CDIO Standards – an *Active Learning* exercise

Europe-UK & Ireland Regional Meeting 2021

Dr Matt Murphy
Director of Education
Department of Mechanical, Materials & Aerospace Engineering
University of Liverpool, UK

CDIO Council Member-at-Large

Dr. Sc. Juha Kontio
Dean
Faculty of Engineering and Business
Turku University of Applied Sciences
Finland

CDIO Council Member-at-Large

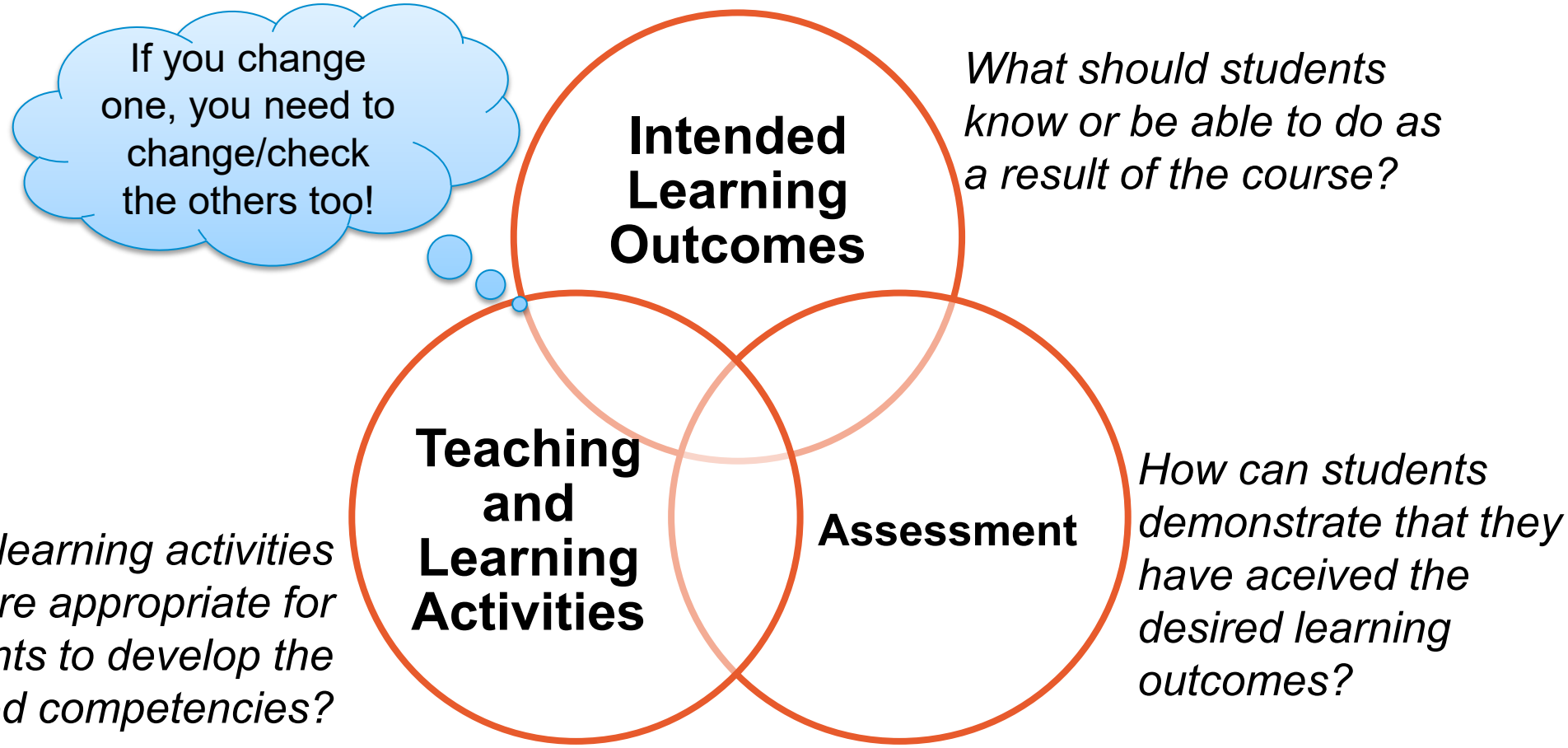
Importance of Activating Learners

”…the teacher’s fundamental task is to get students to engage in learning activities that are likely to result in their achieving the desired outcomes.

Remember that what the student does is actually more important in determining what is learned than what the teacher does.”

Shuell, T. J. (1986). Cognitive conceptions of learning. Review of Educational Research, 56(4), 411-436.

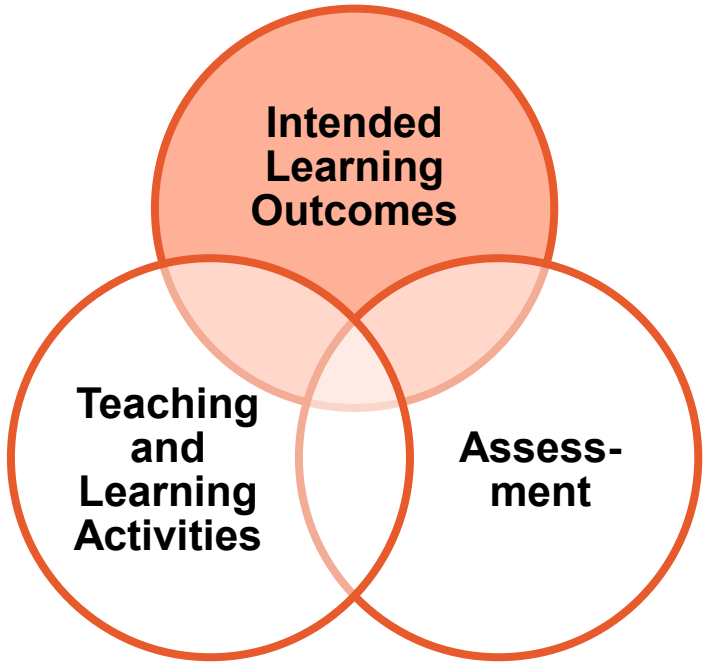
Constructive alignment: aligning competences, activities and assessment



Our intended learning outcomes for this session are:

1. to **understand** the purpose of CDIO standards

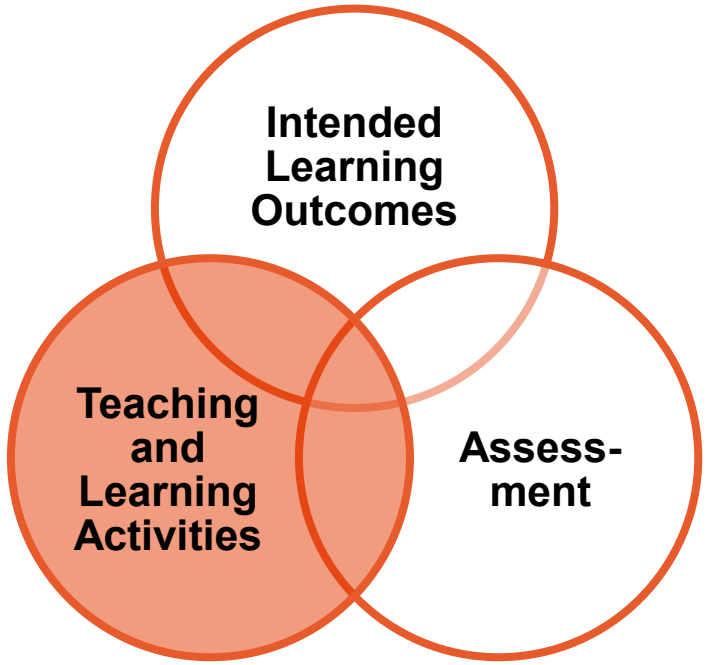
2. to **learn** about 5 of the CDIO standards



