Making Groups Work by Chris Meyer

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Editor's note:
This is the second in a series of articles by Chris Meyer describing his experiences implementing a Workshop Physics program. To help guide Chris's ensuing articles, please give him feedback or ask him questions by emailing him directly.

"Life would be simple if not for other people".
"To really screw things up requires a committee".

We have all experienced the good, the bad, and the ugly of working in groups. By the time they reach our physics classes, so have our students. Their experiences are as varied as our own, and many students are justifiably concerned when the time comes to work in groups. How can we help students overcome bad or ugly experiences and derive the greatest benefits from group work? This instalment will describe how to:

1) make clear the value of cooperative group work,
2) provide coaching and strategies for effective habits, and
3) create an environment that encourages collaborative learning.

Changed Teaching Practice

Physics Education Researchers have measured student gain in conceptual understanding for a variety of instructional models[i]. One of the findings is the significant educational value of working in groups. Edward Redish of the University of Maryland calls this the *social learning principle.* "For most individuals, learning is most effectively carried out via social interactions." [ii] Social learning helps students who don't yet have the inner mental debate that allows them to effectively probe, explore and confront new ideas on their own.

The outstanding learning results produced by courses founded upon group work far outstrip those achieved by the most carefully reformed lecture-based courses[iv]. Two examples of very successful collaborative learning programs are *Physics by Inquiry*[v] at the University of Washington and Dickinson College's *Workshop Physics*[vi]. The evidence strongly suggests the shift from teacher- to student-centred learning needs to be made.

Explain the benefits

In a traditional physics course we may place students in cooperative small groups (to perform lab work, for instance), implicitly expecting them to acquire the skills of collaborative learning simply by virtue of working in groups. If, instead, the teacher explicitly addresses these skills students will better understand the value of group work and will improve their experiences in small groups.

Cooperative small group work generates skill building and ancillary benefits in the following areas:

(i) **The Power of Explanation**. If we cannot use our native tongue to explain new ideas to a friend, then we simply don't understand those ideas. In a teacher-centred classroom students have very little opportunity to apply their own powers of explanation and even less opportunity to get feedback on their ability to explain. In contrast, in a small group environment application and feedback are constantly taking place between students and with the assistance of the facilitating teacher.

(ii) **Peer Tutoring**. A weak student working in a small group has the opportunity to get regular assistance through group discussion that exposes him to others' thought processes. Strong students benefit equally. Many traditionally "strong" students are quick to memorize and recite answers but may possess surprisingly little understanding. The obligation to discuss and explain allows them to confront inconsistencies in their own thinking, furthering their understanding.

(iii) **More Teacher Attention**. Liberated from the demands of lecturing, teachers can turn their attention from their own train of thought to that of their students. A few tours of the classroom during a 60-minute activity can provide time to check in with every student, if only briefly, every day.

(iv) **Teamwork**. Oft cited as a highly prized skill[vii].

(v) **Responsibility**. Students begin to learn that it is their effort and energy that produces understanding and helps build skills. The traditional "lazy" way of learning - copying down notes, and memorizing laws and solutions has been largely eliminated.

Explain how groups work

What can the teacher can do to allay student concerns about group work and encourage a positive group experience? Begin by providing a detailed introduction to the group work programme of the course. Discuss:

(i) **Consistency and Regularity.** Making group work an everyday feature of the course will allow student get used to this structure. In time they will consider it normal and accept it. Using group work infrequently is problematic: students can choose to "wait it out" and not invest themselves in the process.

(ii) **Structure**. Provide clear structure for and training in the functioning of a group. This is often done using a system of rotating specialized roles and responsibilities. A typical cooperative small group has three members: a manager, a recorder and a sceptic[viii].

(iii) **Composition**. A group of three students of heterogeneous ability is the best composition and should be chosen carefully by the teacher when possible. Shuffle the groups periodically – every unit or every three to four weeks. The group is together long enough to commit to one another, but not so long that the group interactions get stale.

(iv) **Seating**. Group members need to sit facing one another. Working side by side often leaves one student out. A common workspace, such as a large whiteboard or chart paper, facilitates participation by every member.

(v) **Problems.** What do you do when a group is not functioning at its best? Most students simply don't know. Typical problems that crop up in small groups are: one member dominating, one member not contributing or lacking commitment, the group wandering off track, or a personality conflict. Address these potential problems at the outset, before they occur, and provide helpful suggestions for their resolution[ix].

(vi) **Time constraints**. Most students have evolved, by the senior grades, to be *competitive*. The goal of group work is to deepen students' understanding through *collaboration*. Encouraging this requires a fine balance. Provide enough time for vital discussion and tutoring to take place, but not so much that a sense of exigency disappears. Adequate time pressure will encourage the group to remain on task; unreasonable time pressure will simply encourage the dominant student to take over just to 'get it done' in the time allotted.

(vii) **Assessment**. Assessment must be carefully balanced between process and product. Students need to be allowed to make mistakes; otherwise, the especially marks-anxious individuals will take over the group. Analyze the activities in advance to judge which ones lend themselves to the assessment of care and thoughtfulness in process and which ones would be better assessed based on the accuracy of students' results.

Positive results

I have designed and constructed an active-learning grade 12 physics course based on group work, using guided inquiry activities and problem solving challenges. (See my resources freely available at: www.meyercreations.com). I invest a considerable amount of time and energy, especially at the beginning of the course, in instructing my students on the value of group work and techniques for its success. The results compare as day to night with my old teaching practices. The level of student engagement is considerably higher; students remain intellectually active for the majority of the class. Problems still arise, and no strategies work for everyone, but when my students aren't sweating too much they often give away how much they enjoy physics in groups.

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[i] See Force Concept Inventory as one example: http://se.cersp.com/yjzy/UploadFiles_5449/200607/20060705142003187.pdf

[ii] Redish, E. *Teaching Physics with the Physics Suite*, Hoboken, NJ: John Wiley & Sons, 2003, pg. 39, http://www2.physics.umd.edu/~redish/Book/

[iv] Redish, E., pg. 176 and 179

[v] http://www.phys.washington.edu/groups/peg/pbi.html

[vi] http://physics.dickinson.edu/~wp_web/wp_homepage.html

[vii] One recent example: Toronto Star, Sept 27, "Toronto scientist shaking up field of infectious disease", http://www.healthzone.ca/health/newsfeatures/article/866651--toronto-scientist-shaking-up-field-of-infectious-disease

[viii] An excellent manual describing many aspects of group work: http://groups.physics.umn.edu/physed/Research/CGPS/Green%20Book/chapter3.pdf

[ix] U of T Practicals: Teamwork Module – Student Guide, http://www.upscale.utoronto.ca/Practicals/Modules/Modules.html