Benefits of Engaging Students in Constructing Scientific Explanations

Benefits for Students

Gaining a deeper understanding of science concepts. Examining data for patterns and connecting that data to claims, evidence, and other science ideas helps students develop an understanding of science concepts that is much more meaningful than simply reading about and memorizing them. Such scientific reasoning facilitates deeper understandings of science ideas as connections are made across the content storyline of a unit. In contrast with memorizing ideas and quickly forgetting them, students will be more likely to develop understandings that stick with them and become their new way of viewing the world. Because they understand and have made sense of these new ideas, they can then use and apply them in reasoning about other situations and phenomena (and not just in school!). These more powerful understandings are also motivating, helping students recognize that they can make sense of and learn to see their world in richer ways. Asking "why" questions becomes much more exciting when students have confidence that there are ways they can explore and answer their questions.

Using scientific practices. Constructing scientific explanations relies on the ability to design and conduct fair tests and to collect, organize, analyze, and represent data. In addition, when students compare their explanations with those of others, they engage in scientific argumentation, another important science practice. These practices are highlighted in the *Next Generation Science Standards* (NGSS).

Understanding the nature of science. By engaging in constructing scientific explanations and argumentation, students learn that science is a social enterprise in which scientists discuss and debate their ideas at conferences and through publications. Evidence is critical to these debates and is used to determine which ideas to support, modify, or reject. Science is misrepresented when it is presented as a static body of facts, and this discourages students from being interested in it.

Developing twenty-first-century problem-solving skills. The kind of problem solving students engage in while constructing scientific explanations involves reasoning logically from the questions, data, and knowledge they have. This kind of problem solving is essential to twenty-first-century learning.

Developing twenty-first-century communication skills. As students learn to communicate using evidence to support scientific claims, they are developing the ability to use scientific language and norms effectively. They are also learning about a powerful form of persuasive and empirical writing. Communicating in these complex ways is central to twenty-first-century learning across disciplines.

Developing listening and constructive-response skills. An important but often-neglected aspect of communication is listening and then responding in appropriate and productive ways. In explanation-focused science classrooms, students learn how to listen more effectively and engage in productive debate. As they grow more constructively critical of others' spoken and written explanations, they learn how to listen for how others are justifying their claims and whether those justifications are reasonable. They also learn how to support or disagree with others' ideas constructively, using the norms of scientific discourse; thus, they're learning to communicate in scientific ways. The ability to consider and critique alternative explanations is an important skill to have in twenty-first-century job contexts and other real-world situations.

Developing literacy skills. Research shows that intentionally connecting science and literacy instruction can enhance students' learning of both. Explanation-focused science teaching can provide a motivating context for students to use language and texts to figure out something new about phenomena they are observing.

Benefits for Teachers

Becoming more attentive to student thinking and understanding. Teachers who focus on engaging students in constructing scientific explanations are more attentive to their students' understandings and ways of thinking. They learn a lot about how students are interpreting classroom activities, often in very logical but unintended ways. They also learn about students who sound knowledgeable because of their mastery of scientific vocabulary but are actually misunderstanding big ideas. This knowledge prompts teachers to slow down and adapt their approach so that all students can understand important science concepts, not just students who understand right away.

Becoming more attentive to science content. Explanation-focused teachers are also more attentive to science content and more careful to represent concepts in ways that don't unintentionally reinforce or support the development of student misconceptions.

Facilitating ELL learning. Engaging ELL students in constructing good scientific explanations empowers teachers to facilitate learning among students who come from cultures that value ways of thinking, reasoning, and making sense of the world that differ from scientific reasoning. This strategy also enables teacher to make visible for students the norms and "rules" of the scientific culture they're studying and promote active and effective participation in this new culture.

Recognizing the importance of classroom talk. Teachers come to recognize the importance of talk and its role in learning as they focus on teaching students to construct scientific explanations. Teachers understand that rich classroom talk, including disagreements, is not only productive in terms of student sensemaking but is also essential.

Adopting more interactive roles in small groups. Teachers in explanation-focused classrooms take on new roles in supporting small-group work. Instead of focusing their interactions on checking to see how students are doing and assisting with procedures, they listen carefully to students' ideas and thinking. They interact with students regarding science ideas related to the group's work, asking them about patterns they observe, their initial claims, and their reasoning about how the evidence supports (or does not support) their initial claims. Thus, they help students focus on science ideas and thinking during classroom activities, a practice that the TIMSS (Trends in Mathematics and Science) video study, was found to be lacking in US science classrooms but was present in science classrooms in higher-achieving countries.

References

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