Science Assessments for Language Diversity in Early Elementary Classrooms (SALDEE)

Designing Next Generation Science Standards-Aligned Formative Assessments: Progress and Lessons Learned About First-Grade Assessment Development

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Project Overview

There is an urgent need for vetted Next Generation Science Standards (NGSS)-aligned, classroom-based formative assessment tasks for the early grades that incorporate the language and literacy development of young students into the design. This project is designing instructional assessment materials using the Science Assessments for Language Diversity in Early Elementary Classrooms (SALDEE) approach that brings together elements of evidence-centered design (ECD) and a framework for designing science materials for varied learning experiences. In this poster, we show our progress toward answering the research questions and describe our lessons learned.

Development Goals

This project will develop a suite of NGSS-aligned formative assessment tasks for first-grade science and a set of instructional materials to support teachers as they administer the formative assessments to students with developing language skills and capacities.

Research Questions

1. ***Assessment validity.*** Are the assessment tasks valid and reliable for measuring student proficiencies in science?
2. ***Equity and inclusivity task features.*** Do different task features support access for students who have diverse language and/or literacy skills?
3. ***Instructional validity.*** Are the resources usable and supportive of teachers implementing formative assessment practices in their classrooms?

Design Perspective

This project bridges the Next Generation Science Assessment for Young Scientists (NGSA-YS) and the Equity and Inclusion Curriculum Design (EI-CD) approaches to generate a novel and innovative assessment design and development approach called SALDEE. The combined approach will generate new assessments that reliably measure young learners' NGSS three-dimensional science proficiency and purposefully position support for language and literacy development as central to the design of the assessments.

SALDEE Assessment Design Approach

Figure 1. SALDEE Approach

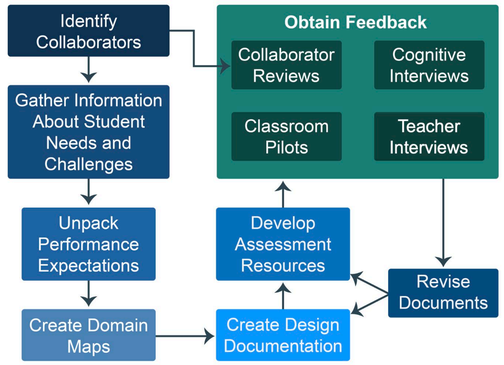


Figure 2. Integrated Dimension Maps

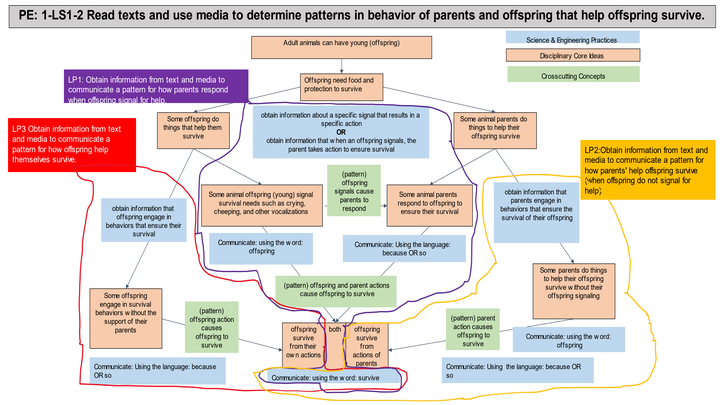


Figure 3. Learning Performances

PS4-1: Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.
LP1: Plan an investigation to provide evidence that when sound travels it can cause materials to vibrate.
LP2: Conduct an investigation to provide evidence that when sound travels it can cause materials to vibrate.
LP3: Plan an investigation to provide evidence that vibrating material can cause a sound.
LP4: Conduct an investigation to provide evidence that vibrating material can cause a sound.

PS4-3: Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.
LP1: Use observations to describe what happens when an object is placed in the path of a light source.
LP2: Use observations of a variety of objects or materials to draw a conclusion about the effect of placing similar (or different) objects or materials in the path of a light source.
LP3: Use observations of a variety of objects or materials to describe aspects of a material that relate to an effect on the path of light (e.g., materials that are clear allow light to pass through them).

PS4-2: Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.
LP1: Articulate and support a claim that objects can only be seen if a light source illuminates them.

PS4-4: Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.
LP1: Students can design a device or method for using sound to communicate over a distance.
LP2: Students can design a device or method for using light to communicate over a distance.

LS1-1: Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.
LP1: Students can design a structure similar to an animal part to address a need.
LP2: Students can design a structure similar to a plant part to address a need.

ESS1-1: Use observations of the sun, moon, and stars to describe patterns that can be predicted.
LP1: Use observations of the sun, moon, and stars to describe their patterns.
LP2: Make predictions of the sun, moon, and stars based on patterns.

ESS1-1: Make observations at different times of the year to relate the amount of daylight of the year.
LP1: Use observations to describe patterns of sunrise and sunset and/or amount of daylight as related to the time of year.
LP2: Make a prediction of the position of the sun, moon, or stars based on patterns.

LS3-1: Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.
LP1: Construct an evidence-based account using observable patterns that animal offspring have visible features that are similar to those of their parents, but those features are not exactly the same.
LP2: Ability to construct an explanation for how animal parents and offspring are similar but not exactly the same as each other based on patterns they have observed.
LP3: Construct an evidence-based account using observable patterns that plant offspring have visible features that are similar to those of their parents, but those features are not exactly the same.
LP4: Ability to construct an explanation for how plant parents and offspring are similar but not exactly the same as each other based on a pattern they have observed.

