Are We There Yet?
Assessing Our Reforms

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What is Assessment?

Assessment is a two-way street
- Feedback loop for faculty/students

Assessment is a journey
- We never “arrive”
- There’s more than one route
- It “drives” student learning

Assessment is a road to scholarship
Types of Assessment

- Formative vs. Summative
- Quantitative vs. Qualitative
- Program vs. Course vs. Topic
Types of Assessment

Have we gone off the road?  
Did we arrive at our destination?

- Formative vs. Summative
- Quantitative vs. Qualitative
- Program vs. Course vs. Topic
Types of Assessment

- Formative vs. Summative
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High Generalizability
Low Resolution

High Resolution
Low Generalizability
Types of Assessment

- Formative vs. Summative
- Quantitative vs. Qualitative
- Program vs. Course vs. Topic

Grain size: what is your purpose?
Methods

- Pre/post Testing
- Student Evaluation of Instruction
- Comparisons to Others
- Longitudinal Studies
- Portfolios
- Interviews & Focus Groups
Methods

- Pre/post Testing
- Student Evaluations
- Comparisons to Others
- Longitudinal Studies
- Portfolios
- Interviews & Focus Groups
The methods you use are determined by your reasons for conducting an assessment.

You have to be able to measure something.
COURSE GOALS FOR THE SCALE-UP CURRICULUM

Measurable learning objectives of what students should achieve after one year of SCALE-UP introductory physics

I. Students should develop a good functional understanding of physics.

II. Students should begin developing expert-like problem solving skills.

III. Students should develop laboratory skills.

IV. Students should develop technology skills.

VI. Students should develop attitudes that are favorable for learning physics.
I. Students should develop a good functional understanding of physics. They should be able to:

A. describe and explain physics concepts including knowing where and when they apply

B. apply physics concepts when solving problems and examining physical phenomena

C. apply concepts in new contexts (transfer)

D. translate between multiple-representations of the same concept (for example: between words, equations, graphs, and diagrams)

E. combine concepts when analyzing a situation.

F. evaluate explanations of physical phenomena
II. Students should begin developing expert-like **problem solving** skills. They should be able to:

A. satisfactorily solve standard **textbook problems**

B. apply all or part(s) of the **GOAL** expert problem-solving protocol in any context

C. solve more **challenging** problems, including:
   1. context-rich ("**Real World**") problems
   2. **estimation** problems
   3. **multi-step** problems
   4. **multi-concept** problems
   5. problems requiring **qualitative** reasoning

D. **evaluate** other people’s written solutions and solution plans
III. Students should develop **laboratory skills**. They should be able to:

A. interact (set up, calibrate, set zero, determine uncertainty, etc.) with an apparatus and make measurements

B. explain the underlying physical principles of the operation of the apparatus, measurements, physical situation being studied and analysis of data

C. design, execute, analyze, and explain a scientific experiment to test a hypothesis

D. evaluate someone else’s experimental design
COURSE GOALS FOR THE SCALE-UP CURRICULUM

IV. Students should develop technology skills. They should be able to:

A. use simulations to develop mathematical models of physical situations

B. utilize a spreadsheet to graph and do curve fitting

C. find information on the web

D. use microcomputer, video, and web-based software and hardware for data collection and analysis
VI. Students should develop **attitudes** that are favorable for learning physics. They should:

- A. recognize that understanding physics means seeing the **underlying concepts** and principles instead of focusing on knowing and using equations
- B. see physics as a **coherent framework** of ideas that can be used to understand many different physical situations
- C. see what they are learning in the classroom as useful and strongly **connected to the real world**
- D. be cognizant of the **scientific process/approach** and how to apply it
- E. indicate a willingness to **continue learning** about physics and its applications
- F. see themselves as part of a classroom **community of learners**
Conceptual Tests

- Lots of tests available
- Generally well thought-out and evaluated
- Can normalize across different institutions
- Often deceptively “easy” for us
20. An object moves according to the graph below:

How far does it move during the interval from $t = 4$ s to $t = 8$ s?

(A) 0.75 m    (B) 3.0 m    (C) 4.0 m    (D) 8.0 m    (E) 12.0 m
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How far does it move during the interval from \( t = 4 \) s to \( t = 8 \) s?

(A) 0.75 m  (B) 3.0 m  (C) 4.0 m  (D) 8.0 m  (E) 12.0 m

73%
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How far does it move during the interval from $t = 4$ s to $t = 8$ s?

(A) 0.75 m  
(B) 3.0 m  
(C) 4.0 m  
(D) 8.0 m  
(E) 12.0 m  

73 %

1. Velocity versus time graphs for five objects are shown below. All axes have the same scale. Which object had the greatest change in position during the interval?

10 %
www.ncsu.edu/per/TestInfo.html

FCI Halloun, Hake, Mosca, & Hestenes’ *Force Concept Inventory*
FMCE Thornton & Sokoloff’s *Force & Motion Conceptual Evaluation*
MBT Hestenes and Well’s *Mechanics Baseline Test*
ECS Singh’s *Energy Concepts Survey*

BEMA Chabay & Sherwood's *Brief Electricity & Magnetism* Assessment
CSEM Maloney, et.al.’s *Conceptual Survey in Electricity and Magnetism*
DIRECT Engelhardt & B’s *Determining & Interpreting Resistive Electrical Circuits Test*
ECCE Workshop Physics’ *Electric Circuits Conceptual Evaluation*

HCTE Workshop Physics’ *Heat & Temperature Conceptual Evaluation*
QMVI Robinett’s *Quantum Mechanics Visualization Instrument*

TMUC Deardorff & Beichner's *Test of Measurement Uncertainty* Concepts
MMCE Workshop Physics’ *Mathematical Modeling* Conceptual Evaluation
TUG-K Beichner's *Test of Understanding Graphs* in Kinematics

MPEX UMd’s *Maryland Physics Expectations* Survey
VASS ASU’s *Views About Science Survey*

etc.
Conceptual Tests

You want to compare classes, but how do you account for differences in students?

Hake’s “normalized gain”

- Goal is 100% by all students
- How much progress was made?

\[ <g> = \frac{\text{actual gain}}{\text{possible gain}} = \frac{\text{posttest} - \text{pretest}}{100 - \text{pretest}} \]

Possible Gain

<table>
<thead>
<tr>
<th>PRE</th>
<th>Actual Gain</th>
<th>Not Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>PreTest Score</td>
<td>PostTest Score</td>
</tr>
</tbody>
</table>

Traditional 23%
Interactive 48%
Caveats

- Try small scale first, if you can.
- Higher level outcomes are harder to measure.
- Do you want to “reform to the test?”
- Assess program/course/topic, not students or instructor.
- Be open to unexpected findings.
- Don’t do a single type of assessment - triangulate.
- Assessment is never finished.
Caveats

- Be prepared for initially lower results & evaluations.
- Iteration is important. Trying and giving up is worse than not trying at all.
- If reforming service courses, review the ABET criteria.
- It’s unsettling to change things - be prepared for discomfort. Seek out support and resources.


Resources

- NCSU site <www.ncsu.edu/per/TestInfo.html>
- FLAG site <www.flaguide.org>
- WebAssign or similar system
- Campus-based help
  - University assessment teams
  - Education department
- Professional evaluators (but not too soon)
- Colleagues (start by writing objectives)
Enjoy the trip!