Solving 21st-Century Problems Requires Skills That Few Are Trained In, Scientists Find

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From companies trying to resolve data security risks to coastal communities preparing for rising sea levels, solving modern problems requires teamwork that draws on a broad range of expertise and life experiences. Yet individuals receive little formal training to develop the skills that are vital to these collaborations.

In a [new scientific report](#) published in *Psychological Science in the Public Interest,* an interdisciplinary team of researchers identifies the essential cognitive and social components of collaborative problem solving (CPS) and shows how integrating existing knowledge from a variety of fields can lead to new ways of assessing and training these abilities.

The [report](#), authored by Arthur C. Graesser (University of Memphis), Stephen M. Fiore (University of Central Florida), Samuel Greiff (University of Luxembourg), Jessica Andrews-Todd (Educational Testing Service), Peter W. Foltz (Pearson and University of Colorado), and Friedrich W. Hesse (Leibniz-Institut fur Wissensmedien and University of Tu?bingen), is accompanied by a [commentary](#) from cognitive development expert Mary Gauvain (University of California, Riverside).

"CPS is an essential skill in the workforce and the community because many of the problems faced in the modern world require teams to integrate group achievements with team members' idiosyncratic knowledge," the authors of the report say.

As societies and technologies become increasingly complex, they generate increasingly complex problems. Devising efficient, effective, and innovative solutions to these complex problems requires CPS skills that most students lack. Only 8% of students around the world showed strong CPS skills, according to a 2015 assessment of more than 500,000 15-year-old students conducted by the Organisation for Economic Cooperation and Development.

"The experiences of students in and out of the classroom are not preparing them for these skills that are needed as adults," Graesser and colleagues write.

This unique set of cognitive and social skills support core aspects of CPS, including:

- **Shared understanding**: Group members share common goals when solving a new problem.
- **Accountability**: The contributions that each member makes are visible to the rest of the group.
- **Differentiated roles**: Group members draw on their specific expertise to complete different tasks.
- **Interdependency**: Group members depend on the contributions of others to solve the problem.

One reason for the lack of CPS training is a deficit in evidence-based standards and curricula. Secondary school curricula typically focus on educating task- and discipline-specific knowledge, placing little emphasis on educating students' ability to communicate and collaborate effectively.

"Students rarely receive meaningful instruction, modeling, and feedback on collaboration," the researchers note.

When students do receive training relevant to CPS, it is often because they participate in extracurricular activities such as band, sports, student newspapers, and volunteer activities. Even then, the collaborative competencies are not directly relevant to problem solving. The authors argue that it is time to make CPS activities a core part of the curriculum.

Although considerable psychological, educational, and management research has examined factors that contribute to effective learning, teamwork, and decision making, research that directly examines how to improve collaborative problem solving is scarce.

According to the authors, "we are nearly at ground zero in identifying pedagogical approaches to improving CPS skills."

Developing and implementing effective CPS training stands to have significant societal impacts across a wide range of domains, including business, science, education, technology, environment, and public health. In a project funded by the National Science Foundation, for example, Fiore and other research team members are training students to collaborate across a range of disciplines — including environmental science, ecology, biology, law, and policy — to identify ways to address social, business, and agricultural effects of rising sea levels in Virginia's Eastern Shore.

"It's exciting to engage in real world testing of methods developed in laboratory studies on teamwork, to see how feedback on collaboration, and reflection on that feedback to improve teamwork strategies, can improve students' problem solving," Fiore explains.

Identifying the necessary components of this kind of training and determining how to translate those components across a variety of real-world settings will, itself, require interdisciplinary cooperation among researchers, educators, and policymakers.

In the commentary, Gauvain emphasizes that achieving a comprehensive understanding of CPS requires taking a developmental perspective and she notes that psychological scientists will be essential in this endeavor. Graesser and colleagues agree:

"When psychological scientists collaborate with educational researchers, computer scientists, psychometricians, and educational experts, we hope to move forward in addressing this global deficit in CPS," they conclude.

The report and commentary are available online:
Advancing the Science of Collaborative Problem Solving
Arthur C. Graesser, Stephen M. Fiore, Samuel Greiff, Jessica Andrews-Todd, Peter W. Foltz, Friedrich W. Hesse

Collaborative Problem Solving: Social and Developmental Considerations
Mary Gauvain