

Cooperative Learning

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Exercise:

An instructor decides to have students do projects in teams. Students self-select teams of four. One assignment is handed in per team and all the team members get the same grade.

What problems are likely to occur with this approach?

Cooperative learning: A subset of collaborative learning in which students work in teams on structured learning tasks under conditions that meet five criteria:

1. *Positive interdependence.* Team members must rely on one another to accomplish goal.
2. *Individual accountability.* Members held accountable for (a) doing their share of the work and (b) mastering all material.
3. *Face-to-face interaction.* Some or all work done by members working together.
4. *Appropriate use of interpersonal skills.* Team members practice and receive instruction in leadership, decision-making, communication, and conflict management.
5. *Regular self-assessment of group functioning.* Teams periodically reflect on what they are doing well as a team, what they could improve, and what (if anything) they will do differently in the future.

Cooperative learning is *not*

- students sitting around a table studying together
- group projects with one or two students doing all the work

Three levels of cooperative learning

- *Informal cooperative learning.* Active learning involving groups that stay together for a class period or less to answer questions or solve problems. No strict compliance with the five conditions.
- *Formal cooperative learning.* Groups stay together for extended periods up to the entire course to produce a product (homework sets, design project, class presentation)
- *Cooperative base groups.* Groups stay together to provide mutual academic and personal support, possibly for several years. Use for academic work and/or advising.

Formal CL Activities (Structures)

- **Team Homework**

- Assignments done and handed in by teams.
- Only names of participants on final products.
- One grade per team (may adjust for individual performance on the team).
- *For problem sets, each member should outline solutions individually, complete solutions together.*
- Option: Individual outlines turned in along with group solution.

- **Team Projects**

- Projects (design, experiment, presentation) done by teams.
- Specialized training provided for individuals (Jigsaw).
- One grade per team adjusted for individual performance on the team.

- **Jigsaw¹**

Students work in teams on projects (laboratory exercises, design projects, test review) that have several subtasks, each requiring specialized knowledge.

- *Form home teams.* Students in each team number off (1, 2, 3...). All 1's are experts on Subtask 1, 2's on Subtask 2, etc.
- *Form expert groups*—all 1's together, all 2's together. Expert groups each receive handouts and training on their specialties.
- *Complete assignments in home teams.* Each team member takes the lead in making sure his/her area of expertise is covered.

In-Class Jigsaw Activity

- Form teams, designate experts. Give experts reading assignments or supplementary handouts prior to the class period in which the activity will occur.
- Expert groups meet, receive additional training and checklists, share ideas and responses to questions with the group. Home teams reconvene, complete activity.
- Teams report out. Ideally, team members report on work in an area of expertise other than theirs (promotes individual accountability and positive interdependence)

Jigsaw Projects (Design, Research, Laboratory, Term Paper)

- Assign areas of expertise (literature review, theory, experimental design, data analysis, specific articles) and/or team roles (coordinator, recorder, checker, graphic designer, programmer, statistician, modeler, group work facilitator) to each home team member
- Give specialized training, resources, and checklists to all experts with the same role
- To get individual accountability
 - give quizzes or exams to individual students covering every aspect of the project
 - call on students to report orally on parts of the project outside their area of expertise
 - have students individually assess the quality of each team member's performance on the team

Jigsaw (cont'd)

¹ Johnson, D. W., Johnson, R. T., & Smith, K. A. (1998). *Active learning: Cooperation in the college classroom* (2nd ed.). Edina, MN: Interaction Book Co.

Examination review jigsaw

- Divide material for an examination into three or four sections. Assign each expert group one of the sections.
 - Have expert groups go back through their notes and readings for their section of material and identify the important concepts or generate questions that might be on the exam. Go over questions with them, offer suggestions.
 - In home groups, the students share the work of each expert, quiz one another.
- **Pair Composition²** Students work in pairs to complete individual writing assignments (summary of article, research paper, position or reflection paper).
 - Student A describes to Student B what he or she is planning to write. After asking probing and clarifying questions, Student B outlines Student A's composition and gives it to Student A. Then the procedure is reversed. Each student researches the topic.
 - The two students together write the first paragraph of each composition. Then each student writes his or her composition individually.
 - When completed, the students read each other's compositions and make suggestions for revision.
 - After individual revision, students proofread both compositions and sign them to indicate there are no errors.
 - A similar process can be used between groups writing laboratory or design reports.
 - **Structured Controversy³**
 - Identify a topic that has well-documented positions. Organize students into groups of four and assign positions. Give students (or pairs) reading material that supports their position.
 - Groups have goals to (1) reach consensus on the issue, (2) master all the material relevant to each side as measured by a test, and (3) write a group report.
 - After researching and preparing their positions, students present their cases to the others.
 - Then they reverse perspectives and forcefully present the other positions.
 - The group members drop their advocacy and reach consensus on the issue. They write a group report including supporting evidence and their rationale, take a test on both positions, and process how well the group functioned.
 - **Pairs Testing.** Students take one or two of the course tests in pairs rather than individually. *Make the tests harder.*
 - **Individual Test Followed by Pair or Group Test⁴**
 - A test is given individually for a grade.
 - The same test is given to pairs or cooperative learning groups whose task is to correctly answer each question with one answer that all can agree upon and explain.
 - If the pair or group scores 90% or better on the test, each member receives a bonus of 5 or 10 points to be added to the individual test score.

