June 10th webcast

Assessing Student Learning Outcomes in Undergraduate STEM courses

Registrant Q & A

1. How can you do assessment online that is fair and which discourages/minimizes cheating/coordination among students?

   In large enrollment courses where grading is a limiting factor, I use pools of test questions that are randomized. For each question, I can ask variants (e.g. one question set might include variations that ask students to describe/interpret data in different time periods or segments of data on the same graph or map)I have been advised to randomize the questions and not allow students to backtrack so that students who might be taking an online exam together won't get the same questions at the same time. If they do land on a question from the same "set" it is likely they won't get asked the same version of the question. In smaller courses variations might also work (e.g. make interpretations or predictions about different parts of a single data set) or different stages of an experiment or demonstration.

2. How to assess students accurately using online tests given that online tools, such as Lockdown Browser, are inadequate in preventing students from cheating.
   See ideas in #1
3. How to perform better assessments with less time for grading?
   See ideas in #1

4. What are some strategies for assessment that are not time-sinks? Perhaps an analysis of what the point of assessment and grades is all about. Also, a summary of what feedback practices actually help students learn and engage better. Some studies say that students never read feedback and increasing feedback does not improve learning, so prioritizing what actually has been shown to help students while not being hugely time-intensive would be awesome.

   A good rule of thumb is that if students are not going to resubmit something (e.g. a paper or project they are going to revise and resubmit) then your feedback is not likely to be used by students (why would they use it?), so focus your time on feedback in formative but not summative assessments. Peer evaluation is another way for students to get feedback. I like to have students submit all prior versions and evaluations every time they resubmit versions of a paper/project, so I can see if they are incorporating feedback. Rubrics with feedback from me or their peers can include space for students

to indicate how they incorporated feedback (like a “response to reviewers” letter for papers in review for publication.

5. Strategies for effective peer-assessment (both formative & summative feedback) of soft skills in the context of group projects. (Students do not take the rubrics I've tried very seriously, and just rate their peers highly on every dimension).
   When I have students use rubrics for peer review, the reviewer also gets a grade based on the score they have given and the comments they provide. So, if student X gives student Y a 10/10, the comments from student X to student Y must specifically indicate how the assignment meets the criteria for 10 points. I also emphasize that reviewer feedback is going to help each other improve their peers’ final product. This gives reviewers a sense of responsibility in helping their peers.

6. How to ensure students collect publishable data without having to do it yourself?

   In a classroom context, this is the purpose of CUREs (Course-Based Undergraduate Research Experiences) as it teaches students authentic science skills by having them work in a current area of research in collaboration with a faculty member.
   https://www2.calstate.edu/impact-of-the-csu/research/stem-net/Pages/webcasts/course-based-undergraduate-research-experiences.aspx

7. Please provide some ways of assessing lab courses that have gone online.
   The primary thing to consider would be what are the intended outcomes for the lab course. Is it data analysis, being able to use equipment, writing a lab report, etc.? Some of these can be translated online without much changing (e.g. providing data for analysis, using a video or simulation and having students write a lab report). Others, like using equipment, would likely only be possible if students can be shipped appropriate equipment. They can then make videos of themselves that could be graded in the same way a lab practical might be. The literature on Digital Badging in laboratory courses may be relevant here.

8. What are some good assessment tools beyond multiple choice and short answer questions on an exam?
   In-class formative assessments can include questions for students to answer about course content (with clickers/polls and/or in groups), asking them to develop questions about data, methodologies (in groups), asking them to interpret data, etc. When groups report their results, the instructor can learn whether students learned the material or have misconceptions that need to be addressed (by the instructor or by asking other students to contribute).

   Here’s a link to a bunch of different types of assessment activities :
   https://serc.carleton.edu/NAGTWorkshops/assess/types.html

9. Do you have specific tools to assess the learning outcomes of CUREs?

This article may provide a good starting point “How to Assess Your CURE: A Practical Guide for Instructors of Course-Based Undergraduate Research Experiences” 10.1128/jmbe.v17i3.1103

Another good resource maybe CSU-wide CUREs network; for more information: https://www.getrevue.co/profile/csuperb-cures

10. How do you implement equitable assessments on student performance when socioeconomic disadvantages are exacerbated by remote learning (unstable internet, crowded living conditions, no quiet space, caretaking responsibilities, lack of proper equipment, confusion with using online tools, etc.)?