Our learning activites for this session are:

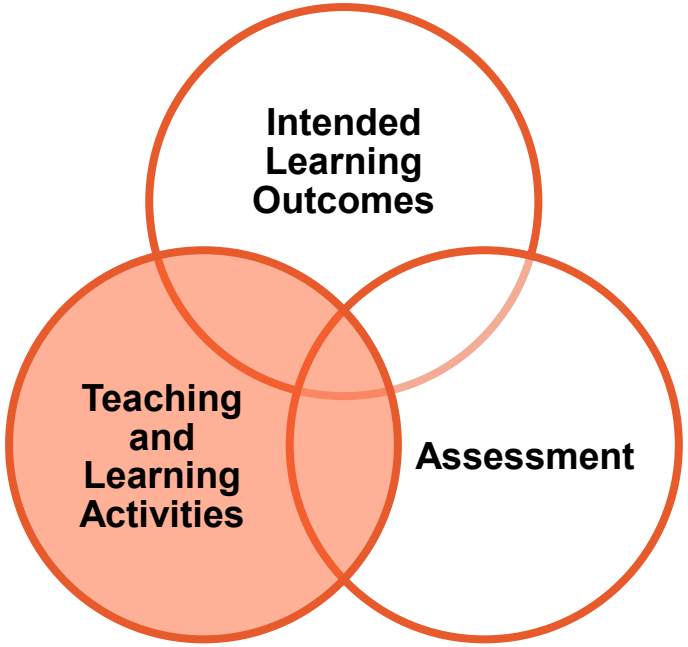
You will **experience** 3 active learning methods that can be used in the classroom:

- Jigsaw Classroom
- Audience Response Systems
- 1-Minute Paper

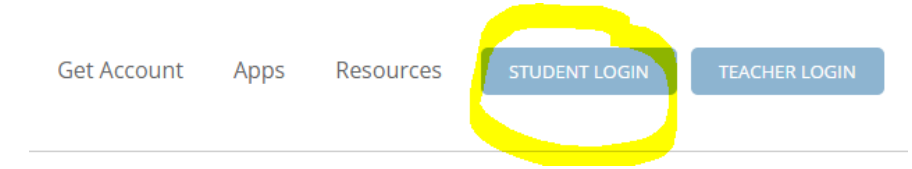


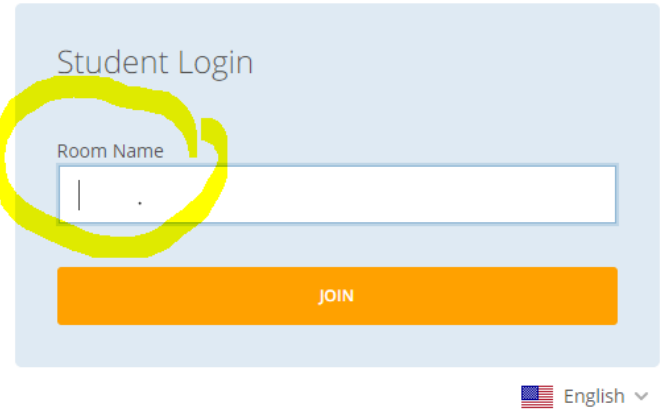
… and one of those teaching and learning activities is:

The tool for activating you



- Use your mobile or other device and go to: http://www.socrative.com/
  - Choose ‘Student Login’
  - Write Room name: **TELI2020**
- Input your “name” and join the competition..

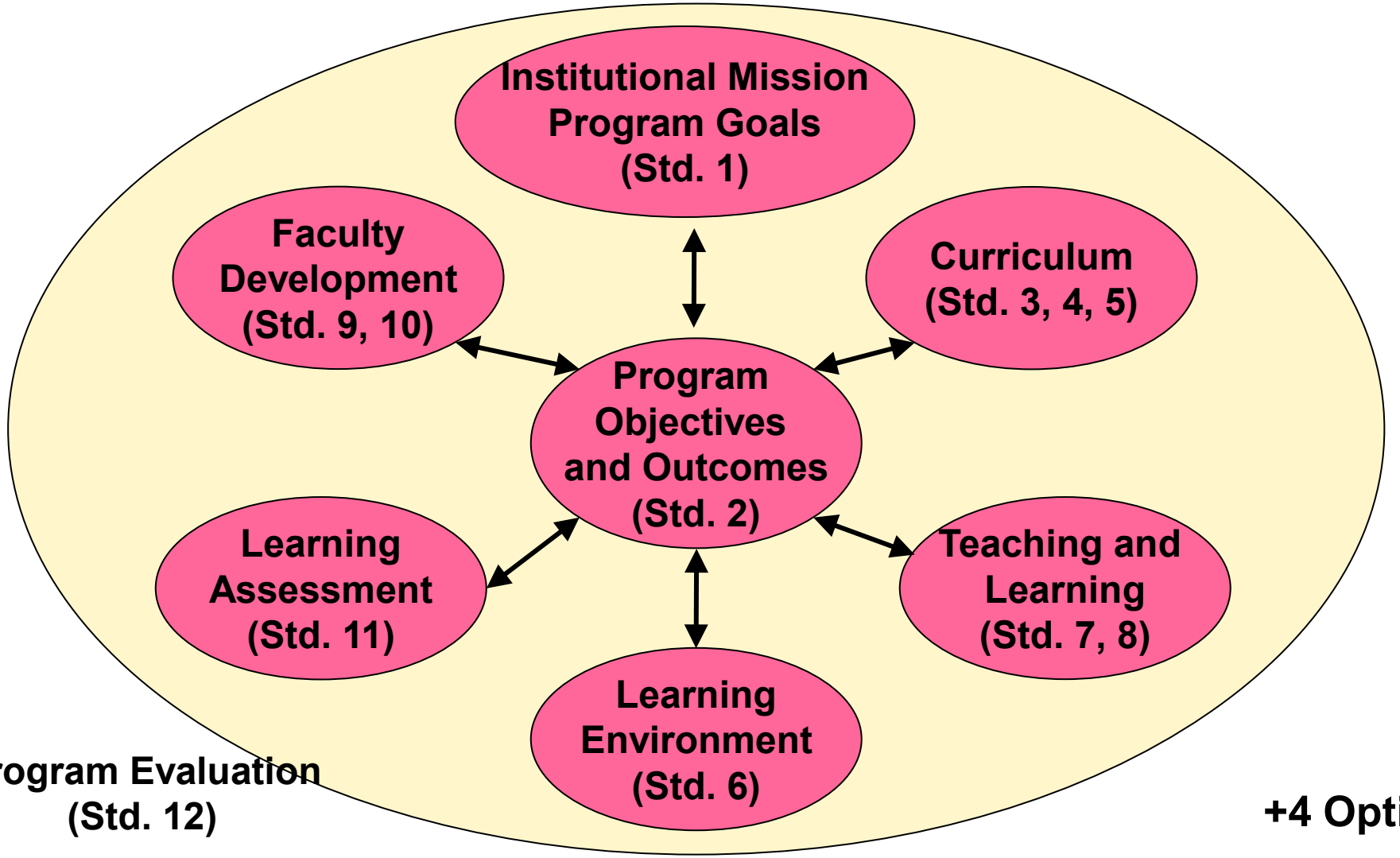




Test question:

Where are you from?