Benefits of Cooperative Learning (references on E-21)

Improved

² Johnson, D. W., Johnson, R. T., & Smith, K. A. (1998). *Active learning: Cooperation in the college classroom* (2nd ed.). Edina, MN: Interaction Book Co.

³ Johnson, D. W., & Johnson, R. T., & Smith, K. A. (1996). *Academic controversy: Enriching college instruction through intellectual conflict*. ASHE-ERIC Higher Education Report V. 25 No. 3. Washington, DC: The George Washington University Graduate School of Education and Human Development.

⁴ Johnson, D. W., Johnson, R. T., & Smith, K. A. (1998). *Active learning: Cooperation in the college classroom* (2nd ed.). Edina, MN: Interaction Book Co.

- student-faculty interaction
- student-student interaction
- information retention, grades
- higher-level thinking skills
- attitudes toward subject, motivation to learn it
- teamwork, interpersonal skills
- communication skills
- understanding of professional environment
- self-esteem, lower level of anxiety (due to less emphasis on competition)
- race, gender relations (if CL is implemented carefully)
- class attendance

Plus far fewer (and better) papers to grade!

Meta-analysis* of 39 studies of small-group learning in college science, mathematics, engineering, and technology courses(1997):

- positive effect ($d=0.51$) on achievement (sufficient to move student from 50th percentile to 70th percentile on a standardized test). (d = standardized mean difference)
- positive effect ($d=0.46$) on persistence (sufficient to reduce attrition from SMET courses and programs by 22%)
- positive effect ($d=0.55$) on student attitudes (far exceeds the average effect on affective outcome measures of $d=0.28$ for classroom-based educational interventions)

* “Measuring the Success of Small-Group Learning in College-level SMET Teaching: A Meta-Analysis” by Leonard Springer, Mary Elizabeth Stanne, and Samuel Donovan.
<<http://www.wcer.wisc.edu/nise/CL1/CL/resource/R2.htm>>

Why It Works

- Active learning
- Individual students get stuck, give up. Groups keep going.
- Students see and learn alternative problem-solving strategies.
- More and better question generation, less fear in class
- *Cognitive rehearsal*: Students, like professors, learn best what they teach!

Implementing Formal Cooperative Learning

Forming Teams

- **Criteria for team formation**

1. **Mixed ability levels**

- Option 1: Form teams for a mixture of abilities using GPA, expected GPA, or grades in selected prerequisite courses (obtained from voluntary first-day survey).
- Option 2 Let students self-select, but prohibit teams in which more than half the team members have A's in specified courses or GPA's greater than a specified amount.
- Option 3: Form practice teams randomly. After the first test (2-3 weeks into the semester), re-form teams for ability heterogeneity using the test results.

2. **Common blocks of time to meet outside class**

3. **Early in the curriculum when the risk of dropping out is highest, don't let at-risk populations** (e.g. women in engineering) **be outnumbered on a team.** Research indicates that those students will play a more passive role and not get the same benefits from teamwork as more active participants.

4. **(Optional) Common interests.**

- **Instructors should form the teams** (avoid student self-selection). (a) It's the only way to ensure that the given criteria are met; (b) Research indicates that instructor-formed teams perform better than self-selected teams^{*}; (c) It's what will happen on the job, so they may as well learn to do it now.^{**}
- **Use a voluntary first-day survey** (p. 34) to get key information needed to form teams. Ask for (1) gender, (2) ethnicity, (3) grades in selected courses, (4) interests/hobbies, and (5) times not available during week for teamwork.
- **Teams of 3-4 members work best.** For formal CL teams, two is too small because there's not enough diversity of ideas, and more than four leads to some members of the team not actively participating.
- **Option for project teams:** Announce project topics and use a lottery system to let students choose the projects they prefer to work on.
- **For homework teams (as opposed to teams working on a semester-long project), give the teams an option to re-form once during the semester.** All must choose to stay together, otherwise the team will be dissolved and re-formed—gives dysfunctional teams a new life.

* For a summary of the research, see B.J. Millis & P.G. Cottell, Jr. (1998). *Cooperative learning for higher education faculty*. Phoenix: Oryx Press, pp. 50–53.

** If the idea of forming teams yourself is too troublesome, don't let it stop you from using cooperative learning. Go ahead and let the students self-select, and in a year or two reconsider instructor-formed teams.

