



*Mapping, Clarifying, and Communicating Key Ideas about
Collaborative Learning to STEM Audiences*

Collaborative Argumentation for Learning

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This primer addresses the following questions:

- What are the benefits and challenges of integrating collaborative argumentation practices in the classroom?
- What strategies can support students' learning and argumentation skills?
- What strategies foster a culture of critical thinking and communication in the classroom?

This document culminates with strategies, tips, and resources to help you apply the ideas to making your classroom collaborations more successful.

Key Takeaways

- Argumentation is a high impact approach for building scientific knowledge and deepening student understanding.
- When argumentation is structured as a collective effort to build knowledge and consensus, rather than as a way to "win an argument" or persuade, it fosters collaboration and deeper engagement with ideas.
- An asset-based approach such as funds of knowledge can bridge the gap between students' home and school experiences, making argumentation more inclusive.
- Argumentation provides benefits to students but can be challenging due to time constraints, a lack of fit with the curriculum, lack of teacher training, and a lack of system-level support.

Background

Argumentation is how knowledge is built in science. As a discourse process, it helps a community determine the most plausible explanation for phenomena when more than one explanation exists. While we've known for decades about the centrality of argumentation in scientific knowledge building, it was named explicitly as a scientific practice in the Next Generation Science Standards (NGSS) in 2014 and is now recognized as one of the core practices in science education (NGSS, 2014). For example, in a science class that is investigating properties of matter, students may conduct experiments where they put different objects into containers of water and measure the displacement of the water. Often, some students think that larger objects will cause a larger displacement of water, while others think that denser objects will displace more water. By prompting students to provide evidence for their claims,

This material is based upon work supported by the National Science Foundation under grant 2101341. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

reason as a group about different claims, and connect claims to evidence, teachers can help students move beyond initial, often incomplete, explanations toward a more robust understanding of a phenomenon through a process of collaborative, evidence-based reasoning.

Argumentation is one of the most impactful strategies that a teacher can use to improve science learning for students because it leads to deeper understanding and imparts the true nature of how science knowledge evolves. Still, the teacher co-authors of this brief reported that the use of argumentation in science classrooms remains minimal. Argumentation skills are often not emphasized in the curriculum. Helping students learn to argue and giving feedback on their arguments and argumentation skills takes a lot of time. Instead, classroom dialogue too often follows a pattern where the teacher asks a question, students respond, the teacher evaluates the response, and the conversation ends. This approach trains students to give brief responses rather than engaging in critique, reflection, and deeper evaluation of ideas. As a result, students have few opportunities to practice collaborative argumentation skills.

Fortunately, research suggests several promising strategies for improving student learning and argumentation capabilities in ways that take into account teachers' available time. Through a powerful approach called *peer review*, students review and assess each other's arguments, serving to both improve student learning and reduce teacher workload. This strategy works especially well when teachers use role-playing games, prompts, and other scaffolds to seed peer reviewing the discussions as students practice argumentation skills (Clark et al, 2009).

Another strategy for encouraging students to propose claims and support them with evidence and reasoning is to use the Claim-Evidence-Reasoning (CER) framework (McNeill & Krajcik, 2011). Using the CER framework, students formulate a claim, provide evidence, and offer reasoning for how the evidence logically connects to their claim, as in [The Argumentation Toolkit](#). CER is one of the most common argumentation frameworks used in the classroom, but it has also been critiqued as being too simplistic. Argument structures with more components such as backings, warrants, grounds, rebuttals, modalities, and claims have been proposed for science learning (e.g., Toulmin, Rieke, & Janik, 1979). However, researchers who study argumentation in the classroom report that it is just as useful, and more manageable, to reduce this complexity to three essential elements—hypotheses (claims), evidence, and reasoning (the relationships between hypotheses and evidence)—as these can be used to represent the core of an argument (Kollar, Fischer, & Slotta, 2005; Schank, 1995).