CDIO standards – best practices



Program Evaluation
(Std. 12)

+4 Optional standards

12 (+4) CDIO Standards – Best Practices

1. CDIO as Context
Adoption of the principle that product and system lifecycle development and deployment are the context for engineering education

2. Learning Outcomes*
Specific, detailed learning outcomes for personal, interpersonal, and product and system building skills, consistent with program goals and validated by program stakeholders

3. Integrated Curriculum
A curriculum designed with mutually supporting disciplinary subjects, with an explicit plan to integrate personal, interpersonal, and product and system building skills

4. Introduction to Engineering
An introductory course that provides the framework for engineering practice in product and system building, and introduces essential personal and interpersonal skills

5. Design-Implement Experiences
A curriculum that includes two or more design-implement experiences, including one at a basic level and one at an advanced level

6. Engineering Workspaces
Workspaces and laboratories that support and encourage hands-on learning of product and system building, disciplinary knowledge, and social learning

7. Integrated Learning Experiences
Integrated learning experiences that lead to the acquisition of disciplinary knowledge, as well as personal, interpersonal, and product and system building skills

8. Active Learning
Teaching and learning based on active experiential learning methods

9. Enhancement of Faculty Competence
Actions that enhance faculty competence in personal, interpersonal, and product and system building skills

10. Enhancement of Faculty Teaching Competence
Actions that enhance faculty competence in providing integrated learning experiences, in using active experiential learning methods, and in assessing student learning

11. Learning Assessment
Assessment of student learning in personal, interpersonal, and product and system building skills, as well as in disciplinary knowledge

12. Program Evaluation
A system that evaluates programs against these 12 standards, and provides feedback to students, faculty, and other stakeholders for the purposes of continuous improvement

Optional standards:

1. Sustainable development
2. Simulation-based mathematics
3. Engineering entrepreneurship
4. Internationalization & mobility

General structure of standards

Description

- The description elaborates the statement of the standard, explaining its meaning.
- It defines significant terms and provides background information.

Rationale

- The rationale highlights reasons for the adoption of the standard.
- Reasons are based on educational research and best practices in engineering and higher education.
- The rationale explains ways in which the standard distinguishes the CDIO approach from other educational reform efforts.

Rubric

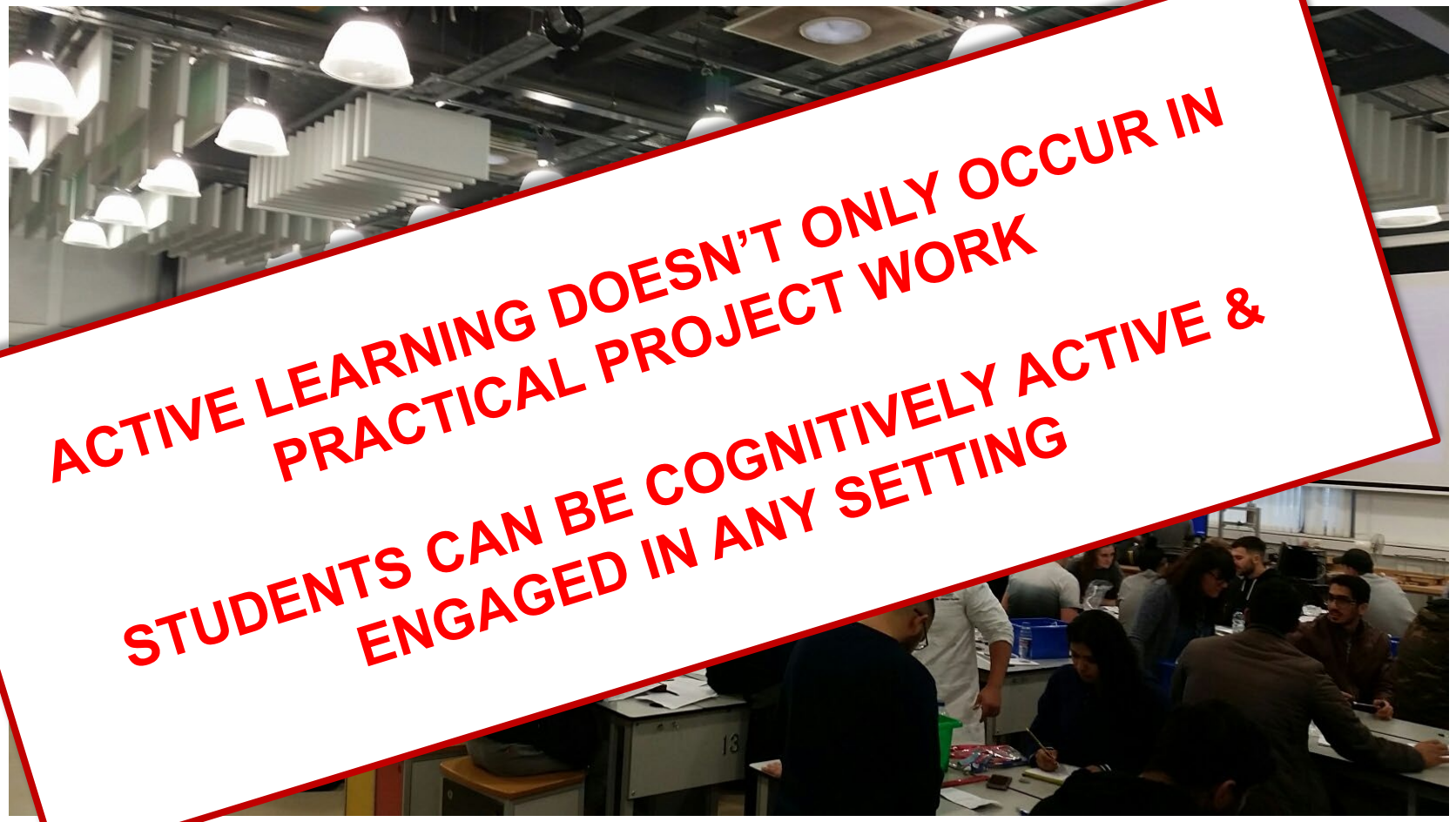
- A rubric is a scoring guide that seeks to evaluate levels of performance.
- The rubric of the CDIO Standards is a six-point rating scale for assessing levels of compliance with the standard.
- Criteria for each level are based on the description and rationale of the standard.
- The rubric highlights the nature of the evidence that indicates compliance at each level.