Implementing Cooperative Learning

	Positive interdependence	Individual accountability	Face-to-face interaction	Interpersonal skills	Group self-assessment
Require teams to establish & sign off on goals & expectations					
Give early team-building exercises					
Give one set of resources, require single team product					
Assign different roles (coordinator, recorder,...), rotate					
Use jigsaw (each team member has a different area of expertise)					
Assess individual performance in team roles or areas of expertise					
Require periodic team self-assessment of performance					
Provide guidance in management of interpersonal conflicts					
Assign team monitor to check everyone's understanding					
Arbitrarily select team members to report on results					
Collect peer ratings, use to adjust team grades					
Give individual tests on total content					
Give point bonus on tests to teams with average grade ≥ 80					
Provide last-resort options of firing and quitting					

Satisfying the Criteria for Cooperative Learning

Help students develop skills in teamwork

- **Establish team goals, expectations.** As part of the first assignment, have teams generate and sign a list of goals and expectations (e.g. being prepared before team sessions, calling if they have time conflicts, etc.). Have them sign the list and make copies for themselves and you. (See example on page E-14)
- **Consider using team building exercises early.** Some instructors spend a class session early in the semester doing activities designed to enhance team skills. Good resources for such activities are Items 2, 16, and 21 on pages E-21 and E-22.
- **Keep groups intact for at least a month.** It takes at least that long for the teams to encounter problems and learning to work through the problems is part of what we're trying to teach them.
- **Provide teamwork instruction as needed.** Another approach to teamwork instruction is to provide it on as problems begin to arise. Two-three weeks into the semester, collect anonymous reactions to teamwork. Pick out common problems to present as scenarios in class. Brainstorm possible group responses and add your suggestions as needed.
- **Provide for periodic self-assessment of team functioning.** At least 2 or 3 times during the semester, have teams respond to questions like:

How well are we meeting our goals and expectations?

What are we doing well?

What needs improvement?

What (if anything) will we do differently next time?

Promote positive interdependence

- **Assign different roles to team members** (e.g. coordinator, recorder, checker, group process monitor). Rotate roles periodically or for each assignment. The coordinator reminds team members of when and where they should meet and keeps everyone on task during team meetings. The recorder prepares the final solution to be turned in. The checker double-checks the solution before it is handed in and makes sure the assignment is turned in on time. The monitor checks to be sure everyone understands the solutions and the strategies used to get them. In teams of three, the coordinator may also assume the duties of the monitor.
- **Provide one set of resources and require a single team product.**
- **Use Jigsaw** (E-3 and E-4) to provide specialized expertise within each team. Jigsaw works best when teams are working on a project with identifiable sub-tasks.
- **Give bonus on test** (3–5 points) to groups in which the team average is above (say) 80%. Notice that the bonus isn't tied to each person on the team getting a certain grade; that approach would put too much pressure on weaker members of the team and over-penalize teams with one very weak student. Instead the bonus comes when the team reaches a set average giving the stronger students incentive to help their team members and to get the highest grade they can.

- **Arbitrarily select a student to report and give everyone in the student's team the same grade** (also promotes individual accountability). For a presentation, everyone should be ready to present and answer questions about each part of the project. The instructor may arbitrarily assign team members to present a certain part right before the presentation.

Build in individual accountability

- **Use primarily individual testing.** Individual tests ensure that students understand the material and are not overly-dependent on their team.
- **Include group homework grades in determination of final course grade only when a student has a passing average on tests.**
- **Have someone in the team routinely checking everyone's understanding.** The monitor should make sure everyone understands the group's work.
- **Call randomly on individuals to present and explain team results** (both while teams are working and after work is complete). During teamwork, the instructor may ask individuals to summarize what the group is doing. After teamwork, the instructor should call randomly on students to report on what their team did.
- **Make teams responsible for seeing that non-contributors don't get credit.** Students should be reminded that only contributing members should have their names on the product.
- **Get each team member to rate everyone's team performance, factor results into project grades.** (Detailed procedure on E-17) Alternatively, have students write narrative evaluations of each team member's contributions. The opportunity for peer review helps lessen student resistance and encourages full participation by all members of the team.
- **Provide last resort options of firing and quitting.**
 - If a team member refuses to cooperate on an assignment, his/her name should not be included on the completed work. If the non-cooperation continues, the team should meet with the instructor so that the problem can be resolved, if possible (Use active listening.).
 - If no resolution is achieved, the cooperating team members may notify the uncooperative member in writing that he/she is in danger of being fired, sending a copy of the memo to the instructor. If there is no subsequent improvement, they should notify the individual in writing (copy to the instructor) that he/she is no longer with the team. The fired student should meet with his/her instructor to discuss options.
 - Similarly, students who are consistently doing all the work for their team may issue a warning memo that they will quit unless they start getting cooperation, and a second memo quitting the team if the cooperation is not forthcoming.
 - Students who get fired or quit must find a team of 3 willing to accept them as a member, otherwise they get zeroes for the remaining assignments.
 - These options are rarely exercised, but it is important to have them available for hopelessly dysfunctional teams.