Technology and artificial intelligence (AI) techniques have also been used to help learners construct and critique arguments. For example, in the [ArgumentPeer](#) project, students relate hypotheses and claims in an argument diagram and submit them online for review by their peers, each of whom is randomly assigned a set of arguments to review. An intelligent help system prompts students as they draw their diagrams and write their reviews. The reviewers, having read the same sources and prepared their own argument diagrams, critique each other's arguments, providing useful suggestions while refining their own knowledge.

What Does the Research Say?

Why would an educator want to incorporate collaborative argumentation into their practice? Research shows that argumentation is a core practice that helps students interact richly around a topic and improve their critical thinking and knowledge building skills (Scardamalia & Bereiter, 2014).

Argumentation is challenging because it requires students to engage with competing ideas and complex topics, use appropriate evidence and reasoning, and communicate productively with peers and teachers. Scaffolding argumentation and providing feedback takes extra time in class to learn and practice, and can require extra resources. But curricular goals and accountability measures primarily reward learning about and repeating only disciplinary core ideas, and teachers are not trained on how to do argumentation well. Thus, it is challenging to implement effectively. Key challenges and strategies for fostering collaborative argumentation are described in more detail below.

But first, why is the practice of argumentation worth the effort? What are the benefits to students? Chinn and Clark (2013) summarize many benefits, including the following:

- **Enhance intrinsic motivation.** Students experience agency when they present their perspectives, socially interact with others, and come to understand the topic better.
- **Improve content learning.** Learning can be improved because students articulate their understanding, learn new things from their peers, examine claims, and gain more knowledge and strategies to evaluate the plausibility of claims.
- **Improve argumentation in a specific domain.** As students engage in argumentation in a given domain, they learn more content and practice new skills, which they can then apply to discuss and evaluate claims, evidence, and reasoning more deeply in that domain. Students also gain a more authentic understanding of how knowledge progresses in the world.
- **Improve and transfer general argumentation skills.** Students internalize skills that they observe and practice, for example, by listening to alternative positions, considering other viewpoints, and evaluating claims. Practicing collaborative argumentation skills in the classroom improves students' ability to use these skills when making decisions in other parts of life.
- **Improve knowledge building practices.** As students participate and contribute to social practices like argumentation, they improve their general social knowledge and collaboration skills.

How might teachers foster a culture of critical thinking and communication that will support argumentation and learning? Research and teacher experience suggest a number of essential practices that foster a culture of critical thinking and communication in the classroom and promote the benefits outlined above. These practices include: treating argumentation as a collective responsibility for building knowledge, building a classroom culture and norms of trust and respect, incorporating multiple perspectives, scaffolding discussion and reflection, and providing frequent opportunities for engagement in collaborative argumentation.

Research suggests that when students engage in arguing to reach consensus rather than arguing to convince or persuade, they make a commitment to understand the arguments and to integrate their thinking; they are more likely to elicit ideas, elaborate on ideas, and work to integrate the ideas rather than to show that they were right and close down discussion (Felton, et al., 2015). These practices are described in more detail below, in the section Recommended Application to Teacher Practice.

In addition, one of the larger challenges that good argumentation practices can address is students' lack of agency in the classroom. The "funds of knowledge" approach (Esteban-Guitart, 2021) encourages teachers to recognize and build on students' skills and knowledge acquired from their families, communities, and peer groups to help bridge the gap between home and school. Collaborative argumentation creates a dynamic learning environment where multiple perspectives thrive, serving to validate students' experiences and foster inclusive spaces for learning.

Practitioner Perspectives

Lack of systems-level support. Teachers have varied experience with argumentation in middle school science. Generally, argumentation is viewed as a valuable and engaging practice that can be integrated into a variety of science topics and activities. However, if the curriculum or school system doesn't directly support the ability for the teacher to foster argumentation, it becomes harder for them to bring argumentation into their practice.

