Assessing three-dimensional performance: science and engineering practices

SEPs SENSE-MAKING

The science and engineering practices (SEPs) are the "how" of science—the behaviors and processes that scientists engage in to make sense of phenomena and design solutions to problems. **Assessment tasks should provide evidence of students' ability to engage in the SEPs appropriately**: this includes both understanding of **what each SEP entails** (e.g., what makes a scientific question; that models have limitations) as well as **how to use the practice** (how to model phenomena to explain or predict; how to develop a strong argument for a claim about a phenomenon based on evidence). In science teaching, learning, and assessment, the SEPs are both a mechanism to make student thinking visible as well as a critical part of the assessment target (what we want to know about student learning).

What we've learned about science and engineering practices in science assessments:

✓ Skills vs. Practices.

Assessing the SEPs is different from assessing skills because of an emphasis on purpose—assessing the SEPs requires that students purposefully use the SEPs to make sense of phenomena or solve problems, rather than just demonstrating the necessary, purely procedural aspects of scientific endeavors. Skills are isolated pieces of the SEPs that are disconnected from sense-making, while SEPs are meaningful tools to deepen students' science exploration and sense-making connected to phenomena and problems. Skills are a necessary, but not sufficient, component of students' science performances.

✓ Representing vs. Sense-making.

SEPs are used for two purposes in science tasks that are designed for three-dimensional standards:

- To **represent ideas that students have previously learned** (for example, developing a diagram that shows how energy flows between producers, consumers, and decomposes in an ecosystem). Representations are an important part of developing an understanding of the SEP, but aren't, alone, enough to make a claim that students are proficient in a particular SEP.
- To **make sense of a phenomenon or problem** (for example, developing a visual model to explain why a magnet rotates when another magnet is placed closeby).

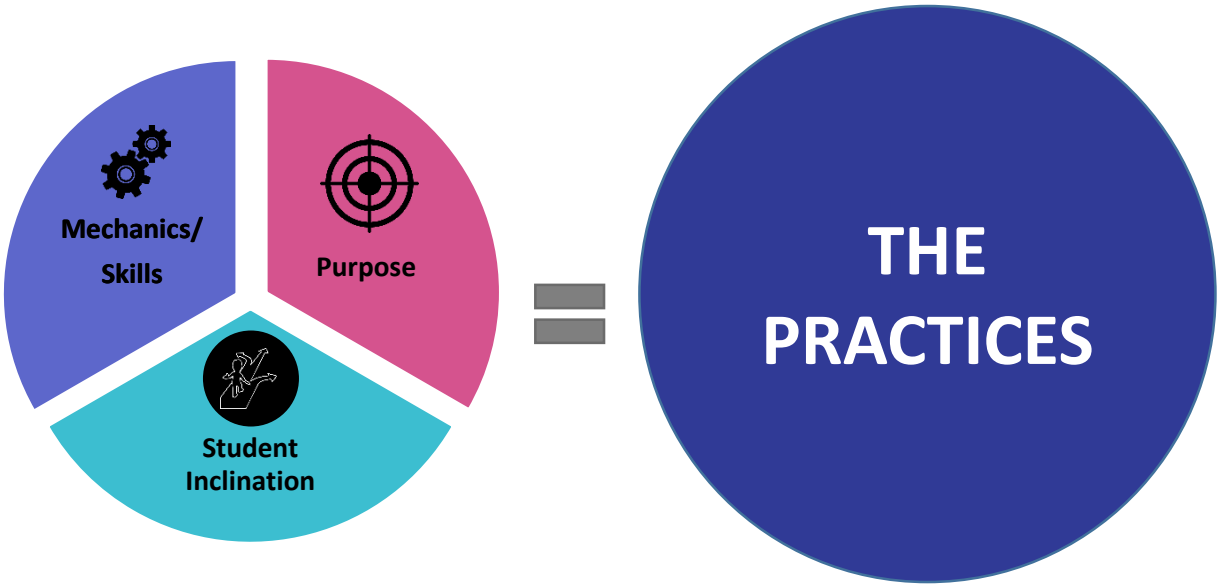
Implications for educators and developers

Educators should look for and use assessment tasks that reveal the needed information about student progress.

- If the focus of the task is on whether students deeply understand the targeted DCI or CCC, it may be appropriate to ask students to use part of a practice to represent their thinking.
- If the purpose of the assessment is to provide a formative check on students SEP development, it may be appropriate to ask students to focus on providing opportunities to develop and receive feedback on skills as part of meaningful learning experience.
- If the goal is to surface students' understanding and ability to use the SEP, it is important that tasks provide ample opportunity for students to use the SEP in service of sense-making.

Developers should be clear about what tasks are and are not revealing with regard to the SEP. This should include support for the kinds of inferences about student progress and proficiency that can be made with different tasks.

In order to make claims about whether students are meeting the standards, tasks have to surface evidence that students can use the SEPs in service of sense-making.



Mechanics/Skills

Mechanics or skills of the practice are procedural features and knowledge pieces like reading graphs and charts, drawing and labeling diagrams, what makes a scientific question, etc. Demonstrating these features is a **necessary** component of demonstrating SEPs, but alone are **insufficient evidence** of students' use of SEPs.

Purpose

This is ***why*** a student is demonstrating this practice. This can be divided into two categories:

Making thinking visible to represent their ideas. This might include expected/previously learned ideas, but does not involve figuring out something new. This could look like drawing a representation of a an expected DCI understanding, describing why a well-understood phenomenon occurs, etc.

This is **necessary but not sufficient** to make claims about student proficiency with SEPs.

Making thinking visible in service of sense-making. This includes using a practice to make connections among previously learned ideas to figure out a new phenomenon or problem. This could be in the form of modeling, explanation, argumentation, posing questions and hypotheses, designing investigations, etc.

Making claims about student proficiency with SEPs requires evidence that students can use SEPs in service of sense-making.

Student Inclination

This can be thought of as a sliding scale that describes how much choice, agency, or ownership students have over their decisions to engage in the SEP. For example, are they being directly told to draw a model, or have they been given an open-ended phenomenon to address and can choose whichever SEP they want?

The level of student inclination required by the task changes the inferences that can be made about student proficiency. For example, if students are given the freedom to choose the SEP they use, the task cannot be used to make the claim that students' are not proficient with a particular SEP.