General Suggestions

- **Start small and build.** If you've never used CL, consider starting with informal structures in class. Once you're comfortable with that, try a CL team project or assignment.
- **Start early in the semester.** In the very first class session, use informal cooperative learning activities. If you're planning to use formal teams, form them within the first week so that students will become accustomed to the idea that teamwork is an integral part of the course.
- **Explain to students what you're doing and why.** Mention benefits, particularly grades. (See E-21, Reference 2 for specifics.) This step will help to minimize the resistance some students have for cooperative learning.
- **Share comments from previous students about the value of team work.** Using this approach will help convince students to give teamwork a chance and will minimize student resistance to the technique.
- **Make CL assignments more challenging (but not longer) than traditional individual assignments.** CL works best for challenging problems and activities requiring higher level thinking skills. Students will resent having to spend time in teams on assignments they could easily complete themselves.
- **Don't curve course grades.** It should be theoretically possible for every student in a class to earn an A. If grades are curved, team members have little incentive to help each other.
- **Conduct a midterm assessment to find out how students feel about teamwork.** At about mid-semester, ask students to report anonymously on what's working and what's not working in their team. If many teams are having problems, spend some time in class on the relevant team skills. Most of the time, however, the assessment will show that most teams are working well. (Without the assessment, the instructor only hears the complaints.)
- **Expect initial resistance from students.** (See E-21, References 1 and 3 for suggestions.)

Forms for Cooperative Learning*

Following are forms that may be used when students are working on assignments in teams in a course.

1. Preliminary questionnaire (E-12)

Administer and collect on Day 1 of the course. Form teams based on ability heterogeneity, not allowing members of minority populations to be outnumbered in a group (especially in first- and second-year courses), common interests (optional), and common blocks of time outside class.

2. Team policies and expectations (E-13)

Hand this (or your own version) out on Day 1 and go over it in class.

3. Team expectations assignment (E-14)

Have teams fill out this form, sign it, and hand it in during the first week. Hand it back to them after 3-4 weeks to remind them of the rules they had agreed on.

3. Team member evaluation form (E-15)

(a) Give to students on Day 1. Tell them that they will be completing the form for each of their teammates and themselves at the end of the semester or when the project is complete, and the ratings will be used to make individual adjustments to their team grade. Briefly go through the form with them.

(b) When the team has worked together for at least a month, have them fill the forms out and exchange and discuss them with one another. Tell each student to fill one out for each of his/her teammates and share them with one another. You don't see these—they're mainly to give students who haven't been pulling their weight a warning that unless they get it together their grade on the assignments will be hurt. When ratings that count are later collected, low ones will not come as a surprise to anyone who got them in this practice round and didn't change his or her behavior.

4. Peer rating of team members (E-16)

Hand out at the end of the semester and/or when the project is complete and/or at mid-semester and/or after every assignment. Students fill them out confidentially and turn them in to you. You convert the verbal ratings to numbers and use the next form to determine individual weighting factors for the team project grade or the average of the grades for the period in question.

5. Autorating system (E-17)

Enter the ratings from the previous form on a spreadsheet. Calculate each student's average rating, the team average rating, and a weighting factor for each student equal to the student's average rating divided by the team average rating. The individual's grade for the period covered by the rating sheet is the product of the weighting factor and the team project grade. To count the ratings less, use the square root of the individual rating over the team rating as the weighting factor.

You are strongly advised not to explain this system to students in class. If someone asks about it, tell them that you don't want to take up class time going through it but you'll be happy to do so during your office hours, and if they persist do so. (Few will ever ask, and you'll avoid much subsequent explaining and arguing by not elaborating on the system.)

6. Cooperative learning checklists (E-18, E-19)

Checklists are provided to help you select appropriate implementation techniques for cooperative learning in homework groups, design projects/major presentations, and laboratory courses.

7. Activity matrix for formal cooperative learning (E-20)

CHE 205
PRELIMINARY QUESTIONNAIRE*

Name (Last, First) _____ Nickname _____

Section _____ Instructor _____

Main interests/hobbies: _____

Gender: ___ Female ___ Male

Ethnicity: ___ African-American ___ Asian-American ___ Hispanic
 ___ International ___ Native American ___ Other (specify) _____

Grades in prerequisite courses: CH 107 ___ MA 241 ___ PY 205 ___

Times unavailable for group work. In the spaces below, please cross out the times when you will *not* be available to work outside class on assignments with your group. Mark only genuine conflicts, such as with classes or job responsibilities.

