
Navigating NGSS—Volume 2

# *Long Term vs. Short Term Gains*

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## To teach to the test or not to teach to the test?

As a teacher transitioning to Next Generation Science Standards (NGSS), one of the common challenges you may be struggling with is assessing your students' progress toward three-dimensional learning. For example, at present there is no assessment instrument shared by teachers implementing NGSS in High School Physical Sciences courses. This is in contrast to the College Board's Advanced Placement® program, throughout which students may take the same end-of-subject exam regardless of the state in which they reside or the school they attend. Similarly, there is no formal way for you to assess learning the DCIs for core chemistry or physics curricula. But let's consider for a minute the positives or opportunities that exist in a curriculum that doesn't have formal assessment or must seek to create alternative methods of assessment to measure student understanding of phenomena-based instruction.

## Short-Term Versus Long-Term Learning

Every first-year cadet in the United States Air Force Academy (USAFA) must enroll in Calculus I. The cadets are randomly assigned to course sections of about 20 students per class. The sections follow the same syllabus, use the same end-of-course exam and have standardized grading procedures to prevent subjective score adjustments. This highly controlled, standardized curriculum allowed a pair of economists, Scott E. Carrell and James E. West, to study the impact of different teaching styles on student outcomes. Carrell and West examined performance data from thousands of cadets who had taken Calculus I over a 10-year period, with

instruction delivered by around 100 professors. They found that students with instructors who prioritized high test grades received higher exam and course grades than students with instructors who prioritized the connections between the subject matter and the students' lives and future careers. Moreover, instructors that taught to the test received more favorable student reviews. These results would suggest that teaching to the test is the better pedagogical choice. However, these results reflect only short-term learning. What does the long-term view look like?

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When the researchers examined the performance of the same students in subsequent math and engineering courses that required Calculus I as a prerequisite, they found that students who took Calculus I sections with an exam-only focus did not do as well in later courses as students who had experienced Calculus I sections with a broader focus. In the words of the researchers, "professors who excel at promoting contemporaneous student achievement teach in ways that improve student evaluations but harm follow-on achievement of their students in more advanced classes." The researchers note that less experienced professors are better at promoting short-term learning whereas more experienced professors are better at promoting lasting learning. They speculate that "the less experienced professors may adhere more strictly to the regimented curriculum being tested whereas the more experienced professors broaden the curriculum and produce students with a deeper understanding of the material."

## Exploratory Learning

So what does this mean for you as you navigate the uncertain waters of assessing instruction informed by NGSS? Carrell and West suggest that an exploratory style of learning like what is experienced in the NGSS can have a lasting, positive impact on learning. Moreover, they indicate that widely adopted, written assessment instrument(s) are not always the best way to promote lasting learning. Instead, consider engaging your students in conversation as they carry out an experiment. Ask them simple questions like "Why is that step important?" or "What is the independent variable in your procedure?" or "Why are you collecting these data? What question will the data help you answer?" These are the types of questions asked in university research labs, and they really get at the science practice side of things. You can create a semiquantitative scale for tracking their progress, in which "1" indicates a novice scientist still unable to engage in the scientific method; and "5" represents a high-level scientific thinker able to design an experiment and articulate clearly the reasons for doing the things they do in the lab. You can record these numbers in a journal along with a note or two about your conversation with each student. The NGSS were designed to encourage students to think like scientists. Ironically, it can be very hard to quantify that ability. But if you are able to engage with your students on a regular basis as they set up and carry out experiments, all the while engaging them in conversation about their thought processes, you can get a great feel for their abilities. The key is to be a diligent observer and recorder of insights… kind of like a scientist!

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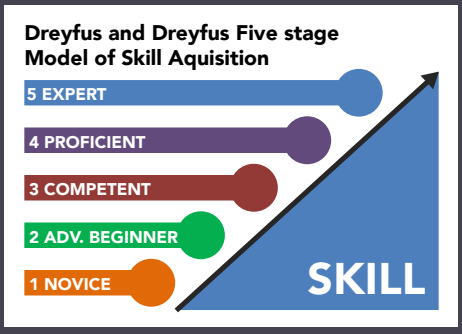

## Question Stems for Lab Exploration

- **Why is that step important?**
- **What is the independent variable in your procedure?**
- **Why are you collecting that data?**
- **What question will these data help you answer?**

## References

Carrell and West. 2015. "Does Professor Quality Matter? Evidence from Random Assignment of Students to Professors." *Journal of Political Economy*. (3): 409-32.

## Images

Academy instructors help cadets through extra instruction. From usafa.af.mil. Photo by Virin. 2013

*Five Stage Models of Skill Acquisition*. Based on Dreyfus, H.L., Dreyfus, S.E., Athanasiou, T. 1986.

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