CDIO Standard 8: Active Learning

Teaching and learning is based on active and experiential learning methods

- **Engage** students directly in thinking and problem solving
- **Help** students recognize what and how they learn
- **Increase** student learning motivation
- **Help** students form habits of lifelong learning

University of Liverpool, UK, Engineering Active Learning Laboratory



ACTIVE LEARNING DOESN'T ONLY OCCUR IN PRACTICAL PROJECT WORK

STUDENTS CAN BE COGNITIVELY ACTIVE & ENGAGED IN ANY SETTING

Active Learning

120 1st year Mechanical Engineering students

Sem1 Introductory Design-Build-Test project: ***Dragster Racing***

Active vs Experiential Learning

ACTIVE LEARNING

- **Engages** students directly in **thinking** and **problem solving activities**
- Emphasis on engaging students in manipulating, applying, analyzing, and evaluating ideas

- Examples:
  - Pair-and-Share
  - Group discussions
  - Recitation / Ticking
  - Concept questions

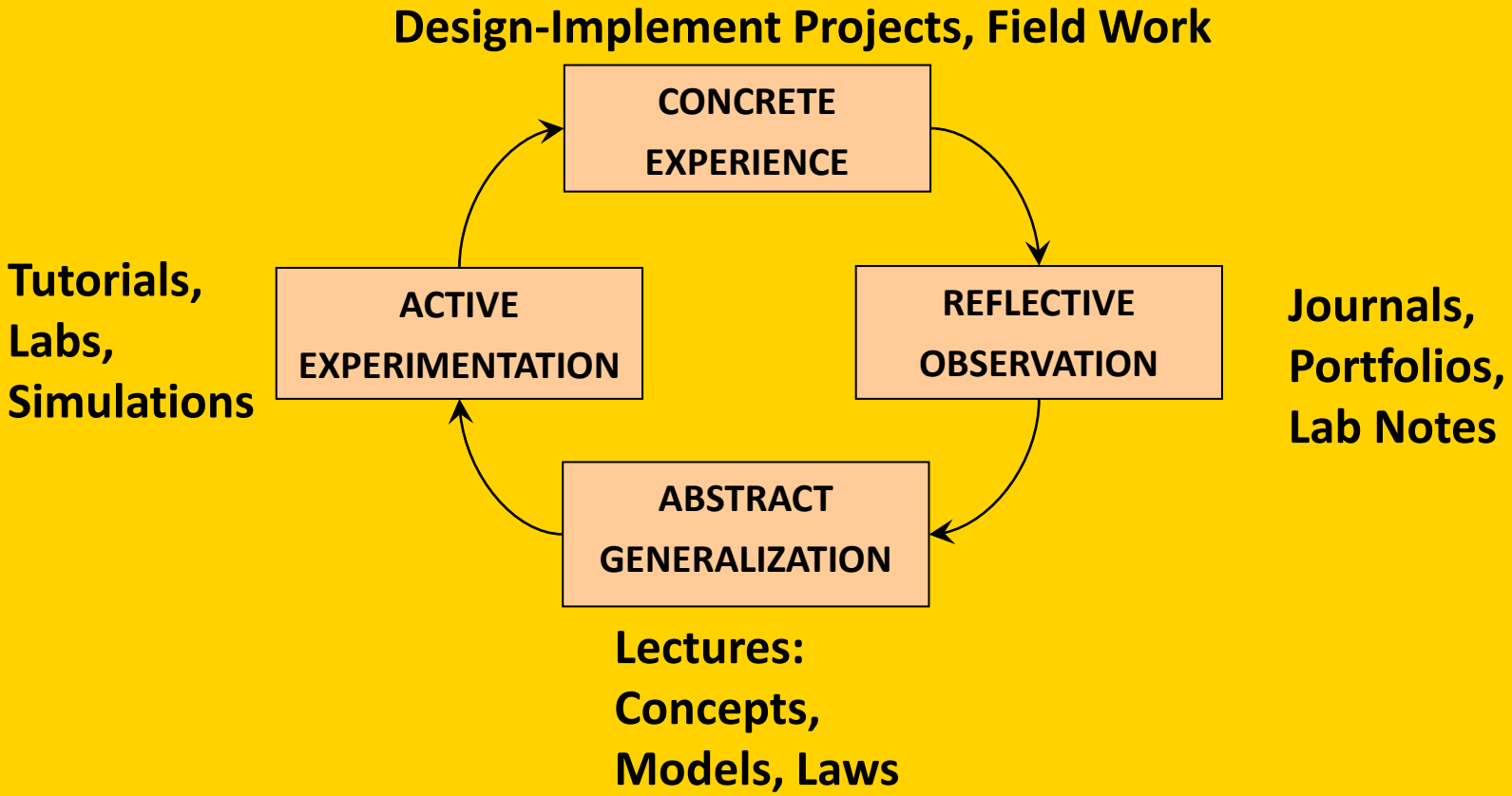
EXPERIENTIAL LEARNING

- Active learning in which **students take on roles that follow professional practice**

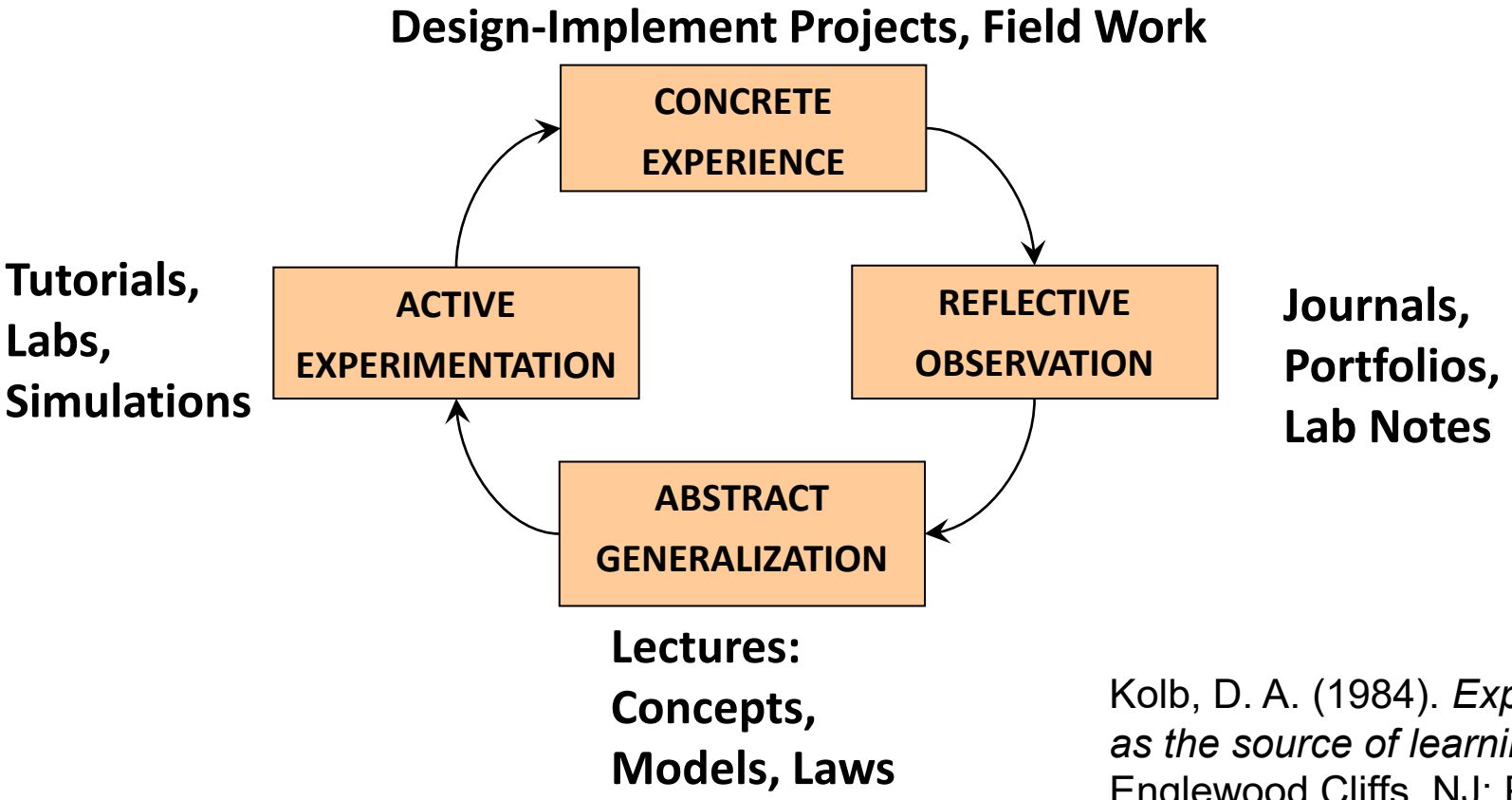
- Examples:
  - Design-implement experiences
  - Problem-based learning
  - Project-based learning
  - Simulations
  - Case studies