Time	M	T	W	H	F	Sat	Sun
8-9 a.m.							
9-10							
10-11							
11-12							
12-1 p.m.							
1-2							
2-3							
3-4							
4-5							
5-6							
6-7							
7-8							
8-9							
9-10							
10-?							

* We would be grateful if you answer every question, but if for any reason you wish to skip those on gender, ethnicity, and interests you may do so.

Team Policies and Expectations

Your team will have a number of responsibilities as it completes problem and project assignments.

- *Designate a coordinator, recorder and checker for each assignment.* Rotate these roles for every assignment.
- *Agree on a common meeting time and what each member should have done before the meeting* (readings, taking the first cut at some or all of the assigned work, etc.)
- *Do the required individual preparation.*
- *Coordinator checks with other team members before the meeting to remind them of when and where they will meet and what they are supposed to do.*
- *Meet and work.* **Coordinator** keeps everyone on task and makes sure everyone is involved, **recorder** prepares final solution to be turned in, **monitor** checks to make sure everyone understands both the solution and the strategy used to get it, and **checker** double-checks it before it is handed in. Agree on next meeting time and roles for next assignment. For teams of three, the same person should cover the monitor and checker roles.
- *Checker turns in the assignment, with the names on it of every team member who participated actively in completing it.* If the checker anticipates a problem getting to class on time on the due date of the assignment, it is his/her responsibility to make sure *someone* turns it in.
- *Review returned assignments.* Make sure everyone understands why points were lost and how to correct errors.
- *Consult with your instructor if a conflict arises that can't be worked through by the team.*
- **If a team member refuses to cooperate on an assignment, his/her name should not be included on the completed work.** If the non-cooperation continues, the team should meet with the instructor so that the problem can be resolved, if possible. If no resolution is achieved, the cooperating team members may notify the uncooperative member in writing that he/she is in danger of being fired, sending a copy of the memo to the instructor. If there is no subsequent improvement, they should notify the individual in writing (copy to the instructor) that he/she is no longer with the team. The fired student should meet with his/her instructor to discuss options. Similarly, students who are consistently doing all the work for their team may issue a warning memo that they will quit unless they start getting cooperation, and a second memo quitting the team if the cooperation is not forthcoming. Students who get fired or quit must find a team of 3 willing to accept them as a member, otherwise they get zeroes for the remaining assignments.

As you will find out, group work isn't always easy—team members sometimes cannot prepare for or attend group sessions because of other responsibilities, and conflicts often result from differing skill levels and work ethics. When teams work and communicate well, however, the benefits more than compensate for the difficulties. One way to improve the chances that a team will work well is to agree beforehand on what everyone on the team expects from everyone else. Reaching this agreement is the goal of the assignment on the last page of this handout.

Team Expectations Assignment

On a single sheet of paper, put your names and list the rules and expectations you agree as a team to adopt. You can deal with any or all aspects of the responsibilities outlined above—preparation for and attendance at group meetings, making sure everyone understands all the solutions, communicating frankly but with respect when conflicts arise, etc. Each team member should sign the sheet, indicating acceptance of these expectations and intention to fulfill them.

These expectations are for your use and benefit—we won't grade them or even comment on them unless you ask us to. Note, however, that if you make the list fairly thorough without being unrealistic you'll be giving yourselves the best chance. For example, "We will each solve every problem in every assignment completely before we get together" or "We will get 100 on every assignment" or "We will never miss a meeting" are probably unrealistic, but "We will try to set up the problems individually before meeting" and "We will make sure that anyone who misses a meeting for good cause gets caught up on the work" are realistic.

Peer Rating of Team Members*

Name _____

Group # _____

Please write the names of all of your team members, INCLUDING YOURSELF, and rate the degree to which each member fulfilled his/her responsibilities in completing the homework assignments. The possible ratings are as follows:

Excellent	Consistently went above and beyond—tutored teammates, carried more than his/her fair share of the load
Very good	Consistently did what he/she was supposed to do, very well prepared and cooperative
Satisfactory	Usually did what he/she was supposed to do, acceptably prepared and cooperative
Ordinary	Often did what he/she was supposed to do, minimally prepared and cooperative
Marginal	Sometimes failed to show up or complete assignments, rarely prepared
Deficient	Often failed to show up or complete assignments, rarely prepared
Unsatisfactory	Consistently failed to show up or complete assignments, unprepared
Superficial	Practically no participation
No show	No participation at all

These ratings should reflect each individual's level of participation and effort and sense of responsibility, not his or her academic ability.

<u>Name of team member</u>	<u>Rating</u>	<u>Reason for Rating < Satisfactory</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Your signature: _____

* R.M. Felder, 2004. Each student fills out this form, instructor collects and uses to adjust team project grades for individual team members using procedure on following page.