    We know that using a variety of assessment strategies (formative and summative) supports learning in a variety of formats, which allows students to succeed in multiple ways (rather than focusing success only on students who happen to be good test takers). For example, some students will excel in small group activities while others will do better on short answer questions and others at multiple choice questions. Offering all three modes (or more) gives more students the opportunity to shine.

    Offering students options for different ways of earning points is another way to offer students choice in assessments so they have some autonomy (thus increasing their confidence) in assessment. An example would be to offer students the option of writing a paper or creating a video on a topic. The assignment can include the same criteria, but the product they submit can vary.

11. What is the appropriate balance for assessing student learning outcomes vs. cheating enforcement? For example, is it better to assess students with A) a difficult, synchronous, 24-hour, open note, open book, open internet exam or a B) an easy, synchronous, 2 hour closed note, closed book, closed internet exam with lockdown browser and eye tracking software? In Example A students have substantially more freedom to cheat with their peers, but it is substantially more equitable because it gives students a longer time period to navigate socioeconomic disadvantages. Conversely, in Example B cheating is drastically limited, but students who have less accommodating living conditions will be significantly disadvantaged.

    I have tried group oral exams in my biochemistry course (50 students) - it’s very hard to cheat on an oral exam, it’s good for assessing conceptual understanding, especially when paired with student teamwork during the term (students practice weekly in small groups to answer conceptual questions to complete a case study report and prepare for group oral exam). The main barrier to using oral exam is student fear of the unknown; however, once students try it - many say they prefer this assessment method to traditional exam, and they learn more from both preparing and taking the group oral exam. Additional benefit - it helps students develop oral communication skills (listening

and talking). Anecdotally, students from disadvantaged situations and with DRC accommodations told me they preferred this type of assessment.

12. How are approaches in identifying Learning Outcomes and their assessment shifting based on teaching in an online environment?

    Addressing learning outcomes in an online environment may require a shift in the activities we traditionally have used to support students meeting those outcomes. For example, having students interact or manipulate samples (e.g. identify 25 different rock samples) may not be realistic, but could shift to using digital models of samples to make observations (e.g. grain size, minerals present) that help them identify the types of rocks that belong to different environments or processes of formation.

    In other cases, experiments can be recorded in a video and data can still be interpreted by students. Students can develop questions to ask based on data collected in the recorded experiment or can read a case study that describes experimental methodologies so they can identify flaws in the research design or that could lead to errors.

13. How to assess research skills and processes (e.g. as part of CUREs or inquiry-based stem labs)? How do you assess these skills in an online environment?

    As noted in #12, experiments can be recorded in a video and data can still be interpreted by students. Students can develop questions to ask based on data collected in the recorded experiment or can read a case study that describes experimental methodologies so they can identify flaws in the research design or that could lead to errors.

14. What are the most effective ways to word and frame learning outcomes?

    This site has a nice overview and examples of setting/writing learning outcomes: https://serc.carleton.edu/integrate/info_team_members/currdev/effective_materials/learning_goals.html

15. How do you assess skills in debugging, troubleshooting, etc.?

    This paper describes using case studies for students to identify flaws in research design: Grunwald, S., & Hartman, A. (2010). A case-based approach improves science students' experimental variable identification skills. *Journal of College Science Teaching*, *39*(3).

16. Is it possible for all instructors in a given field to agree on a single set of validated and standardized assessment items that can be used to assess learning in different courses which cover different sub-topics within a given discipline? If so, how can we get to this point?

Chemistry has a history of this with the Exams Institute: https://uwm.edu/acs-exams/. The American Chemical Society standardized exams have been around in some form since the 1930s. However, this is unique to chemistry, and not all faculty use these instruments though they are developed by committees of their peers. It may be possible to create something like this in other disciplines, and the push to start creating instrument databases (like PhysPort: https://www.physport.org/Assessment.cfm) may be one step in this direction.