	Demonstrate
Shift	Represent
	…
4. **Analysis**	
Compare	Differentiate
Analyze	Arrange
Classify	Distill
Detect	Overview
Discriminate	Sort
Categorize	Prioritize
	…



The Bloom Taxonomy - Cognitive Level

Examples of verbs that can be used in actively formulating learning objectives

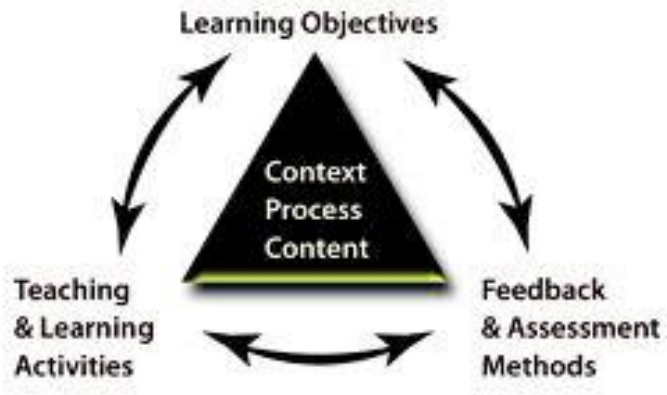
5. Synthesis Compile Derive Hypothesize Develop Design Combine.	Construct Produce Outline Create Conceive Organize …
6. **Evaluation** Assess Associate Weigh Consider Substantiate Evaluate	Contemplate Criticize Recommend Summarize Appraise Compare …



Example: designing a STEM course

Apply the Constructive alignment approach:

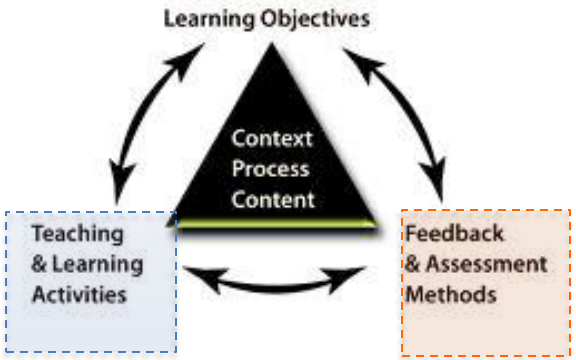
1. **Context**:
   - Define clear learning objectives
2. **Process**:
   - Define activities: Teaching, Feedback, assessment
3. **Content**:
   - Define Material to be taught
4. **Align**
   - Context /Process/Content



Example designing a STEM course (1/4)

- **Course topic**: Web services and cloud-based systems
- **Level**: MSc.
- **Target students**:
  - Computer Science (mandatory),
  - Artificial intelligence, Information science, … (Elective, free choice)

- **Problems** facing the design of such course:
  - Students have **different background**
  - **Large** number ~ 100
  - Labs require **technical expertise**, use open-source software **not supported by University**.



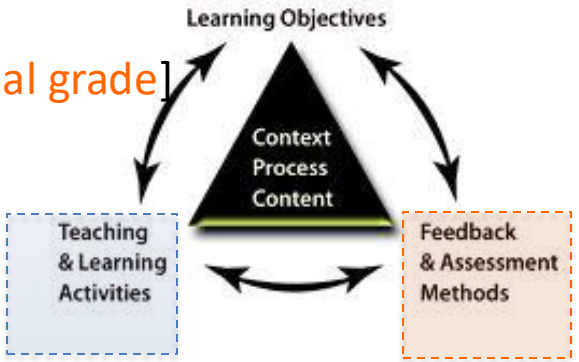
Example designing a STEM course

Step 1,2,4: the Content

Learning Objectives:

- You will learn to describe the core features of Cloud systems, Cloud Standards and Cloud technology and apply them to design Cloud applications
  - Lecture / homework [**Quiz** ➔ 20% of the final grade] [feedback(1)]
- You will develop practical skills to implement micro-service architectures
  - practical Lab assignments/small projects [**demo/report** ➔ 45% of the final grade] [feedback(2)]
- You will develop the ability to analyse scientific publications on cloud related topics
  - Literature study [**presentation/report** ➔ 35% of the final grade] [feedback(3)]

(1) Group feedback during lectures or posted in canvas.
(2) personal feedback are given during Lab session (by TA),
(3) posted in canvas or email (lecturers and TA),



Example designing a STEM course

Step 3: the Content

Bloom taxonomy (1)

Knowledge
- **Lectures**

Comprehension
- **Lectures**

Application
- **Lab Sessions**

Analysis
- **Reading Assignment**

Synthesis

Evaluation
- **Literature study**

"**Bodies of Knowledge** are defined as collection of core concepts and definitions of a given discipline"
IEEE computer SOCIETY

Conclusions
(Topics not covered in detail)

Active learning Promote Critical Thinking

- How do you stimulate the Critical Thinking?
- What is the best educational environment for critical thinking?

Principles of Coaching and Providing Feedback

- encourage students to bring out the best in themselves?'
- Provide feedback plays a significant role in this.

Interactive Teaching Methods and Group Dynamics

- The role of the teacher to help the group develop into a safe, stimulate learning environment where hard work takes place?