California 6th grade science books: Climate change a matter of opinion not scientific fact

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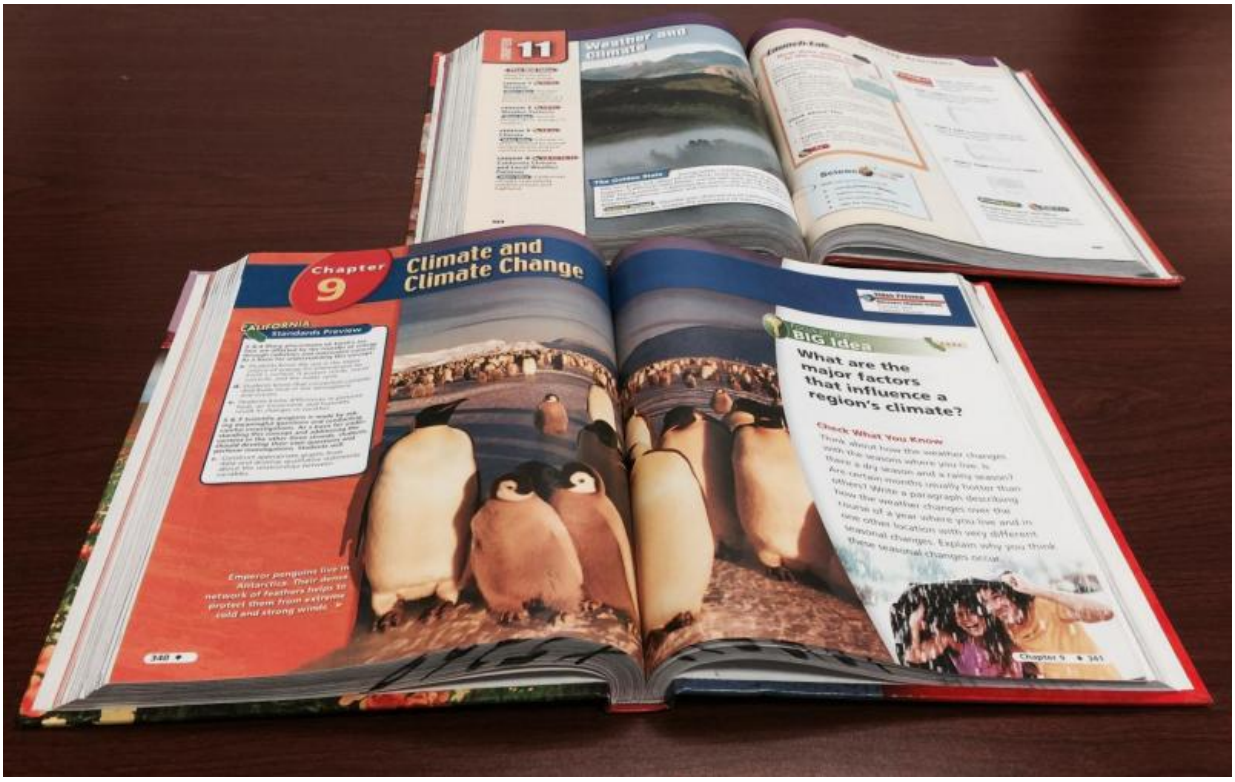

A new study from SMU, Dallas, and Stanford University that analyzed four California science textbooks from major publishers found they position climate change as a debate over differing opinions. Contrary to the near majority of climate scientists who cite scientific data and evidence of human-caused climate change, the textbooks present the topic as uncertain, that humans may or may not cause it, and that its unclear if we need immediate mitigating action, the researchers found. Credit: Diego Román, SMU

If American teens are unsure about climate change or its cause, some school textbooks aren't helping, says teaching expert Diego Román, Southern Methodist University, Dallas, co-author of a new study on the subject.

Studies estimate that only 3 percent of scientists who are experts in climate analysis disagree about the causes of climate change. But the most recent report from the Intergovernmental Panel on Climate Change—the evidence of 600 climate researchers in 32 countries reporting changes to Earth's atmosphere, ice and seas—in 2013 stated "human influence on the climate system is clear."

Yet only 54 percent of American teens believe climate change is happening, 43 percent don't believe it's caused by humans, and 57 percent aren't concerned about it.

The new study measured how four sixth-grade science textbooks adopted for use in California frame the subject of global warming. Sixth grade is the first time California state standards indicate students will encounter climate change in their formal science curriculum.

The researchers examined different textbooks, each published in either 2007 or 2008 by a different major publisher. They found and analyzed 279 clauses containing 2,770 words discussing climate change.

"We found that climate change is presented as a controversial debate stemming from differing opinions," said Román, an assistant professor in the Department of Teaching and Learning in the SMU Simmons School. "Climate skeptics and climate deniers are given equal time and treated with equal weight as scientists and scientific facts—even though scientists who refute global warming total a miniscule number."

The message communicated in the four textbooks was that climate

change is possibly happening, that humans may or may not be causing it, and its unclear if we need to take immediate mitigating action, the researchers found.