Investing additional time and effort. Argumentation is challenging for both students and teachers, as it requires using appropriate evidence and reasoning as well as engaging in productive discourse with peers and teachers. Effective teaching methods and evaluation activities are needed to enhance students' ability to argue and promote a culture of debate within the classroom. Arguments can be enhanced by using multiple sources of data and evidence such as graphs, tables, models, simulations, texts, and video. But all of these take time to find or create. (For examples, see [Teacher's Roles in Supporting Collaborative Learning](#) and the [Collaborative Learning Toolkit](#)).

Creating classroom culture and encouraging feedback. The content of arguments developed by students is influenced by various factors, such as students' prior knowledge, motivation, interests, and identity. There is also a learning curve for students regarding argumentation. Comfort increases when students interact with mutual respect in an environment in which mistakes are expected and encouraged. Teachers don't want to be the sole source of feedback; that isn't engaging for them or the students. If the teacher and students can develop a classroom culture of trust and respect, students can learn to both give and receive critical feedback. A classroom in which students trust each other enough to receive and provide feedback requires the teacher to shift their pedagogical practice toward creating more student-led systems within that space, gradually releasing interpretive authority to the students (Dragnić-Cindrić et al., 2024) (see "Creating Classroom Culture for Collaborative Learning" in the [Collaborative Learning Toolkit](#)). When the teacher and students create a culture of respect and a safe environment to discuss claims, student engagement increases and learning occurs.

Understanding argumentation’s role in coming to consensus. If teachers view argumentation primarily as “convincing” others, their students won’t experience the full potential of argumentation as a tool for learning. With appropriate structure and context, argumentation can help students feel heard, learn new things from their peers, evaluate claims, change their beliefs, reach agreement, and better understand a topic (Felton, et al., 2015). Argumentation for understanding and consensus building—rather than “winning”—is a key idea and challenge for teachers.

Collaborative Argumentation of Learning In Practice

Of the strategies that have been found to support students’ argumentation skills and foster a culture of critical thinking and communication in the classroom, the following have the most evidence behind them:

Introduce “argumentation” as “building knowledge and consensus” in the classroom. A key purpose of education is to help students develop lifelong skills to participate and thrive in knowledge-building communities that solve problems and build common understanding. Argumentation is a process of reasoning and dialogue that can support these practices. Collaborative knowledge building (Scardamalia & Bereiter, 2014) emphasizes collective responsibility in co-constructing knowledge. Researchers recommend that when introducing argumentation, teachers emphasize and demonstrate that the goal is to focus on learning together (vs. persuading), understanding the world (vs. winning), working collaboratively in relationship with others (vs. individually), and discussing and setting group norms for dialogue.

Establish a classroom culture that prioritizes reciprocal relationships and curiosity. Build a healthy classroom culture and build it early. Communities thrive when participants engage in reciprocal dialogue, curiosity, and play. Reciprocity is a concept in research where partners support each other in a mutual and balanced way and is considered important for gaining a sense of belonging and feeling seen (see [Collaborative Learning Toolkit](#): Collaboration. Curiosity enables engagement, and play is a safe way to practice new skills. When students feel included in a community that is curious, playful, and has strong reciprocal relationships, they become more engaged, learn more, and can better support each other’s learning (Levine et al, 2020).

Seed discussion with multiple perspectives and support students in considering a variety of perspectives within their arguments. The best learning happens when students are integrating and critiquing their peers’ arguments (Vogel et al., 2016; Matos, 2021). Learning is improved by seeding student groups with alternative ideas and assigning to groups students who hold alternative ideas, rather than randomly assigning students to groups (Clark et al., 2009). Students can also be asked to take on different roles (“wear different hats”) to think about many sides of an issue.

Provide prompts and scaffolds. Prompts that scaffold learners to reflect and identify argument components can help students elaborate their understanding and learn more as a result. Prompts can

include sentence starters, such as “My theory is...,” “We agree that...,” “Our collective claim is...” (Scardamalia, 2002). Prompts and scaffolds that help students paraphrase, criticize, ask questions, and synthesize arguments facilitate knowledge construction, resulting in students gaining significantly more domain-specific and domain-general knowledge (Firetto et al., 2019; Noroozi et al., 2013).