New question:

Who developed this experiential learning cycle?



***Experiential Learning Cycle*: variety in learning methods**

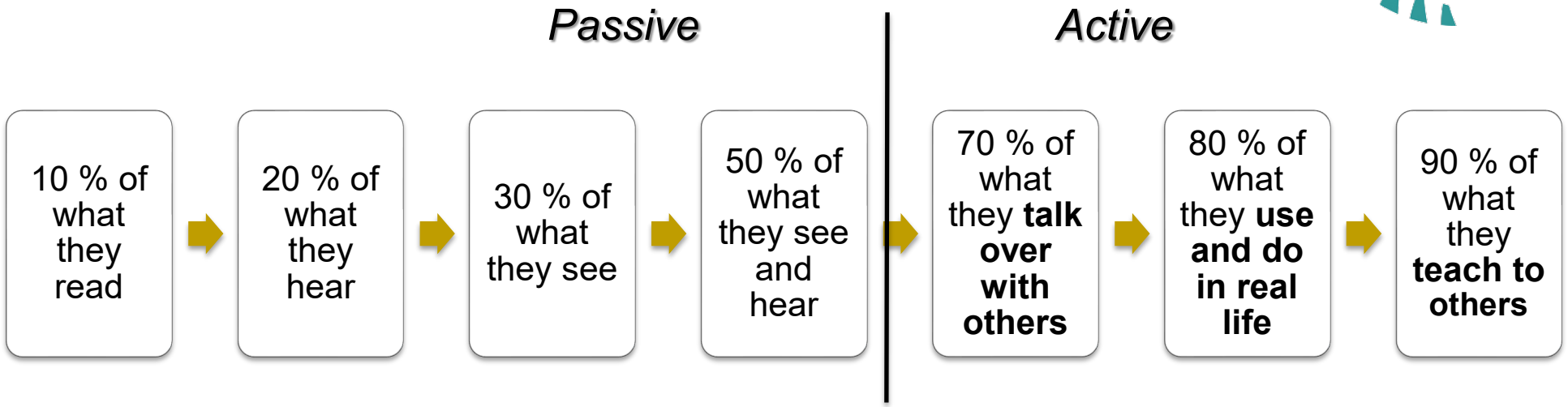


Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development* (Vol. 1). Englewood Cliffs, NJ: Prentice-Hall.

New question:

The ”learning pyramid” suggests that most people learn _____ % of what they explain to someone else?

Towards effective & efficient learning….



The 2 key factors that underpin effective learning are

- **the learner activity**
- **interaction with others**

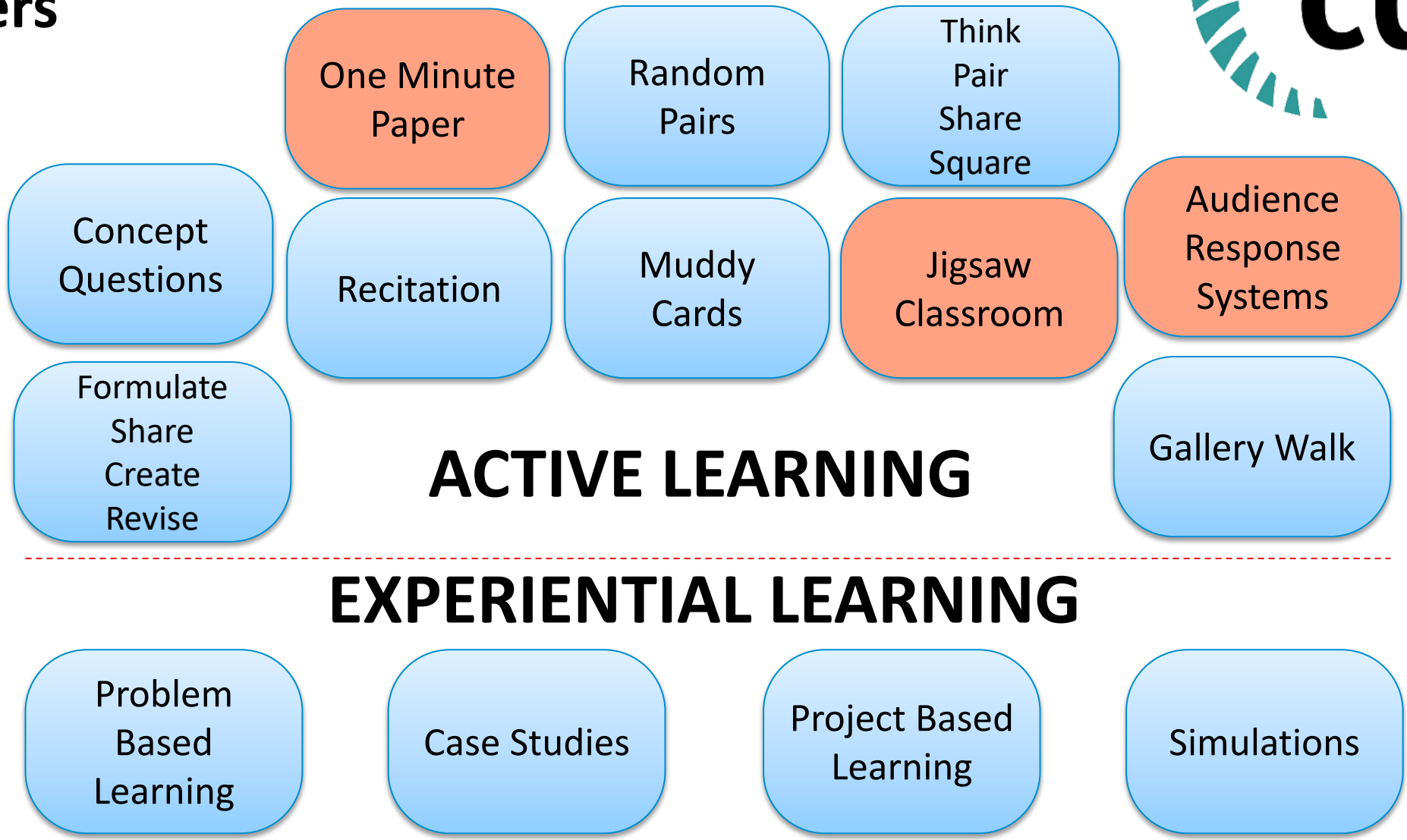
Gibbs, G. (1992) Improving the Quality of Student Learning. Bristol, UK: Technical and Educational Services

Several studies have shown that there is strong correlation between

- **extent of activity** and
- **efficiency of learning**

Biggs, J. (1999) Teaching for Quality Learning at University (pp. 165-203). Buckingham, UK: SRHE and Open University Press.

