Assessment: Measuring the Impact of Our Teaching on Student Learning

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The Testing Challenge

- Design an examination question to see if a student:
  - Knows that at standard sea level pressure water boils at 100 [C] ;
  - Routinely uses appropriate control volumes in thermodynamic analysis of engineering systems.

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Workshop Question

- How do we assess students' developing understanding of the fundamental and broadly applicable ideas in our disciplines?

- The ideas (threshold concepts) which are often:
  – Troublesome
  – Transformative
  – Irreversible

Session Outline

- Initial Thoughts
- Framework for Understanding Assessment
- Pre/Post Assessment Example
  - Guidelines for pre-assessment
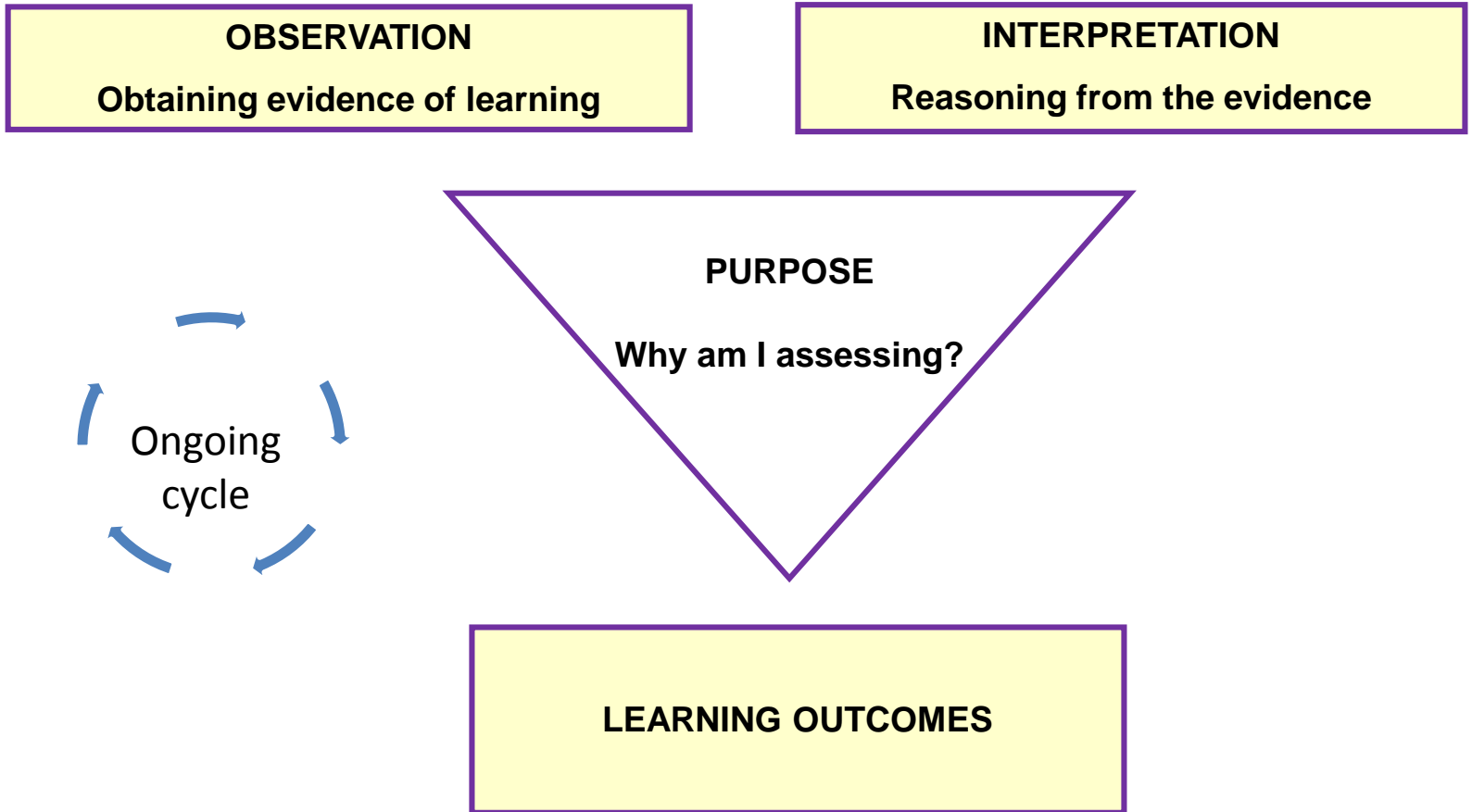- Development of Pre-test
- Wrap-up

INITIAL THOUGHTS

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Initial Thoughts

- In SIX words (no more) describe the purpose of assessment:

- Form can be a question, six key words, a statement, etc.

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Group Themes

- Assemble into three groups: teaching < 5 years, 5-10 years, > 10 years
- Share SIX words and identify themes in your group:

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FRAMEWORK FOR UNDERSTANDING

Framework for Assessment

OBSERVATION

Obtaining evidence of learning

INTERPRETATION

Reasoning from the evidence

PURPOSE

Why am I assessing?