Autorating System*

1. Determine group project or average homework grade.
2. Convert individual verbal ratings to numbers:
 - Excellent = 100
 - Very good = 87.5
 - Satisfactory = 75
 - Ordinary = 62.5
 - Marginal = 50
 - Deficient = 37.5
 - Unsatisfactory = 25
 - Superficial = 12.5
 - No show = 0
3. On a spreadsheet, enter numerical ratings received by team members in rows. In the “Vote 1” column are the votes given by Betty to herself, Carlos, John, and Angela; under “Vote 2” are all of the votes given by Carlos, etc.
4. Average individual marks, calculate overall team average, calculate adjustment factors as individual average divided by team average. **Impose an upper limit of 1.05 on any individual student’s adjustment factor.**
5. Individual project grade = (team grade) x (adjustment factor).

Example

Team project grade	80							Indiv. Proj. Grade
Name	Vote 1	Vote 2	Vote 3	Vote 4	Indiv. Avg.	Team Avg.	Adj. Fctr.	
Betty	87.5	87.5	75	87.5	84.4	82.0	1.02	82
Carlos	87.5	100	87.5	87.5	90.6	82.0	1.05	84
John	62.5	75	50	75	65.6	82.0	0.80	64
Angela	87.5	87.5	87.5	87.5	87.5	82.0	1.05	84

*This sheet is for instructor use and is not handed out to students. Adapted from Brown, R. W. (1995). *Autorating: Getting individual marks from team marks and enhancing teamwork*. 1995 *Frontiers in Education Conference Proceedings*, Paper 3C24. For a complete reprint, contact Rob Brown at rwb@rmit.edu.au.

* To read about research done on the effectiveness of this instrument, look at Kaufman, D. B., Felder, R. M., & Fuller, H. (2000). Accounting for individual effort in cooperative learning teams. *Journal of Engineering Education*, 89 (2), 133-140, available online at

<http://www.ncsu.edu/felder-/public/Papers/Kaufmanpap.pdf>

Checklists for CL Implementation by Type of Assignment

Homework Groups

- ___ Include all policies and procedures for homework groups in the material you pass out on Day 1 of the course. (See B-12 for an example.) Include a copy of the “Team Member Evaluation Form” (E-15).
- ___ Group formation: Groups should be teacher-assigned and have 3-4 members with a mixture of ability levels. Follow the tips on group formation for specific suggestions (E-6).
- ___ First Assignment: As part of the first assignment, have teams write a list of expectations they have for each other (e.g. come to meetings prepared and on time, do what you’re supposed to do, let the others know if you won’t be able to fulfill a responsibility, etc.) and sign them (E-14).
- ___ Regular Assignments: A team assignment is turned in with only the participants’ names and roles on the paper. (Don’t give credit to no-shows.) Roles (coordinator, recorder, checker, monitor) should rotate with no one repeating a role until everyone in the group has had a turn at each one. In 3-person groups, combine the roles of checker and monitor. You might require students to complete individual outlines of the solution to encourage accountability and require all students to get problem solutions started instead of relying on the group for that step.
- ___ Individual accountability comes primarily through individual tests. Some teachers offer a bonus on tests (3-5 points) to groups in which the team average is above (say) 80%.
- ___ After a month, include in the assignment the questions for self-assessment of group functioning (E-8). Teams may also evaluate themselves on how well they are meeting the expectations they set in the first assignment.
- ___ At mid-semester, have students complete a “Peer Rating of Team Members” (E-16). Use the results to adjust the homework grade for the first half of the semester. Another option is to share the results with students so that they can make changes in their team performance, but don’t use them to adjust grades.
- ___ Provide last resort options of firing and quitting (E-9).
- ___ At the end of the semester, have students complete the “Peer Rating of Team Members” (E-16) and use the results to adjust homework grades (E-17).

Design Projects/Major Presentations

These CL groups are used when there is a major project or presentation to be completed and presented. Generally only one such project or presentation is done in a semester.

- ___ Include in the syllabus a copy of the “Team Member Evaluation Form” (E-15) and a description of how the final presentation will be organized.
- ___ Follow guidelines for group formation (E-6).
- ___ First Assignment: Have teams write a list of team expectations (be on time, come prepared, etc.) they have for each other and sign them (E-14).
- ___ Use Jigsaw (E-3 and E-4) to provide specialized expertise within the group.
- ___ Consider breaking the project into intermediate steps with parts turned in throughout the semester (preliminary plans and cost analysis, list of related literature, etc.). This practice helps teams distribute the work and reveals problems with individual members before the end of the semester when it may be too late to address them.

