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Volume 26, Number 3
May/June 2010

Unleashing the "Brain Power" of Groups in the Classroom

The neuroscience behind collaborative work

By NANCY WALSER

History teacher Rachel Otty often assigns group work in her classroom to keep her teens engaged.

In a warm, stuffy room on the third floor of Cambridge (Mass.) Rindge & Latin High School, 22 tenth graders in U.S. History I start their day by jotting down their opinions on how much progress has been made toward gender equity in the U.S. since women agitated for and won the right to vote.

Taking direction from a slide projected onto the blackboard, they break up into assigned groups of three to read charges against men leveled by 19th-century feminists in the 1848 Declaration of Sentiments, and compare them with statistics on the status of men and women in the U.S. today. They cut up pieces of paper labeled "government," "education," and "employment" and debate where to paste them on a line extending from "fully redressed" to "not redressed" based on current statistics.

After students return to their seats, their teacher, Rachel Otty, announces that next week the class will be divided into groups to prepare for a debate on whether or not President Andrew Jackson should have been impeached.

"I love debates!" a student blurts out.

Not so surprisingly, so does her teacher. "I remember history in high school as just lecturing, and I didn't enjoy it much," recalls Otty, who has garnered a reputation at the school for her skillful use of group work. "In graduate school, we learned about differentiated instruction, and group work is a way to do that. It's tough work and it requires a lot of brain power."

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Research by educators, psychologists, and, increasingly, neuroscientists supports Otty's personal experience. Done right, group work can harness the natural propensity of humans to interact, and—most important—make learning for a wide variety of students more engaging, memorable, and equitable. While it is more difficult to do than traditional lecturing, teachers say, most of the hard work is in the preparation, and the payoffs make the time invested well worth it.

Recent research by neuroscientists points to the existence of a "social brain" that enables humans to interact with each other. Summarizing the evidence gathered so far, Chris Frith, professor in neuropsychology at the Wellcome Trust Centre for NeuroImaging at University College London, has identified four regions of the brain associated with functions that allow humans to "read" others' states of mind and predict what they will do (see sidebar "The Brain and Collaboration"). **The**

Brain and Collaboration

According to British neuropsychologist Chris Frith, four regions of the brain are implicated in the human ability to interact with others. Among other things, these regions allow humans to read facial expressions (amygdala), to draw on knowledge from prior interpersonal experience (temporal poles), assess movement (posterior superior temporal sulcus/temporo-parietal junction), and think about others' mental states (medial prefrontal cortex). The ability to assign mental states to oneself and others—often referred to as "theory of mind"—has been documented in children as young as four, with precursor skills observed in infants less than one year old.

Brain-imaging studies also provide emerging evidence of a neurological "mirror system": When we observe a movement or emotion in someone else, the corresponding areas in our own brain are stimulated. It is as if we were actually experiencing the same movement or emotion ourselves.

The ability to interact and collaborate with others has been credited for humans' ability to rise to the top of the food chain despite being weaker than other species.
In his popular book *Brain Rules*, John Medina, a developmental molecular biologist and director of the Brain Center for Applied Learning Research at Seattle Pacific University, illustrates this with the example of engaging an ally to help fight off a woolly mammoth by driving it off a cliff. "And there is ample evidence that this is exactly what we did," he writes. "[Humans] learned to cooperate, which means creating a shared goal that takes into account your allies' interests as well as your own."

At a seminar held in February at London's Royal Society for the Encouragement of Arts, Manufactures and Commerce (RSA) to discuss implications of the social brain for curriculum, Frith said there was "consensus that work on the social brain does argue for expanding the group learning and cooperative learning projects" in schools. "I certainly believe that the special feature of humans is that we can work together to achieve more than the sum of the individuals in the group. This is because we can share experiences," he wrote in an e-mail, adding, "But we do have to learn how best to do this."

Classroom Benefits of Group Work
In the classroom setting, researchers and teachers say the power of collaborating—typically in small groups—comes from three main activities: identifying and working out differing viewpoints, synthesizing and vocalizing one's own knowledge, and extending one's knowledge through hearing the ideas of others.

