HHS Public Access

Author manuscript

YC Young Child. Author manuscript; available in PMC 2023 August 21.

Published in final edited form as:

YC Young Child. 2023 ; 78(2): 66–72.

Let's Talk: Linking Science and Language Learning in the Preschool Classroom

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One fall afternoon at recess, while on the playground, 5-year-old Emma tells her preschool teacher, Ms. Diaz, "When it gets colder, the leaves turn into different colors."

Wanting to expand on Emma's observations, Ms. Diaz picks up several leaves of various colors—brown, red, orange, and yellow—from the ground, fans them out, and asks Emma, "Why do you think leaves change colors during this time of the year?"

Emma responds, "I'm not sure. Maybe because they don't like cold weather."

Ms. Diaz asks Emma to remember their investigation on the needs of plants. "What do plants need to grow?"

"Sunlight and water," Emma replies.

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> "Yes, they need sunlight and water. Do you notice anything about the sun during this time of the year?" she asks as she looks up at the sky.
>
> Emma replies, "When I get home from school now, it's already getting dark."
>
> "It is getting dark, and the leaves of trees and plants need sunlight and water to create food," Ms. Diaz says as she holds the leaves up again, handing Emma a bright yellow maple leaf. "When the sun isn't out as long, the leaves stop making food for the trees, and they begin to change colors since they are no longer making food. The trees are preparing for winter. Since they are not making any more food, the leaves change colors and then drop to the ground." Ms. Diaz places the leaves on the ground as Emma watches. "It takes energy to make food, so the tree wants to save its energy for winter and not make any more food again until spring."

When 5-year-old Emma asked her preschool teacher, Ms. Diaz, why leaves change colors, she invited Ms. Diaz to step into language development as well as scientific exploration. When Ms. Diaz accepted this invitation and engaged Emma in exploring why and how leaves change colors, she supported Emma's developing language and scientific inquiry skills, which included observation, investigation, and making predictions.

Well-designed early education experiences integrate and promote learning across developmental domains (McClure et al. 2017). Learning that focuses on doing science can facilitate language development when children are encouraged to talk about their experiences, such as describing their observations, making sense of phenomena, and explaining their findings (Bustamante, Greenfield, & Nayfeld 2018). Likewise, promoting strong oral language skills and robust vocabulary knowledge can support children's participation in early science learning by providing words that help them understand meanings and concepts, formulate questions, and develop critical thinking skills (Baroody, Bajwa, & Eiland 2009; Sarama et al. 2012; Méndez, Crais, & Kainz 2018).

We, the authors, make up an interdisciplinary research team with expertise in science education, early childhood education, nutrition, and early language and literacy development. With grant funding from the National Institutes of General Medical Sciences at the National Institutes of Health Science Education Partnership Award, we developed the evidence-based Preschool Education in Applied Sciences (PEAS) approach for early education settings (morepeasplease.org). We mostly conducted our work in Head Start preschool classrooms. PEAS is an integrative approach that emphasizes scientific inquiry, sensory-based learning, language development, and community and family engagement. It is rooted in four areas: Practice science, Engage the senses, Apply science talk, and Support learning. The *P*, *E*, and *A* focus on the child's role in learning, while the *S* focuses on the teacher's role. In this article, we focus on the *A*, Apply science talk.

Science talk is a two-way conversation that happens when engaging in science activities (Rosebery, Warren, & Conant 1992; Duschl & Osborne 2002). It can occur during interactions between a child and others in their learning environments, including teachers, classmates, or family members. It is a powerful tool to encourage science learning and language skills, and it presents opportunities for innovative instruction that can be adapted to a variety of early learning settings (Cabell et al. 2013; Nayfeld, Fuccillo, & Greenfield

2013; Greenfield 2015; Bustamante, White, & Greenfield 2018). We share four strategies to promote science talk that have been shown to foster children's language and science learning. Framed by multimodal instruction and learning, we discuss how these strategies can benefit all children, including emergent multilingual learners.

Using Science Talk to Support Multimodal Science Instruction and Language Learning

It is critical to leverage children's curiosity and eagerness to make sense of their world. Educators can support their learning and overall development by providing high-quality, hands-on science, technology, engineering, and mathematics (STEM) experiences starting in early childhood (NRC 2007, 2012). Active, multimodal, inquiry-based science experiences —such as using the five senses to explore new foods or planting seeds to observe under what conditions plants grow best—provide rich, multiple, and authentic contexts for learning new word meanings and concepts and for describing actions and processes.

Additionally, using multimodal instruction while talking about science may support language and science learning for each and every child, including linguistically diverse children. Incorporating words and concepts in a variety of contexts while doing science—for example, charting observable attributes of objects, engaging in sensory explorations, or using science instruments and tools—can supplement verbal explanations and offer meaningful experiences for all children to develop new knowledge.

> Learning that focuses on doing science can facilitate language development when children are encouraged to talk about their experiences.