Some Methods That Engage And Activate Learners



Learning Activity- Jigsaw Classroom: CDIO Standards

Why?

Deeper understanding of the standards

What?

Learn four standards

Preliminary self-evaluation

How?

Active learning with the Jigsaw method

You need

Standards v. 3.0 from www.cdio.org

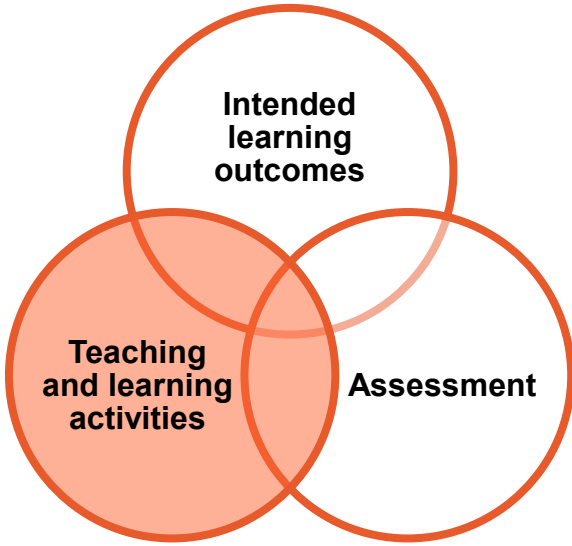
Don't close the Socrative page – we'll continue the quiz later!

Today's Active Learning Activity

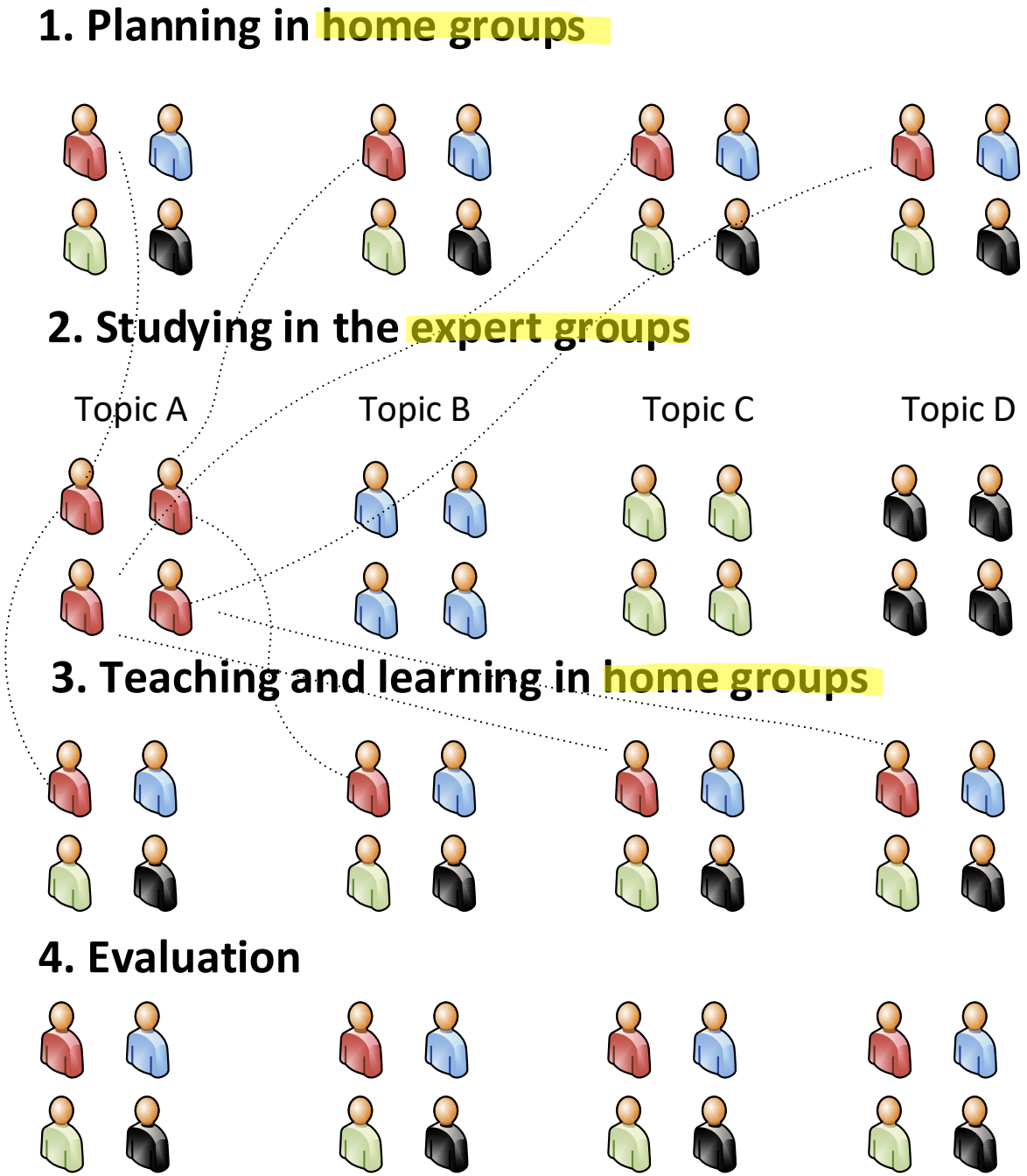
You are going to participate in the **Jigsaw Method**

You will learn 4 CDIO standards (**2, 5, 7,10**)
+ Jigsaw method

You will be "expert" on one of the standards and teach that to the others



How the *Jigsaw* method works (ideal case)



Group Activity: Phase 1

- Let's make **Home Groups** of 4 persons using Zoom breakout rooms (get to know the people in your group – you are a learning team now!) – **please remember the number of your room for the 3rd phase!**

- For each group → learning resources: 4 standard definitions **(2, 5, 7, 10)**
- Within the group **each person selects just one** standard and studies that independently
  - Every member of the group has a different standards to study
  - **This phase is for individual studying**

10 minutes

Group Activity: Phase 2

- People with same standard join together and form **Expert Groups**
- **New breakout rooms are created and you should join to right room as the next slides shows**

To Do:

- Discuss what you have learned and identify/agree the main points
- Consider how you would explain/teach the standard to others (***you will be doing this in Phase 3 to your home group***)
- Take some notes to help you later when teaching your ***Home Group***

15 minutes

Group Activity: Phase 3

- Return to main meeting room and join to your original **Home Group (number X)** (breakout room)
- **Share your new knowledge**
  - Teach each other the standard you have learned
  - Use your notes and experiences of your expert group to support your teaching
  - 4 standards to learn *as a group*!
    - ***20 minutes – 5 minutes/standard***

JIGSAW Classroom

You've all learnt stuff but we haven't taught you anything

A cooperative learning approach in which:

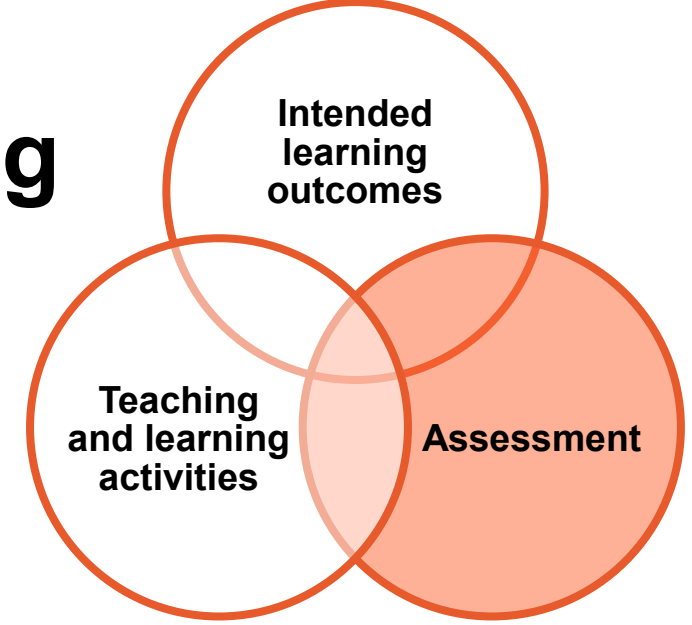
- Instructor facilitates student learning
- The students form 'learning teams' in which they teach themselves and each other

A 'learning contract' is formed between team members

- Students are motivated to take responsibility for their own, and each others, learning
- Enhances student engagement with material
- Facilitates interaction between students
- Develops communication and teamwork skills

An efficient way to cover content

Assessing the Learning in Jigsaw



Because

- the role of the instructor is not to lecture but is to facilitate student learning and
- students teach themselves and each other

Then

- the instructor must check that appropriate student learning has occurred (with respect to intended learning outcomes)

How might instructors check for understanding?

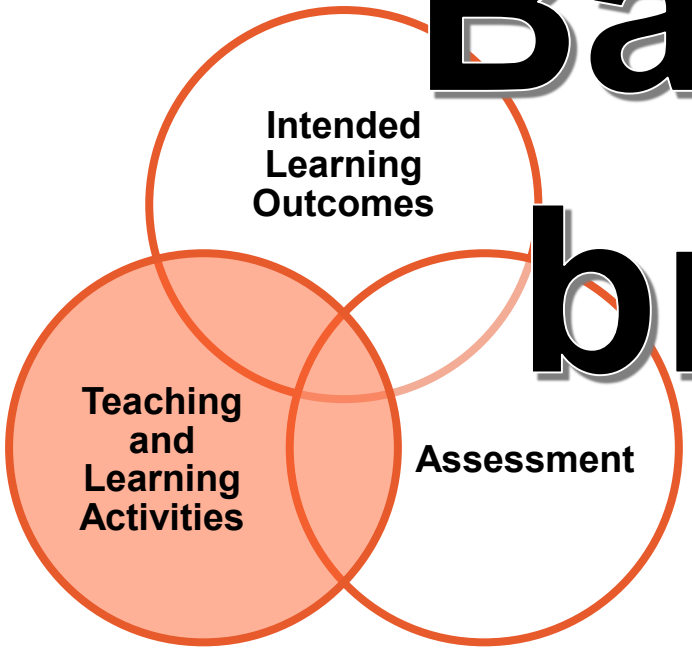
… and one of those teaching and learning activities is:

The tool for activating you

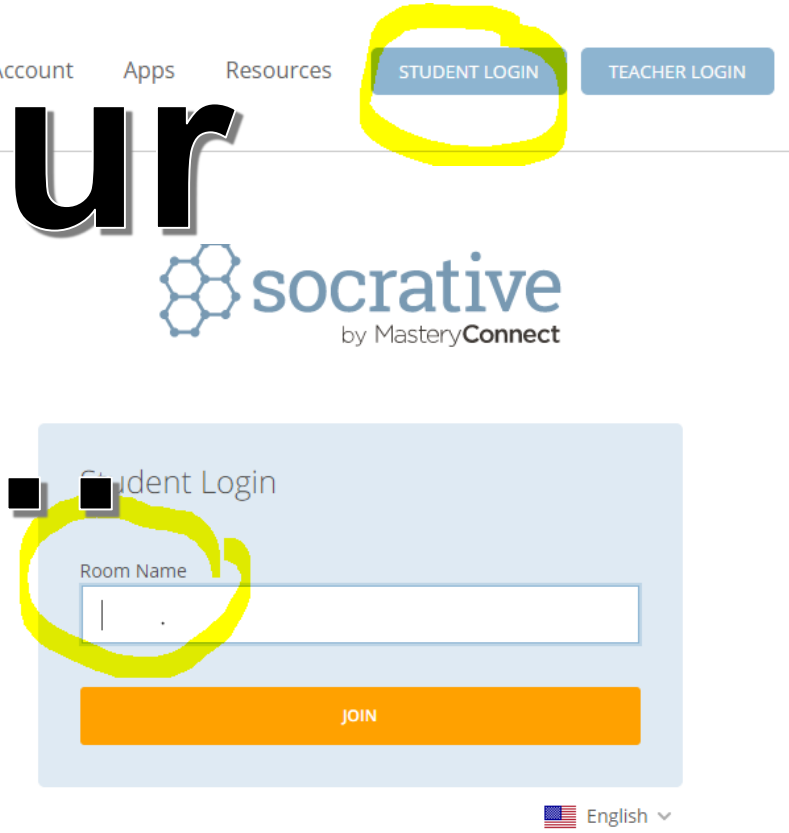
socrative

cdio™

Back to your browser…..



- Use your mobile / other device and go to:
  http://www.socrative.com/
- Choose 'Student Login'
- Write Room name: **TELI2020**
- Input your "name" and join the competition..



New question:

How many CDIO Standards there are in total?

New question:

Which CDIO Standard helps us to design programmes that deliver appropriate graduate knowledge, skills and attitudes?

New question:

The effectiveness of an undergraduate engineering education depends most on which CDIO Standard?

New question:

Which CDIO Standard helps us make more effective use of student learning time to deliver the expected programme outcomes?

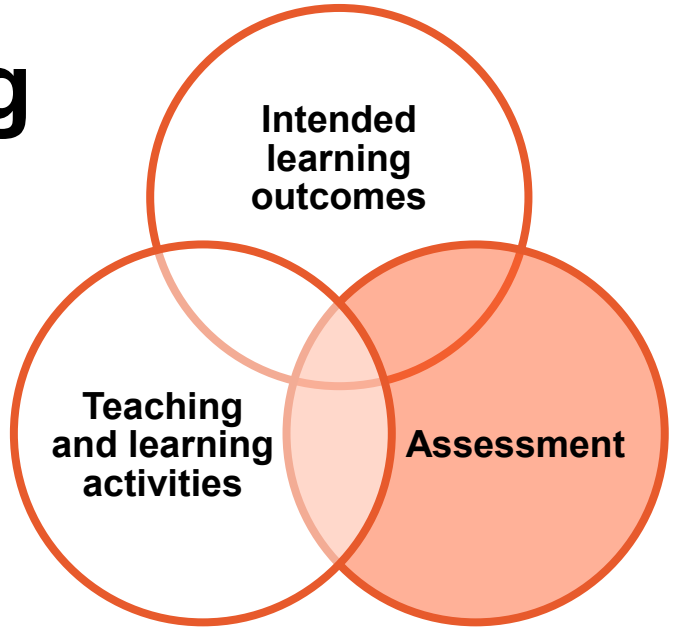
New question:

Which CDIO Standard helps us replicate engineering practice to help our students develop vital professional skills?