- ___ Include questions for self-assessment of group functioning (E-8) to be turned in with each step of the assignment. Teams may also evaluate themselves on how well they are meeting the expectations they set in the first assignment.
- ___ At mid-semester, have students complete a “Team Member Evaluation Form” (E-15). Share the results with students so that they can make adjustments in their team performance, but don’t use them to adjust grades.
- ___ Have the presentation of the project divided into definable sections. The day before the presentation, randomly assign each group member to present each part. Be sure to tell students early in the semester you will be doing this. Base the team’s presentation grade on how well each part is presented.
- ___ If the project is a major portion of the grade in the course, you may want to include some individually prepared portions or other assignments (e.g. learning log, reflection or position paper) to encourage individual accountability. Another option is to use individual testing on key design material.
- ___ At the end of the semester, have students complete the “Peer Rating of Team Members” (E-16) and use the results to adjust the project grade (E-17).

Laboratory Courses

In laboratory courses, students have traditionally been placed in teams to complete a series of experiments or projects. A missing element has often been individual accountability to ensure that groups members are all doing their part and learning what they should from the course.

- ___ Include policies and procedures for the lab teams in your syllabus distributed on Day 1. Include a copy of the “Team Member Evaluation Form” (E-15).
- ___ Follow guidelines for group formation (E-6) paying close attention to ability heterogeneity.
- ___ With the first lab report, have teams write a list of team expectations (be on time, come prepared, etc.) they have for each other and sign them (E-14).
- ___ Define appropriate roles for the lab (coordinator, recorder, data analyst, graphic artist, experimental designer, statistician, theoretical analyst...) and have the roles rotate with each experiment.
- ___ During the lab, circulate and ask individual students to report on what the team is doing.
- ___ Consider giving individual tests on the material covered in the lab to promote individual accountability.
- ___ Use peer editing of lab reports before they are turned in. The editing can take place within the team or teams can swap lab reports to provide peer reviewing and feedback. This step will improve the quality of the product you have to evaluate.
- ___ On 2 or 3 lab reports, have teams complete a self-assessment of group functioning (E-8).
- ___ With each lab report, have students complete a “Peer Rating of Team Members” (E-16). Use the results to adjust each report grade for individual effort (E-17).
- ___ Provide last resort options of firing and quitting. Be sure to describe the procedures in the material you hand out on the first day (E-9).

Implementing Cooperative Learning

	Positive interdependence	Individual accountability	Face-to-face interaction	Interpersonal skills	Group self-assessment
Require teams to establish & sign off on goals & expectations	X		X	X	
Give early team-building exercises	X		X	X	X
Give one set of resources, require single team product	X		X	X	
Assign different roles (coordinator, recorder,...), rotate	X			X	
Use jigsaw (each team member has a different area of expertise)	X		X	X	
Assess individual performance in team roles or areas of expertise		X		X	
Require periodic team self-assessment of performance	X		X	X	X
Provide guidance in management of interpersonal conflicts				X	
Assign team monitor to check everyone's understanding	X	X		X	
Arbitrarily select team members to report on results	X	X	X	X	X
Collect peer ratings, use to adjust team grades	X	X		X	X
Give individual tests on total content		X			
Give point bonus on tests to teams with average grade ≥ 80	X			X	
Provide last-resort options of firing and quitting		X		X	

Resources on Cooperative Learning

To get an overview of CL:

1. Felder, R. M., & Brent, R. (1994). *Cooperative learning in technical courses: Procedures, pitfalls, and payoffs*. Report to the National Science Foundation. (ERIC Document Reproduction Service No. ED 377 038)
View and download at <http://www.ncsu.edu/felder-public/Papers/Coopreport.html>
2. Millis, B. J. & Cottell, Jr., P. G. (1998). *Cooperative learning for higher education faculty*. Phoenix, AZ: Oryx Press.

To find practical suggestions for CL structures and troubleshooting:

3. Felder, R. M., & Brent, R. (1996). Navigating the bumpy road to student-centered instruction. *College Teaching*, 44(2), 43-47. (in the notebook)
View and download at <http://www.ncsu.edu/felder-public/Papers/Resist.html>
4. Felder, R. M., & Brent, R. (2001). FAQs-3. Groupwork in distance learning. *Chemical Engineering Education*, 35(2), 102-103. (in the notebook)
View and download at <http://www.ncsu.edu/felder-public/Columns/FAQs-3.html>
5. Felder, R. M., & Brent, R. (2001). Effective Strategies for Cooperative Learning. *Journal of Cooperation and Collaboration in College Teaching*, 10(2), 69-75.
View and download at [http://www.ncsu.edu/felder-public/Papers/CLStrategies\(JCCCT\).pdf](http://www.ncsu.edu/felder-public/Papers/CLStrategies(JCCCT).pdf)
6. Felder, R.M., & Brent, R. (2003). Designing and Teaching Courses to Satisfy the ABET Engineering Criteria. *J. Engr. Education*, 92(1), 7-25. Appendix E of this paper demonstrates that Cooperative Learning can be used to address all of Outcomes 3a-3k.
View and download at [http://www.ncsu.edu/felder-public/Papers/ABET_Paper_\(JEE\).pdf](http://www.ncsu.edu/felder-public/Papers/ABET_Paper_(JEE).pdf)
7. Johnson, D. W., Johnson, R.T., & Smith, K. A. (1998). *Active learning: Cooperation in the college classroom* (2nd ed.). Edina, MN: Interaction Book Co.
8. Kaufman, D.B., Felder, R. M., & Fuller, H. (2000). Accounting for individual effort in cooperative learning teams. *Journal of Engineering Education*, 89(2), 133-140.
View and download at <http://www.ncsu.edu/felder-public/Papers/Kaufmanpap.pdf>
9. McKeachie, W. J. (2002). *Teaching tips: Strategies, research, and theory for college and university teachers* (11th ed.). Boston: Houghton Mifflin. (Chapter 15)