That representation matches the public discourse around global warming, in which previous studies have shown that media characterize climate change as unsettled science with high levels of scientific uncertainty. The researchers said only 33 percent of the U.S. public believes climate change is a serious threat.

The textbooks misrepresented, however, actual scientific discourse, which asserts climate change is an environmental problem bearing immense risk, where the human impact is clear, and where immediate action is warranted, the authors said.

"The primary purpose of science education is to represent the science accurately, but this analysis of textbooks shows this not to be the case for climate science," they said.

Co-author on the article is K.C. Busch, a Ph.D. candidate in science education in Stanford University's Graduate School of Education.

The authors reported the findings in October at the 11th Conference of the European Science Education Research Association (ESERA), held in Helsinki, Finland.

The findings were also published in the *Environmental Education Research* journal in the article, "Textbooks of doubt: Using systemic functional analysis to explore the framing of climate change in middle-school science textbooks."

New national standards align with scientific discourse

An extensive body of prior research has revealed students have many misconceptions about climate change, confusing it, for example, with causing acid rain and ozone depletion, as well as linking it to skin cancer, the authors note.

Now there's an opportunity to ensure textbooks aren't part of the problem, by altering misleading language, Román said.

States have begun adopting new national standards for science education as a result of recommendations by the U.S. Next Generation Science Standards. Those standards were developed in part by the National Science Teachers Association and the American Association for the Advancement of Science and align more accurately with the scientific discourse.

"As the Next Generation Science Standards become adopted and implemented, publishers are writing new textbooks that include climate change," the authors said. "This reworking of science textbooks provides a rare opportunity to reflect on how we can create texts that enhance science teaching and learning." The standards were completed in April 2013.

Specifically, the textbook researchers recommend against stripping out uncertainty, since even well proven theories carry the possibility of a better theory that contradicts one or more postulates of the theory.

Instead they recommend clarifying what exactly is unknown and why.

They also recommend the inclusion of humans as agents and as the cause of climate change. That fact is scientifically supported and not controversial among scientists who study climate from a broad range of disciplines, including geology, geophysics, geography, paleoclimatology, glaciology, hydrology, ecology, evolutionary biology, environmental

studies and oceanography.

Textbook language doesn't reflect science of climate change

To study the textbooks, the researchers applied text analysis to conduct an exhaustive examination of the choices and frequency of language, including the level of uncertainty as well as the agents involved.

The textbooks did promote uncertainty when addressing the causes of climate change by using verbs such as could, may or might. And some passages created the view that global warming could even be beneficial. One textbook wrote:

"Global warming could have some positive effects. Farmers in some areas that are now cool could plant two crops a year instead of one. Places that are too cold for farming today could become farmland. However, many effects of global warming are likely to be less positive. Higher temperatures would cause water to evaporate from exposed soil, such as plowed farmland. Dry soil blows away easily. Thus, some fertile fields might become 'dust bowls.'"

The texts emphasized abstractions, such as deforestation or the burning of wood, without referencing humans.

When attributing information to scientists, the textbooks used verbs such as believe, think or propose, but rarely were scientists said to be drawing conclusions from evidence or data. There was one occurrence when the noun evidence was used, the authors said, and then it was to suggest the notion that climate change is not new:

"Scientists have found evidence of many major ice ages throughout

Earth's geologic history."

Less frequently used were verbs that describe scientific practices—such as "find," "determine," "measure," "obtain." The most frequently used word when scientists were present in the sentence was "think," which introduces the idea that it was decided rather than observed or found as the result of scientific observation and research, Román said.

Language matters, particularly in California, Texas, New York

The findings suggest that textbooks should be more specific about the facts, should cite sources, and should accurately reflect the methods by which scientists reached their conclusions.

"The work of scientists should be represented accurately rather than saying that scientists think or believe, as if it's a matter of opinion," Román said.

As a social scientist who studies linguistics and the impact of words, Román said language matters, particularly in the textbooks in the nation's three most populated states, California, Texas and New York, which set standards for the rest of the country.

"These textbooks discuss the impact of climate change on the Earth in hypothetical terms, in complete contradiction to scientific research findings," he said.

The researchers note that while it's accurate that agreement isn't unanimous, only about 3 percent of climate scientists disagree about the causes of climate change. "Yet textbooks characterize that with the description 'some scientists,' so students can assume its 50-50, which is

very different from saying '97 percent of scientists,'" he said.

Does the language reflect a compromise by publishers as they walk a fine line?

"It appears textbook publishers include discussion of climate change to appease one segment of their market—but then to appease another segment they suggest doubt, which doesn't reflect the scientific reality," he said.

Textbooks lack specific language to guide student action

Textbook language should reflect the language used in scientific reports, be explicit about the sources of information and should clarify human cause, with specific actions students can take to produce change, the authors recommend.

Yet none of the textbooks explicitly called students to act to mitigate climate change, the authors note.

Generic information, such as "take care of the environment" or "stop burning coal and wood," lack specific solutions for action.

"Students think, 'that's not me—that's the people in the Amazon who are burning forests,'" Román said. "Textbooks must draw the connection between specifics, such as turning off lights or driving less, to relate solutions to students and their lives."

Provided by Southern Methodist University