New question:

Identify the inappropriate use of the CDIO Standard *rubrics*?

Assessing the Learning in Jigsaw

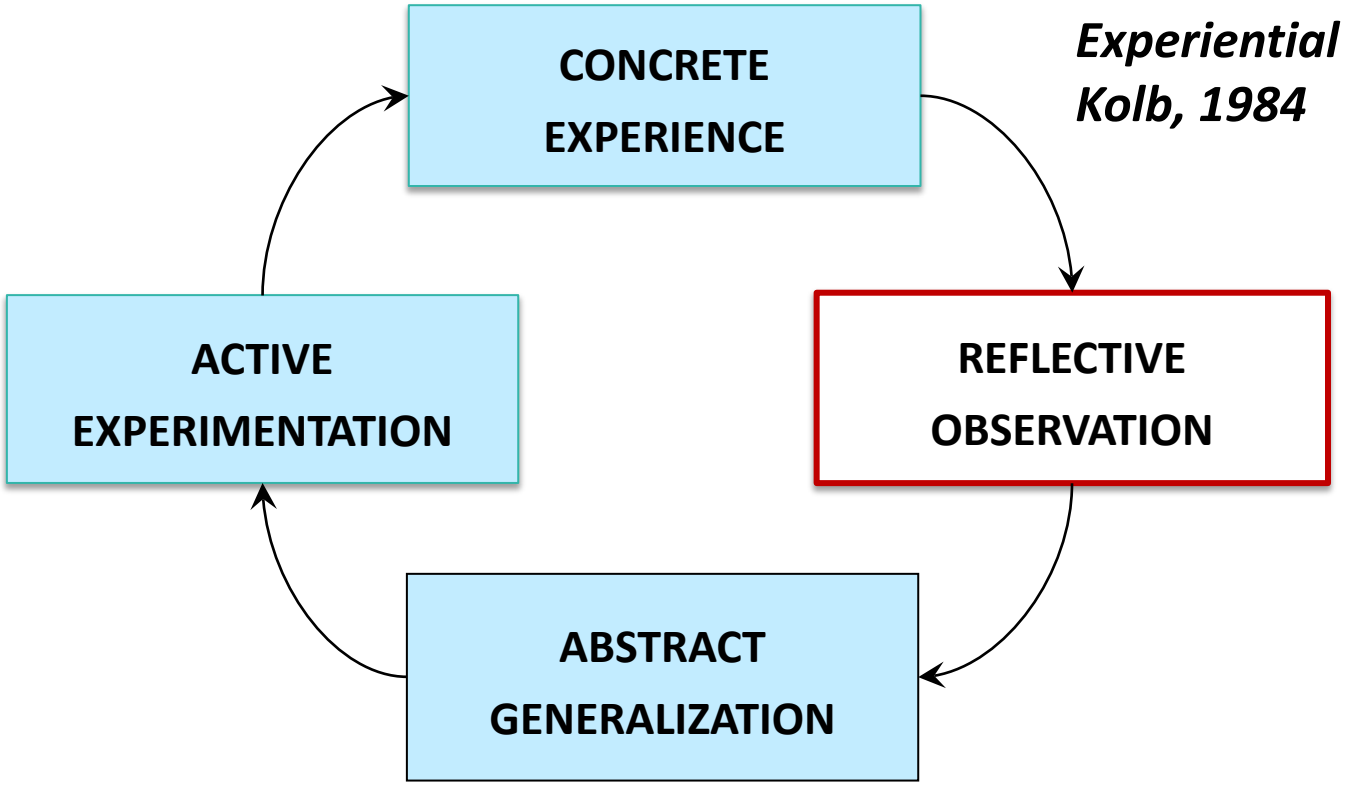


Let's see the results of the quiz & competition!

And remember:

- What's behind a high score!
- Learning pyramid – students retain 90% of what they teach to someone else

Reflecting on our learning experience ….



Experiential Learning Cycle
Kolb, 1984

Learner reflection is important because it:

- encourages learners to take charge of their own learning
- builds stronger connections between learning outcomes
- generates useful feedback for better course design
- sparks peer discussion & social interaction

Why 'Reflection' Encourages a Better Learning Experience

Click to read

Example technique for student reflection:
The 1-Minute Paper

This quick technique helps the teacher find out what students have or haven't learnt from a particular learning activity

It is used to confirm that key syllabus topics have been mastered, and that learning outcomes have been met

In its basic format, the teacher takes <5 minutes at end of class to ask students to answer on paper or Post-Its:

- What was the most important point made in class today?
- What unanswered question do you still have?

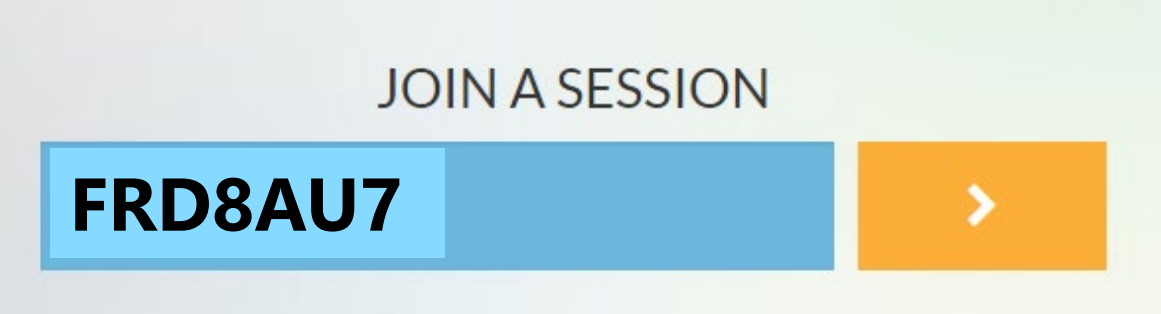
This gives immediate feedback that enables the teacher to adjust the next session to address difficulties, misunderstandings and gaps in knowledge

Example technique for student reflection:
The 1-Minute Paper

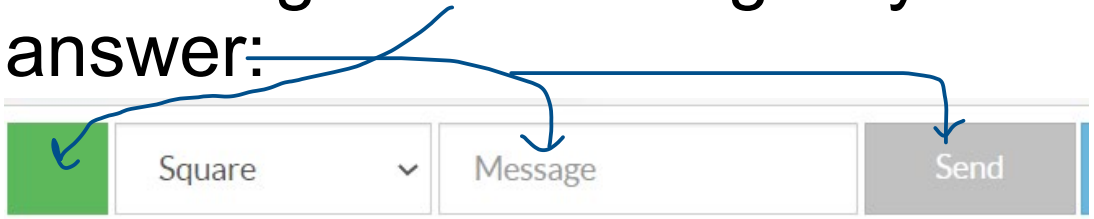
On a **GREEN** post-it note write down the most valuable thing you gained from today's session

On a **RED** post-it note write down those things that we didn't explain well, or ideas on how we could improve our session

Open new website to write post-it notes online: flinga.fi
*(Don't add **www** to the link!)*



Select right color and give your answer:



Thank you!

Questions or Comments?