Four Strategies for the Use of Science Talk

Effective use of science talk can be supported by four evidence-informed language learning strategies that can be easily incorporated in early childhood settings, including

- **modeling descriptive words:** When teachers model the use of descriptive words, they support children's ability to talk about what they observe with their senses, such as the properties of objects (Beck, McKeown, & Kucan 2002). For example, when describing a rock, a teacher might point out some of the rock's attributes by saying, "This rock is *sharp, hard,* and *heavy.*"
- **activation of prior knowledge:** When describing a new science word or concept, teachers can connect the new word or concept to children's prior knowledge to support word learning (Conrad et al. 2004). For example, when exploring bark and leaves, a teacher might build on children's existing understandings by asking where they have seen bark and leaves outside of the classroom.
- **asking why, what, when, and how (WH) and open-ended questions:** Asking WH and open-ended questions can help children engage in science exploration and in science talk (Walsh & Blewitt 2006). To use this strategy most effectively, teachers can first observe a child to learn what piques their interest as they

engage in exploration. Then teachers can ask questions that follow the child's lead and interests. For instance, if a child is observing a bucket full of water and rocks, a teacher might ask, "I wonder how those rocks got to the bottom of the bucket?"

- **using child-friendly definitions:** Teachers can use child-friendly definitions to help children understand science words while using everyday words that children already know (Beck, McKeown, & Kucan 2002; Beck & McKeown 2007). For example, when explaining a science word with a complex meaning, such as the word *observation*, a teacher might say, "When we make an observation, we carefully look at the details of the object. We use our senses to explore the object."

All of these strategies foster vocabulary and language learning in young children (Méndez, Crais, & Kainz 2018). In the following sections, we show these four strategies in action as Ms. Diaz and her children use science talk to study seeds.

Modeling Descriptive Words

Ms. Diaz begins an exploration of seeds by placing pumpkin, pinecone, and apple seeds in a small, covered box. The children reach into the box and touch the seeds; they hold the box up to their noses to smell the seeds inside; they shake the box to hear the various sounds they make.

Ms. Diaz models the use of descriptive words: "I love pumpkin seeds because they are *flat*, have *pointed* ends, and after I bake them in the oven, they're *crunchy*," she says.

She then gives children time to touch, feel, smell, and have their own "seed conversations." Robert and José, who are working together, say they like the "*round* seeds" while Vicky and Balaji say the coolest seeds are "the *flat* and *shiny* ones." Isabel says she likes the "*tiny* seeds" because "they look like the poppy seeds in the muffins I bake with my mom."

Afterward, Ms. Diaz gathers the children into a circle and asks them to describe the seeds' characteristics, writing their observations on a chart for the class to see.

Science talk occurs when teachers like Ms. Diaz explicitly use words that describe the properties and physical characteristics of objects, plants, or animals when engaging children in science exploration. By modeling the use of language to name attributes (such as *hard/soft, long/short, thin/thick, heavy/light, pointed/curvy*), educators can support children's abilities to describe objects and processes based on how they perceive the world through their senses. In addition, by modeling the use of prepositions (such as *front, back, behind,* and *on top*), they can reinforce children's spatial thinking. For instance, while the children in Ms. Diaz's class observe seeds germinating, Emma notices part of the plant coming out. Ms. Diaz remarks, "Look! What do you see at the top of the seed?"

Teachers can set up engaging science explorations that will help children use descriptive words and support the language needs of learners, including linguistically diverse learners (Evans 2019). These explorations might include activities where children

- use all five senses to explore seeds and classify them based on their similarities and differences
- explore the observable properties of nonliving things (human-made objects)
- distinguish between materials that represent nature (rocks, samples of soil, fruits, seeds, branches, bark, leaves) and human-made (plastic, wooden, metal, cloth) objects

Activation of Prior Knowledge

> After the children have explored, observed, described, and classified the various types of seeds and added this information to the chart of seed characteristics, Ms. Diaz builds on their experiences to discuss a seed's life cycle. During circle time, she asks, "We know there are many different sizes and shapes of seeds. What else do you want to know?"
>
> Cristina responds, "Do seeds grow? My grandpa told me that I grew from a tiny seed in my mummy's tummy."
>
> Ms. Diaz replies, "Great question! What do you think, class? Do seeds grow?"

Teachers can tap into children's prior knowledge as a springboard to engage in exploration and science talk. At the very beginning of the class's inquiry into seeds, Ms. Diaz spent time learning about the valuable insights the children already bring to their educational journey based on their everyday experiences, including their cultural and linguistic knowledge, or funds of knowledge (Moll et al. 1992). Children's existing knowledge, such as word knowledge in their home languages, can scaffold the learning of new words and science concepts by connecting the "new with the known" (Tscholl & Lindgren 2016; Méndez, Crais, & Kainz 2018). For example, a teacher might ask a child whose home language is Spanish, "Did you hear that word? *Germinate* o *germinar* en español?"

Later in the unit, when the children investigated the seeds by exploring and naming their attributes, they collectively developed knowledge that Ms. Diaz recorded on the chart. While referring to the class chart that documented their learning, Ms. Diaz encouraged the activation of prior knowledge by asking, "What are seeds?"; "What do they look like?"; "Where can they be found?" Then she engaged them in learning new science concepts about seeds, including that seeds need water to germinate and that wind, animals, and bodies of water can help seeds move.