Ongoing cycle

LEARNING OUTCOMES

Adapted from National Research Council (2001). *Knowing What Students Know*. Washington, DC: National Academy Press, p. 44.

PRE/POST ASSESSMENT EXAMPLE

Threshold Concept(s)

- Distinguishing between **TRANSPORT** and **MIXING** processes in fluid flows involving heat and mass transfer

Photo taken by Thierry Lombry, downloaded September 8, 2015 from
http://epod.usra.edu/blog/2004/06/cumulus-mediocris-clouds.html

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Lifting Condensation Level

$$\text{Relative Humidity} \equiv \frac{\text{mass of water vapour}}{\text{mass of water vapour at saturation}}$$
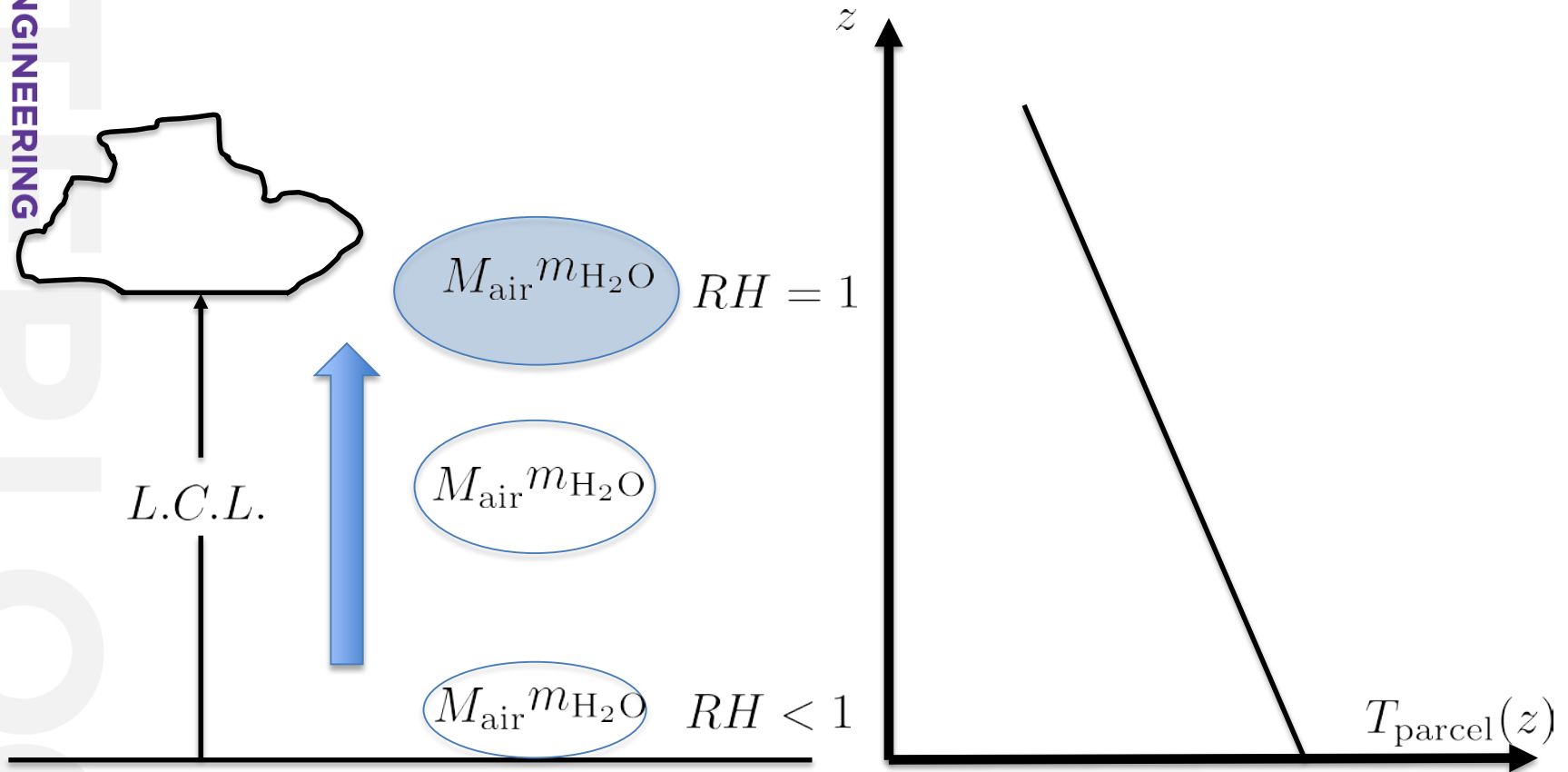
Lifting Condensation Level

- Model: parcel of moist air rises in thermal updraft without mixing

- Temperature of parcel falls at fixed rate:

  – expansion work on surroundings

  – gravitational potential energy gain

- At $L.C.L.$ $RH = 1$

Photo taken by Thierry Lombry, downloaded September 8, 2015 from http://epod.usra.edu/blog/2004/06/cumulus-mediocris-clouds.html

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Pre-assessment Examples

- There are very weak (< 0.1%) up and down motions in atmosphere: In the photograph **identify** a probable region of up motion.