To explore the research base for CL:

10. Johnson, D. W., Johnson, R. T., & Stanne, M.E. (2000). *Cooperative Learning Methods: A meta-analysis*. University of Minnesota, Minneapolis: Cooperative Learning Center. View and download at <http://www.co-operation.org/pages/cl-methods.html>
11. Springer, L., Stanne, M. E., & Donovan, S. (1997). *Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis*. Madison, WI: National Institute for Science Education. View and download at <http://www.wcer.wisc.edu/nise/CL1/CL/resource/R2.htm>
12. Terenzini, P.T., Cabrera, A.F., Colbeck, C.L., Parente, J.M., & Bjorklund, S.A. (2001). Collaborative learning vs. lecture/discussion: Students' reported learning gains. *J. Engr. Education*, 90(1), 123-130.

To read about a longitudinal study of cooperative learning in engineering education:

13. R.M. Felder, G.N. Felder, E.J. Dietz, "A Longitudinal Study of Engineering Student Performance and Retention. V. Comparisons with Traditionally-Taught Students," *J. Engr. Education*, 87(4), 469-480 (1998). View and download at <http://www.ncsu.edu/felder-public/Papers/long5.html>.
14. R.M. Felder, "A Longitudinal Study of Engineering Student Performance and Retention. IV. Instructional Methods and Student Responses to Them," *J. Engr. Education*, 84(4), 361-367 (1995). View and download at <http://www.ncsu.edu/felder-public/Papers/long4.html>
15. R.M. Felder, G.N. Felder, M. Mauney, C.E. Hamrin, Jr., and E.J. Dietz, "A Longitudinal Study of Engineering Student Performance and Retention. III. Gender Differences in Student Performance and Attitudes," *J. Engr. Education*, 84(2), 151-174 (1995).

For online information on CL:

16. **Active/Cooperative Learning: Best Practices in Engineering Education.** A collection of resources compiled by the Foundation Coalition, including excerpts from videotaped interviews with some of the leading practitioners of CL in engineering education on different aspects of planning and implementation. <http://clte.asu.edu/active/main.htm>
17. **Engineering Team Training Workbook.** This workbook of team exercises was developed at Arizona State University. <http://www.eas.asu.edu/~asufc/teaminginfo/teams.html>
18. **IASCE.** The web site of the International Association for the Study of Cooperation in Education. A collection of resources including a newsletter, list of related organizations and links, and a search engine. <http://www.iasce.net/>
19. **Innovations in SMET Education.** The web site of the National Institute for Science Education at the University of Wisconsin. Resources on collaborative learning (including Cooper and Robinson's outstanding annotated bibliography on cooperative learning), learning through technology, and assessment of learning. <http://www.wcer.wisc.edu/nise/CL1/>
20. **Instructional Innovation Network.** A variety of resources related to cooperative learning and case teaching, including lessons and activities. Maintained by Susan Ledlow, Arizona State University. <http://bestpractice.net/>
21. **Online Collaborative Learning in Higher Education.** An excellent resource for articles and links maintained by the Central Queensland University. <http://musgrave.cqu.edu.au/clp/clpsite/index.htm>
22. **TEAMWORKS.** The Virtual Team Assistant. Modules on various aspects of team functioning including team building, project management, problem solving, conflict management, feedback, leadership, oral and written presentations, and (for instructors) teaching with teams. Compiled by Barbara O'Keefe of the University of Illinois. <http://www.vta.spcomm.uiuc.edu/>
23. **Ted Panitz's home page.** A vast collection of resources on cooperative learning including an e-book, articles, faculty surveys, examples, and links to many other sites, compiled by Ted Panitz of Cape Cod Community College. <http://home.capecod.net/~tpanitz>
24. **The University of Minnesota Cooperative Learning Center.** Information and references on different aspects of cooperative learning, including "Cooperative Learning Methods: A Meta-Analysis," which summarizes the results of a large number of CL research studies. The site is maintained by David and Roger Johnson of the University of Minnesota. <http://www.co-operation.org/>