Asking WH and Open-Ended Questions

> During circle time, Ms. Diaz asks the children, "Remember how we talked about living and nonliving things last week? Living things grow, need food, and reproduce. Do you think seeds are a living thing?"

"Yes!" the children respond.

Ms. Diaz continues, "How do you know a seed is a living thing?"

"Seeds grow!" says Cayden.

"Seeds don't have babies!" replies Simmone.

Asking questions as children engage in science practices supports their use of language to help them understand the meaning of new science concepts, explain their thinking, and elaborate on their observations. Questions can also prompt children to engage in scientific processes, such as

- **predicting how something may turn out:** "What happens when the seeds don't get light?"
- **testing their predictions:** "What do seeds need to grow?"
- **supporting their explanations of phenomena:** "How much water do seeds need to grow?"

Ms. Diaz can use WH and open-ended questions to revisit prior concepts taught and discussed in class, to make connections across concepts, and to solidify children's understanding of new concepts.

Teachers can use these types of questions to clear up misconceptions as well. For example, in the above vignette, Simmone responded, "Seeds don't have babies." Her statement reveals a common misconception that living things only reproduce by having "babies." In this case, Simmone applied what she knew about reproduction to the seeds and came to a logical conclusion. Simmone's comment prompted Ms. Diaz to ask, "If seeds do not have babies, where do new plants come from? How do we get so many different plants?" Her follow-up questions opened a new avenue for inquiry, which helped children gain a deeper understanding of how living things reproduce.

Using Child-Friendly Definitions

While exploring what a seed needs to grow, Ms. Diaz introduces the word *germination*. Using a child-friendly definition, she tells the children, "Germination is a word we use to describe what happens when a seed starts to grow."

She then invites Emma to look carefully at the seed through a magnifying glass. "Tell me what you see."

Emma squeals, "I see it! I see it! I see like a baby leaf that is coming out of the seed."

Ms. Diaz responds, "You're right, Emma; the seed is starting to grow. When you see a baby leaf growing, you can say that this seed is germinating. Can you say the word *germinate*?"

When creating child-friendly definitions, Ms. Diaz uses words that the children already know to explain the meaning of more abstract and unfamiliar concepts (Beck, McKeown,

& Kucan 2002). (For a list of child-friendly science words and definitions used in lesson plan examples, visit morepeasplease.org/children-2.) This way of defining new concepts and words encourages science talk most effectively when children are also directly engaged in hands-on scientific exploration with the related concepts in action. For example, engaging in observation of a seed's physical changes as it germinates can promote children's understanding of the word *germination.*

Conclusion

Science talk is not prescriptive in nature; rather, it is a flexible instructional approach that promotes conversations about science while affording children multimodal engagement to learn science and language content and skills. By promoting and participating in conversations during science experiences, preschool teachers can integrate instruction across various domains and content areas, such as language and science. We encourage early childhood educators to include the main strategies of science talk—modeling descriptive words, activating prior knowledge, asking WH and open-ended questions, and using child-friendly definitions—to their existing language and science teaching tool kit. (See "Integration of Four Strategies to Apply Science Talk".) This will widen the purpose and scope of science talk while engaging all children as they learn and grow.

Integration of Four Strategies to Apply Science Talk

In the example below, Ms. Diaz integrated four strategies to promote science talk during an exploratory activity. This activity invited the children to learn new ways to categorize familiar objects as human-made or natural by classifying them based on what they are made of. One of the objects the children explored was a spoon.

Strategy	Exploring the Properties of a Spoon
Activation of prior knowledge	Ms. Diaz addresses the children, who are arranged in partner groups. She holds up a metal spoon and asks the children to observe the object carefully. Then she encourages them to talk about their observations by asking, "Have you ever seen this type of metal spoon before?" and "Did your metal spoon look exactly like this one or different in some ways?" She encourages children to converse with each other. "Now tell your partner, how do you use the metal spoon?" After this exchange, she begins to gather information from each partner group. Shawn and Sofia tell Ms. Diaz that they have this type of metal spoon at home and have seen it other places too.
WH and open-ended questions	Ms. Diaz uses a WH question to help the children consider the origins of the spoon: "Where do you think your family got their metal spoons from?" Morgan raises her hand and says, "From the store."
Modeling descriptive words	When exploring the spoon, Ms. Diaz models using descriptive words to name its attributes: "This spoon is *hard*, *cold*, and *heavy*. What are your spoons at home like?" Sofia says, "We have lots of spoons at my house. Some of them are *big*; others are *shiny* and *light*. My mom uses a really *big* and *heavy* spoon to put food on our plates." Kaya continues the conversation. "You can make lots of sounds with spoons too, although my mom does not always like it, but sometimes we hit our plates and the table with spoons. It is fun."
Child-friendly definitions	After the children have spent time discussing their experiences with spoons and a spoon's characteristics, Ms. Diaz provides them with the science vocabulary words *human-made object*: "We can use the words *human-made objects* to talk about the objects that you have to go to the store to get, like this metal spoon. They are made by us humans. For this reason, we call these spoons *human-made objects*."

Acknowledgments

The work reported in this manuscript was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award no. R25GM132939. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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