This excerpt is from the article

Creating opportunities for students to show what they know: the role of scaffolding in assessment tasks

(Kang, H., Thompson, J., & Windschitl, M., 2014, Science Education, 98(4), 674-704)

**ABSTRACT:** This study examines the ways in which teachers provide students with written scaffolds in assessment tasks and the impact of these on students’ abilities to demonstrate a core disciplinary proficiency—constructing evidence-based explanations. Data include 76 assessment tasks designed by 33 science teachers and 707 samples of student work. We found five types of scaffolding embedded in assessments that allowed students to make their reasoning explicit: (a) using contextualized phenomena, (b) rubrics, (c) checklists, (d) sentence frames, and (e) encouraging students to draw explanatory models in combination with written explanation. Analyses showed that all five forms of scaffolding were significantly associated with the quality of student explanation even when controlling for teacher variance and student background. Providing contextualized phenomena had the greatest impact on the quality of student explanations, both by itself and in combination with other scaffolding. The results indicate that strategic combinations of scaffolds can prompt students across all achievement levels to more readily use what they know to produce evidence-based explanations, but that the scaffolding must be of high quality.


**Using a Combination of Three High- and One Low-Level Scaffolding in a Task:**

**Seasonal Change Assessment (p. 23)**

This focal assessment was about seasonal changes in a seventh-grade earth science unit. Students were prompted to explain: “Why don’t countries near the equator, like Samoa, seem to have seasons like we do here, in Seattle?” As shown in Figure 5, students drew the positions of the earth around the sun in the four seasons and then labeled Seattle and Samoa on their drawing. The teacher gave students options to choose another country near the equator like Cambodia or Kenya. It should be noted that this school has a large population of students of immigrant families from these regions of the world. Next, students were prompted to write a claim in a few sentences guided by the sentence frame: “Countries near the equator, like Samoa, don’t seem to have seasons like we do here in Seattle, because ...” It follows the prompt of “Providing evidence from activities in class (use Summary Table) to support your answer and explain, how your evidence supports your answer using your drawing. Look at the rubric to help you decide what information to include.” By combining modeling with contextualization in this assessment, students were invited to engage in a high level of intellectual work that involved (a) locating geographic positions for two different countries on the earth, (b) identifying the relative positions of the sun and earth during the orbit of the earth at different seasons, and (c) simulating the seasonal changes at two different locations in terms of exposure to the sun’s light. The **focusing sentence frame** seems to help students to get right into the heart of the work, that is, writing a claim about the focal phenomena. In this assessment task, the combination of this high-level scaffolding enabled students not only to draw on their everyday reasoning resources, such as the seasonal differences noted by themselves and their relatives and travel experiences to visit their relatives, but also to express their ideas in a modality other than writing.

Most students demonstrated significant progresses in their explanation about seasonal changes. For example, one student, Nick, a student as a typical category, initially had a “distance theory” about seasonal changes—“the summer is hot because the earth is closer to the sun, and winter is cold because the earth is far.” This was Nick’s initial idea about seasonal changes that were elicited on the first day of this unit. Nick produced the following explanation 2
days before the final day of this unit as response to the assessment task:

[Sentence frame] Countries near the Equator, like Samoa, don’t seem to have seasons like we do here, in Seattle because ... [Nick’s response] the Northern hemisphere is tilted towards the sun (Summer in Seattle). The solar radiation hits the equator at a 90° angle [sic]. The Earth’s seasons are caused by the rotation and tilt of the earth around the sun. Because the Earth’s tilt causes the Northern and Southern Hemispheres to receive more intense/direct solar radiation during part of the year in summer. We only see daylight and temperature patterns associated the seasons if the Earth is tilted. In our Solar Cell demo, the solar cell spins slower when the light has to go through more sheet protectors. So that means that the atmosphere filtered solar radiation, diffusing it. (score: 6 of 7, a constructed, evidence-based, in-depth why explanation with partial coherence & reasoning)

The solar cell investigations being referred to were designed to show that not only is the sun’s light more concentrated in northern latitudes during the months of June through August (amount of radiant energy per unit area), but that when the sun’s light is at a less oblique angle to the earth’s surface, it does not have to pass through as many miles of atmosphere before reaching the surface. As shown in Figure 5, the teacher provided feedback to this question in the form of question to press students to further elaborate his idea: “Yes, but why does Samoa never really experience seasonal changes?” Nick revised his model using a different color pen, stating, “Samoa never really experiences seasonal changes because Samoa receives more solar radiation and stays like that all the year long.” He also added his evidence about it: “The Earth’s tilt causes more solar radiation at the equator. In our solar cell demo, the solar cell spins faster the closer it is to the lamp.”

The overall average score of student explanations across 12 samples of student work from this assessment was 4.4 of 7 (63.1%). Of note, the four students who were identified as the category of “learns with difficulty” did as well as the four students in the typical group (the average score of students in easily learn group: 6.3, typical 3.5, and learn with difficulty: 3.5).

![Figure 5](image-url)

Figure 5. Seasonal change assessment: Using a combination of three high- and one low-level scaffolding in a task.