Provide plenty of authentic opportunities for in-depth argumentation. When possible, engage students in argumentation for extended periods of time—such as through a multi-week unit involving complex problems—so they have the opportunity and motivation to develop domain knowledge, try on different roles (“wear different hats”), and experience and practice norms for collaborative discourse and evaluating arguments. Repeated opportunities with real-life, relevant questions—like the spread of disease or changing weather—that can be investigated from multiple perspectives help students hone argumentation skills (Goldman et al., 2016). You don’t need to conduct a full inquiry unit for every idea in science; even doing argumentation for a minority of the curriculum distributed throughout the school year, and across grades, will be helpful and give students repeated practice. Argumentation activities could involve contrasting competing data sets and opposing scientific ideas, and applying evidence to support competing claims. Performance can be assessed through multiple measures, such as written arguments, oral presentations, debates, and portfolios. Students need such opportunities to collaborate with each other to build and practice critical reasoning skills.

Summary

Collaborative argumentation is a process in which students actively build knowledge and consensus through critical thinking and communicating with others. Across disciplines, argumentation involves reasoning about evidence gathered using community agreed upon disciplinary practices. In **science, technology, engineering and math (STEM)** and some of the social sciences, evidence often comes from the results of experiments and investigations.

Beginning in middle school, students in STEM classes are often asked to conduct experiments and make sense of evidence. When asked to develop arguments and critique them in light of the evidence, students engage cognitive and communication skills to reason about claims and evidence. When space is made in the curriculum, students enjoy developing these skills, can perform well, and learn a lot.

Indeed, argumentation is one the most impactful strategies that a teacher can use to improve learning. But because collaborative argumentation takes more time than direct instruction methods, teachers often avoid argumentation assignments in favor of traditional assessments. Students need more opportunities to practice and develop collaborative argumentation skills.

Getting Started

While the idea of implementing strategies for argumentation may seem daunting—especially if you have not done this before—we recommend reviewing some of the resources below such as the [The](#)

[Argumentation Toolkit](#), which includes videos and other materials to support teachers in successfully integrating argumentation into science lessons. Additionally, the [PD Playlist: Incorporating Scientific Argumentation into Your Classroom](#) contains activities for STEM with further strategies to bring into the classroom including this [Talk Activities Flowchart](#) that can help you plan for student discussions based on different pedagogical goals. Lastly, our [Collaborative Learning Toolkit](#) includes a section on argumentation and other tips for successful collaboration.

Other Primers in this Series:

- [Assessment](#)
- [Classroom Discourse](#)
- [Social Regulation of Learning](#)
- [Teacher's Roles in Supporting Collaborative Learning](#)

Related Resources

- [Collaborative Learning Toolkit](#)
- [The Argumentation Toolkit](#)
- [Braincandy](#)
- [Arguing From Evidence in Middle School Science](#) [PD Playlist: Incorporating Scientific Argumentation into Your Classroom](#)
- [Scientific Argumentation in Biology: 30 classroom activities](#)
- [Foundations of Collaboration](#)

Videos:

- [Classroom Videos of Collaborative Learning](#)

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Recommended Citation

Schank, P., Barth, C., Crawford, V., and Fusco, J. (2025, May). Collaborative Argumentation for Learning. Digital Promise. <https://doi.org/10.51388/20.500.12265/251>

Acknowledgements

We extend our deepest gratitude to our reviewers Rudy Escobar, Cindy Hmelo-Silver, Heisawn Jeong, Cassandra Kelley, Janet Kolodner, and Michelle Pierce, our funder, the National Science Foundation, as well as the whole [Mapping, Clarifying, and Communicating Key Ideas about Collaborative Learning team](#).



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