In a 1991 review of findings from studies comparing the academic outcomes of elementary and secondary students engaged in cooperative learning with those of control groups receiving traditional instruction, Robert E. Slavin, director of the Center for Research and Reform at the Johns Hopkins University School of Education, concluded that 37 of the 44 studies favored group learning over traditional learning as long as the cooperative learning approach included both a group task and individual accountability (see sidebar "Structuring Effective Group Work"). **Structuring Effective Group Work**
How much students get out of group work depends on how well it is structured and how thoroughly students are prepared in ad-vance, researchers say.

In a comprehensive review of classroom studies comparing different types of group work, the late Stanford University education professor Elizabeth Cohen noted that productive group learning does not come naturally for students and that teachers can unwittingly assign group tasks that don't fit the definition of a "true group task."

True group work generally features an "ill-structured task" that has no right answer, often requires higher-level thinking, and can be accomplished only through interaction in a group, according to Cohen. Examples might include explaining how a balance scale works or coming up with an equation that can be used to buy different lengths of shoelaces for different types of shoes.

For productive cooperative learning to occur, students first need instruction on building cooperative skills including how to explain and receive feedback, stay on task, and encourage the contributions and monitor the understanding of others, she wrote.

In her classic work, *Designing Groupwork*, Cohen advised teachers to begin the year establishing "norms" for equal participa-tion that stress listening, asking questions, and allowing everyone in the group to talk. Instruction by the teacher also should not be so specific that it limits the group conversation. Classrooms with the biggest learning gains were those where teachers "were able to delegate authority so that more children could talk and work together at multiple learning centers," she wrote.

Teachers especially need to be attentive to the social and academic status of students in the classroom, which can affect the ability of both "high-" and "low-" status students to learn in groups, according to Helen Featherstone, a retired Michigan State University professor who is writing a book on group instruction based on Cohen's work. High-status students may ignore or reject ideas from low-status students (even though they may be better or more accurate). Low-status students may assume "smart" kids are right and opt out of group discussions. Students who aren't participating in the group may be doing so because they are being marginalized by peers, not because they are necessarily shy or "lazy."

"When the group's task is to ensure that every group member learns something, it is in the interests of every group member to spend time explaining concepts to his or her group mates," Slavin wrote, while noting that students who learned the most "are those who give and receive elaborate explanations."

Students who use the opportunity of working in a group to explain, clarify, and reiterate their understandings are facilitating what neuroscientists call "consolidation"—the process by which short-term "working memory" is converted to more permanent memory. This "mental manipulation" is different from "cramming," which is not considered as effective and can even be counterproductive if done in a context of boredom, fear, or anxiety.

In addition to helping students retain knowledge, collaboration has also been shown to positively affect social climate in schools, student self-esteem, intergroup relations, acceptance of disabled students, and attitudes toward school, Slavin reported. He found academic benefits across the spectrum of grade levels (2–12), subjects, school type, and type of learner. Some researchers have noted particular benefits of group work for English Language Learners.

Maximizing Participation: "Only the Person Who Thinks, Learns"

Group work can also work against factors known to inhibit learning, such as the fear of making mistakes or becoming discouraged, says Judy Willis, a neurologist who has taught elementary and middle school in Santa Barbara for 10 years and often writes and speaks about how findings about the brain can inform teaching.

In her classes, she allots 50 percent of classroom time to group work. "Only the person who thinks, learns," she says, "and you have to make mistakes to learn." With the right pre-teaching and structure, small-group learning can decrease the fear of making mistakes in front of the whole class, thus increasing participation, she says. And participation is not only key to memory making, but also for tapping into the brain's hormone-driven reward systems that reinforce successful interactions, keeping students involved in learning and persevering through challenging material, she says.

