Cooperative Learning in the Science Classroom

Roger T. Johnson and David W. Johnson
Cooperative Learning Center at the University of Minnesota

How should students interact with one another in Science classes?

There are only three major choices. Students can compete with each trying to do better than the other students in the class; students can work individually toward a set criteria; or students can work cooperatively taking responsibility for each others' learning as well as their own. While traditional teaching has strongly encouraged students to work alone, competing with each other, the research on how students learn best goes in the opposite direction.

Our meta-analysis examining over 600 research studies dating back to the 1800's and covering all age groups and subject matter found that students working together cooperatively learned much more, with an effect sizes of over 0.60 when compared to competitive and individualistic learning (Johnson & Johnson, 1989). Since an effect size of 0.25 is considered significant, the effect sizes indicate a major difference in favour of cooperative learning. In addition students in cooperative conditions enjoyed the subject matter more (>0.60), had higher levels of self esteem (>0.40), and were more inclusive and accepting of diversity (>0.60) When just science classrooms were considered, the effect sizes favoring cooperative learning over competition (0.68) and individualistic learning (0.58) on achievement were equally impressive.

In a college level meta-analysis examining only research in science, math, engineering and technology classes, students working together again learned considerably more than student working alone (0.51). Students were also found to be more persistent (less attrition at 0.46) and had more favorable attitudes (0.55) in the small group teaching (Springer, et.al., 1999).

We are updating our 1989 meta-analysis this year examining more than 1000 studies but have only completed the data for middle school/junior high students (ages 12-14). Our finding for these students again yielded large effect sizes favoring cooperation for producing achievement (0.42). We also did an analysis to examine how much of the variance between learning in a small group vs. working alone was due to having good relationships and found that 80% of the difference was due to relationships. Certainly at this age group, and probably at all age groups, it is important that students have positive relationships with other students if we want them to achieve in school (Paper presented at the American Educational Research Association meeting, 2006). There is other data indicating that the more difficult the material and that the more carefully structured the cooperation is in the small groups the wider the achievement gab between students working together and working alone (Johnson & Johnson, 1989).

Of course this research favoring cooperative learning is not new and is now generally known. The current problem is that teachers believe they are doing cooperative learning when they are just putting students into groups to work. Certainly forming small groups is an important first step but the next task is to structure those groups to be cooperative. The structuring of cooperation is complex and much more than learning a few techniques. You are changing the norms of how students interact with each other as they learn. Several books are available that describe the process including Circles of Learning, The Nuts and Bolts of Cooperative Learning and Active Learning: Cooperation in the College Classroom. However, here is some advice for Science teachers who want to, or have already, moved beyond just organizing groups.

1) Stick to small groups (2-3, maybe 4). Small groups take less group member skills to be successful; each student gets more "talk time"; and they complete the task faster than larger groups.
2) For most purposes, make the groups heterogeneous. It enriches the conversation and provides a way for students to get to know more students personally. Working cooperatively is especially important in a diverse classroom as it builds acceptance of differences.
3) Provide a clear group goal that can not be accomplished by an individual. One of easiest ways to do this is to specify a single set of answers or product, signed by all group members to indicate that they contributed, agree with, and can explain the answers.
4) Check individual accountability by moving from group to group and randomly asking one group member to explain a part of the assignment already covered. When students realize that all group members must be able to explain the material and that you are checking to see that they do, they are less likely to try to "hitchhike".

When a student has difficulty explaining, the group needs to go back over that part of the assignment so they can explain it, (and let them know you will be back to check).

5) Provide a set of expected behaviors. This is the operational definition for cooperation and tells them what you are monitoring for when you visit each group. Behaviors like "all group members participating actively", "carefully considering the ideas of others", "encouraging and supporting others' ideas", and "staying with the group until the job is done" are a few helpful guidelines to cooperative behavior.

6) Monitor the groups looking for their understanding of the Science and their participation in the group. Have some specific, honest, positive feedback to give them, and give them a few minutes to discuss within their group how well they thought they did on the assignment and how well they interacted with each other. Setting a goal for next time will also improve the performance of the groups over time.

With the strong research support for cooperative learning, it is one of the strategies that always appears in a list of research based practices for teaching. It is not a huge jump for Science

Teachers who have always used small lab groups. There are other ways to involve students actively and cooperatively in direct teaching and reading as well. After all, cooperative teamwork is how practicing Scientists work, so why not Science students?

REFERENCES

Cooperation and competition: Theory and research. D. W. Johnson and R. T. Johnson. Edina, MN: Interaction Book Company, 1989

Effects of Small-Group Learning on Undergraduates in Science, Mathematics, Engineering, and Technology: A Meta-Analysis. L. Springer, et. Al. *Review of Educational Research*, Spring 1999, Vol 69, No.1, pp 21-51.

Effects of Cooperative Learning and Relationships of Middle School Students toward Achievement. C. Roseth, D.W. Johnson, R.T. Johnson. Paper given at the American Educational Research Association meeting, 2006, San Francisco, CA.

Note: for more information, go to **www.co-operation.org**

(Slavin, 1990) Learners in cooperative learning classrooms liked the subject areas more than other learners. They also had developed peer norms in favor of doing well academically. Critical thinking is stimulated and students clarify ideas through discussion and debate.Â In Hong Kong In the curriculum reform of Hong Kong, the development of studentsâ€™ generic skills and cultivation of attitudes are very important task. The idea of cooperative learning has been around for decades, but it never got to the same prominence as blended learning or differentiated instruction. While itâ€™s debatable as to why cooperative learning flew under the radar for so long, itâ€™s undeniably a powerful and effective teaching strategy. But what are the details behind cooperative learning? And how does it work in the classroom? More importantly, can cooperative learning work in a career and technical education (CTE) setting? Weâ€™ll answer all these questions â€“ and a couple others â€“ below! What Is Cooperative Learning? Cooperative lea...Â He enjoys everything about online marketing, data science, user experience, and corgis.