- What is that we see when we look at clouds?

- Where do the water drops in clouds come from?

Pre-assessment Examples II

- There are very weak (< 0.1%) up and down motions in atmosphere: In the photograph **identify** a probable region of up motion.

- What is that we see when we look at clouds?

- Where do the water drops in clouds come from?

- Application of TC

- Pre-req. knowledge

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Post-test Examples

1. There are very weak (< 0.1%) up and down motions in atmosphere: In the photograph **identify** a probable region of up motion and one of down motion.

2. At sunrise on a clear calm September early morning the ground level RH is high. **Explain** why there are no clouds?

Challenge: Pre-test Design

- How to make a pre-test of conceptual ability prior to teaching?
  - Understandable
  - Actionable
  - Fair
  - Relevant

Motivation - Task Value Determined By:

Element	Description	Instructional Strategies
Intrinsic value	Interesting material and tasks	Use real-world examples Visual-centred activities tend to be engaging
Utility value	Short and long term use	Can they imagine themselves as engineers?
Need satisfaction	Need to succeed/avoid failure	Easily self-check (have data) Minimal consequences of failure
Choice and control	Independent decisions	Provide hints (not answers) – i.e. cloud and non-cloud regions
Influence/ opinions of others	Do what others value	Do with peer support and discussion (Think-Pair-Share)

Adapted from:
Svinicki, M.D. (2004), *Learning and Motivation in the Postsecondary Classroom*, Anker Publishing Co., San Francisco CA.

Motivation - Expectancy Determined By:

Element	Description	Instructional Strategies
Self-efficacy	Capability to succeed	Clear instructions in everyday language Sketching - simple actions easy to start
Difficulty	Appropriate level of challenge	Simplify so concept or issue stands out
Prior experience	Build on past success and connect past work	Know student misconceptions – use to engage Acknowledge contextual validity of prior knowledge
Encouragement	Positive talk and modeling	Model "failure" = learning opportunity Normalize "failure" (clickers) Acknowledge engagement

Adapted from:
Svinicki, M.D. (2004), *Learning and Motivation in the Postsecondary Classroom*, Anker Publishing Co., San Francisco CA.

PRE- TEST DEVELOPMENT

Worksheet 1

- Identify a significant fundamental concept in a course you teach:
- Course:_____
- Concept:

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Worksheet 2

- Design a pre-assessment activity that will illustrate your students' initial understanding or ability to use concept

Feedback

- Share activity with a partner checking that your design is:
  - Understandable
  - Actionable
  - Fair and Relevant

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WRAP-UP

Remaining Questions about Assessment

- What does the lit say about the effectiveness of grades/marks pass/fail (mastery vs. performance learners)?
- What is the cost of the instructor providing feedback? Possible solution – students self-checking
- How can we strategically give feedback, so that students will **care** and use it?
- Relative benefits of negative vs positive feedbacks / atmospheres
- Do we pass students who should be held back or repeat terms.

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EXTRA RESOURCES

Benefits of pre-assessment for instructors

- Can provide useful information about students' knowledge of a topic and about their skills in communicating this knowledge

- Allows you to determine the gap between students' current ways of understanding and your intended outcomes for the course in terms of their understanding

- Allows you to identify preconceptions and misconceptions

- Provides baseline data for making decisions about instruction (i.e., deciding what and how to teach)

- By starting where students are, you provide a "hook for new information to hang on"– this is an important strategy for promoting deep learning

References: Angelo & Cross, 1993; Gunder, 2012; McTighe & O'Connor, 2004

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Benefits for students

- Provides both a preview of material to come and a review of what they already know

- Allows students to assess their level of preparation in relation to the group and find out how the whole class did

- Allows students to recall knowledge and make connections to prior experiences and knowledge, which enables deep learning

Reference: Angelo & Cross, 1993

Suggestions for instructors

- Tell students that their answers will help you make effective instructional decisions and may guide their own approach to learning.

- Try to help mitigate anxiety and fear of failure.

- Convey results of assessment to the group, so that students can gauge their level of preparation.

References: Angelo & Cross, 1993; Gunder, 2012

References

Angelo, T. A., & Cross, P. K. (1993). *Classroom Assessment Techniques: A handbook for college teachers* (2nd ed.). San Francisco, CA: Jossey-Bass.

Gunder, A. (2012, November 1). *Designing effective webinars: Creating pre- and post-assessments.* Retrieved from http://www.adesinamedia.com/webinars/designing/creating-pre-assessment-activities/

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