LS1-2: Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.
LP1: Obtain information from text and media to communicate a pattern for how parents respond when offspring signal for help.
LP2: Obtain information from text and media to communicate a pattern for how parents help offspring survive (when offspring do not signal for help).
LP3. Obtain information from text AND media to communicate a pattern for how offspring help themselves survive.

Figure 4. Example of Design Pattern

Focal Knowledge, Skills, and Abilities	• Students are able to identify and/or describe through observation the placement of an object in the sky (at a specific timepoint). • Students are able to identify and/or describe through observation how an object in the sky moves during a specified interval of time.
Additional Knowledge, Skills, and Abilities	• Knowledge of the sun, moon, and stars. • Knowledge of the terms sunset, sunrise. • Knowledge of directional terms (e.g., east, west, north, south, up, down, left, right).
Potential Work Products	• Identification of a multiple-choice description of where and how an object is in the sky; could be a picture, response to a multiple-choice task, oral description, written description, or a physical response (e.g., acting out).
Potential Observations	• Accuracy of the information identified and/or described. • Accuracy of the description of the pattern. • Completeness of the description of the pattern.
Evidence of High Performance	• Students use scientific terminology, based on multiple instances of the pattern, to describe a pattern of an objects' movement in the sky.
Task Related Features to the LP	• Ensure that examples being used toward the pattern are not contradictory. • Students must be asked to identify or describe a pattern in the movement of an object in the sky. • Students should be provided with at least 2 examples across sources showing the pattern of movement.
Task Features Related to Language and Literacy	• Limit video length to approx. 30 seconds. • Limit text length to 6 pages, approx. 60 words. • Administrator language and text should use the appropriate language structure and vocabulary as supported by the curriculum and/or instruction leading up to the assessment.
Task Features Related to Equity and Inclusion	• Images (still) should refrain from including too much extraneous information. • Images/videos should have enough contrast to support visual discrimination. • Images/videos should avoid "gory" details. • Images/videos should follow guidelines for the ethical treatment of animals. • Familiarity of examples used (may depend on locality, or commonality of the animal).

Face Validity of Tasks

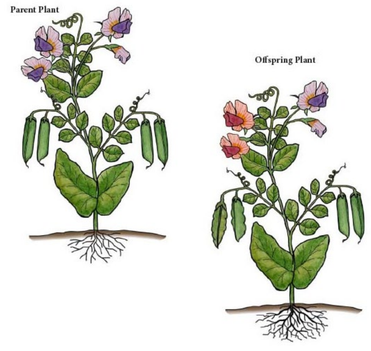
Established the validity of tasks included:

- Approach: expert reviews, student cognitive interviews, and interviewer observations.
- Four experts reviewed and rated all task materials using a questionnaire about NGSS alignment (Billman et al., 2021) and elements for promoting equitable assessment opportunities (Alozie et al., 2018).
- We calculated interrater reliability using Gwet's AC2 with quadratic weighting.
- Three researchers analyzed the student cognitive interview transcripts, interview observation notes, and expert comments using selective qualitative coding methods.

Lessons Learned

- **Provide detailed embedded administrative support for teachers:**
  - Tasks that use discussion and are vocabulary-heavy need additional strategies and instructional support to promote and sustain student engagement.
- **Provide task administration guidance to facilitate small-group discussions that are student-centered:**
  - Eliminate "guess what's in the teacher's head" questions, such as "*Can you tell me what the seasons are?*"
  - Encourage opportunities for peer-peer conversation, such as "*Today we'll be talking about the seasons – winter, spring, summer, and autumn. Turn and tell your neighbor some differences between summer and winter.*"
- **Provide simple language and instructional clarity:**
  - Simplify the language and incorporate ample visuals.
  - Use simple definitions of science terms in the teacher guide so teachers can easily explain them to students.

Figure 5. Example Task: LS3-1 LP3



Part 4: Comparing Parents and Offspring
<Ask the students to keep the images of both pea plants visible.>

SAY: Look at your worksheet and find the question with the number three. I am going to read the directions. You can follow along with me.
READ: Are the pea plants exactly alike? Please circle yes or no.

<Give students time to complete their responses.>

SAY: How did you know? Turn and tell your partner.

<Give students time to share their responses.>

SAY: Now, work together with your group to write your evidence.
READ: Write down two things that you noticed that helped you decide yes or no.
SAY: In other words, if you answered yes, write down 2 things that made you say yes. If you said no, write down 2 things that made you say no.

<Give students time to complete their responses.>

SAY: Turn and tell a partner:
- Do you think parents and their offspring are exactly alike? How do you know?
- What did you learn about parent plants and their offspring?

<Help students reach the conclusion that offspring are similar to, but not exactly like their parents.>

Significance

This work provides:

- A deconstruction of all nine first-grade NGSS performance expectations and integrates language development and young learners' science experiences (unpacking process).
- Dimension maps, learning performances, and design pattern templates to help elementary teachers align curricula and design formative assessments.
- Materials that support teacher learning and are actively used to develop formative assessments for real classrooms.

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