Researchers outline ways to advance scientific thinking in children

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Science educators aim to nurture, enrich and sustain children's natural and spontaneous interest in scientific knowledge using many different approaches. In a new paper published in "*Science*," Carnegie Mellon University's David Klahr and Jamie Jirout and Illinois State University's Corinne Zimmerman use psychology research to outline ways to advance the science of science instruction.

"Instead of looking at this issue from a science education perspective, we looked at it from a cognitive and developmental psychology perspective," said Klahr, the Walter van Dyke Bingham Professor of Cognitive Development and Education Sciences at CMU. "And from our point of view, it's clear that you can't understand how to teach unless you understand how children learn."

For the paper, Klahr and his colleagues reviewed literature on the early development of scientific thinking and then focused on recent research on how to best teach science to children from preschool to middle school. They characterized scientific thinking in terms of two features: content, which includes an array of domain-specific topics such as feedback; and processes, including formulation of hypotheses and designing experiments.

"When you're looking at how children should be taught, the instructional methods should be consistent with their cognitive capacity," Klahr said. "Children can get lost with too much open-ended instruction with too little structure. On the other hand, too much structure can get boring.

There needs to be a fine balance between both."

Another problem Klahr and his team identified was in the way science educators classify their classroom instruction using global terms that are not clearly defined and therefore not uniformly used. The research team introduced a method for clearly describing the type of instruction used that covers aspect, materials, goal setting, physical manipulation of materials by child, design of each experiment, probe questions, explanations, summary, execution of experiments and observation of outcomes.

"Instruction labels don't matter — it's what actually happened in the classroom that matters," Klahr said. "Using clear descriptive explanations of what happens in the classroom are the only way to make advances in science education."

The team also advocates for increased use of intelligent tutors in science education. An example given is TED, which has successfully helped children learn how to design experiments. The tutor looks at mistakes that are made and asks questions to train the children on how to create a solid experiment.

Provided by Carnegie Mellon University

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