Group work can also increase engagement because individuals can be assigned roles that allow them to be "experts in something," so that they can be challenged at a level appropriate to their understanding, she says. To discuss and present various theories for why the Jamestown settlement failed or why the dinosaurs became extinct, for example, more advanced students may be "producers" charged with stopping their group periodically to summarize what is being said; those with attention deficits might be assigned to be "prop directors" to keep track of supplies needed to make a chart for the final presentation. Over the course of the year, Willis works with students to build their skills in areas of weaknesses.

To identify students' strengths and weaknesses, Willis begins each academic year with team-building exercises in which students pick a group name or cheer and then do a vocabulary or geography puzzle together, for example, before rotating to do the same in a different group. "By that time, I'll know who they are academically," Willis says.

The next activity will assess students' social skill levels by teaching each group a game and then regrouping students to teach their games to others. "Teaching the rules of a game is a pretty high-level function," Willis explains. "You have to understand the rules, synthesize them and put them in language that someone else can understand. You also have to be

patient, watch, and supervise—it's a test of one's executive function and maturity to teach a game you want to play before you can play it."

Planning, Pre-Teaching, and Powerful Results

Once she is ready to incorporate a group project into the curriculum, Willis plans backward by asking herself, "What do I want them to know?" Then, she says, "I plan it so that they achieve that academic goal through what they do in the group."

Pre-teaching skills are also key: Students can't join groups until they answer questions from their notes or reading. "It's not a free-for-all; it's very structured," she says.

Willis uses a rubric to keep track of both group and individual progress. She asks students in each group to use different-colored pencils so she can gauge participation levels as well. "There needs to be accountability: [otherwise] some will goof off; some will feel they have to do all the work—plenty of things can go wrong."

But when things go right, says Willis, students are neither bored, oppositional, or turned off by school. She links this to the way that group work prepares the brain to handle new information.

"When information comes into the senses, once it gets to the amygdala [the part of the brain involved in emotions and memory], depending on the emotional state of the [student], the input is either going to be sent to the higher frontal cortex, which governs long-term memories, goal setting, and creative decision making, or the reactive brain, which we don't control. In a group that allows people to enter with their strengths and interests, it's set up for information being processed so they can remember it, use it, and conceptualize it," says Willis.

While the planning and "front-loading" of lessons prior to group exercises is hard, "the student behavior and the quality and quantity of what they remember is the payoff," says Willis. And while introducing group work can take a "leap of faith" for teachers faced with state mandates and inflexible curriculum in some school districts, she says, she has seen "excellent results" on standardized tests. As importantly, she says, "Parents say to me, 'What are you doing? My child comes home and talks about what they are doing in school.'"

At the high school level, powerful results from a group approach to teaching math have also been documented by former Stanford professor Jo Boaler. In a five-year longitudinal study of 700 students published in 2008, Boaler followed the attitudes and outcomes of students who were taught math through the traditional "demonstrate and practice" approach at two suburban schools with those of a diverse urban school (called "Railside"), where teachers had created a sequence of theme-based math courses featuring group work. Although Railside students scored lower on a middle school math test than students at the other two schools, they outperformed the other students by their second year of high school and enrolled in advanced math courses at a higher rate by their senior year. The achievement gaps between white, black, and Latino students closed at Riverside, but not at the other schools.

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Back in Cambridge, Rachel Otty says she uses group work to help students understand difficult concepts or expose them to different viewpoints on an issue. She draws many activities from the History Alive! curriculum, which helps teachers find group exercises aligned with state standards. She also supplements the exercises with additional reading material from primary and secondary sources to provide additional content and context.

When creating groups, Otty typically chooses students of mixed ability for groups of four or fewer. She makes sure that students have at least one other person in the group with whom they can work cooperatively. She also mixes shy students with outgoing ones, as well as grouping those who are particularly distractible with those who are focused. Often she starts with the more distractible students and builds the groups around them. She typically gives students a rubric that explains how their individual effort will be graded and how their group presentation will be graded.

Since her high school adopted 82-minute blocks, Otty says, group work also serves as a good classroom management

tool: She likes to break up the long blocks with three or four transitions during class to keep her teens busy. “That’s what my student interns tell me, ‘Your students are always working,’” she says.

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