



Applying the 5 Key Elements of Cooperative Learning to Create Better Working Student Teams

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Introduction

Many introductory physics courses now incorporate student in-class teamwork. Commonly these in-class activities can range from Peer Instruction (polling with discussion) to more open-ended activities such actual hands-on activities. However, in many classes, the student teams perform more like teams playing pick-up games of basketball rather than teams that practice working together well.

To create better working teams in introductory Student Centered Active Learning Environment to support Upside-down Pedagogies (**SCALE-UP** physics courses, we applied the five key elements of cooperative learning [1] to develop new types of in-class activities. We have also applied these strategies to the other aspects of the course, including classroom design and classroom management techniques. Although optimized for use in **SCALE-UP** classrooms, many of these developed techniques can be used in many introductory physics and astronomy class environments.



Cooperative Learning: Key Elements

- **Positive Interdependence (PI):** Team members have to rely upon one another.
- **Individual Accountability (IA):** Each member is responsible for doing their own fair share of the work and for mastering all the material.
- **Face-to-face Interaction (FI):** Some or all of the team effort must be spent with members working together.
- **Appropriate Use of Interpersonal Skills (IS):** Members must receive instruction and then practice leadership, decision-making, communication, and conflict management.
- **Regular Self-assessment of team Functioning (SA):** Teams need to evaluate how well their team is functioning, where they could improve, and what they should do differently in the future.

Structured Team Guidelines

- The less structured the activity, the more structured the teams should be.
- Teams consist of 3-4 students each; more students, more likely for some students to contribute to group efforts more and some students to contribute less.[2]
- Mixed ability teams, students from top, middle, & bottom third of class in each team
- Minimize ability differences between teams
- Rotating team roles [2]
 - > Manager
 - > Checker/Recorder
 - > Skeptic
 - > Energizer (if 4 member team)

Cooperative Learning Activities

First Day: Get students used to team work

Guesstimate how many 2-step paces it takes to walk from LA to New York. (PI, FI)

- Students do this first individually, record their results on the wall board (typically $10^4 - 10^9$)
- Then students do this in teams and post results (typically $10^6 - 10^8$)
- Student discussion of advantages of team work vs. individual work.

Brainstorm rules for good team brainstorming (PI, FI, IS)

- Helps students develop guidelines for working together and listening to one another

First Team Assignments and First Contracts:

Students negotiate their expectations of one another. This helps minimize effects of differential effort by team members

Students assigned to first teams (usually 2nd week of term to minimize roster changes) and assigned to make team contract (PI, IA, IS, FI)

- Introduce introduce team contract assignment including examples
- Have students brainstorm ideas for their team contracts and share with class (list of their ideas posted on class website)
- Students submit contract signed by all team members as homework assignment
- Teams with valid contracts eligible for 5% bonus on exams if team average is B or better.
- Team members can be fired for not living up to terms of contract (rare occurrence but fired members must complete all team assignments by themselves)

Example Contract

We agree to:
 1. come to class
 2. Make sure that when we miss class that we contact the others in our group.
 3. That we will work assignments collaboratively
 4. Switch roles per assignment
 5. show up to meetings
 6. complete assignments before group meetings
 7. assist others having trouble with the assignments.

This group contract is binding upon all who sign it and is subject to change with prior approval of all members of the group.

Observations:

- Early on, gender and ethnicity are taken into account when assigning the first set of teams. Women and minorities are assigned so that at least one other member of the team is female or minority respectively. This is done because women and minorities are often not as influential in teams.
 - Student contracts become more detailed later in the term as students get more experience working in cooperative teams. For example, setting up weekly study sessions.
 - When students chose their own teams, exam scores suffered significantly and more teams had trouble completing in-class activities.
 - We found that if students stayed in the same teams all semester, between weeks 8-12 there would be a two-week lull where student performances drops appreciably.
- Our hypothesis: student team members get too comfortable with each other. We recommend changing student teams every 4-6 weeks after midterm exams. Second and third assigned team do contracts as homework outside of class.

Throughout the term activities:

Cooperative Group Problem Solving [2, 3] (PI, FI, IS):

- Students taught to apply problem-solving heuristic to context-rich problems: Gather, Organize, Analyze, Learn

Jigsaw activities:[1] (PI, IA, FI, IS):

Like putting together a puzzle:

- Activity is broken into three parts
 - Teams are redistributed, each part completed by a member of each team.
 - Original groups reconstituted
- Members have different pieces of the activity and must share the pieces to complete the activity

Team Evaluations (IA, SA):

After long open ended activities like Cooperative Group Problem Solving, lab activities, or jigsaw activities, each team member critiques:

- The team's performance
- How well each team member performed in their assigned roles
- How the team can work better together next time

Classroom Encourages Teamwork



Coming into a **SCALE-UP** rooms, students expectations are open to possibilities beyond lecture. Research on table size and shape found that circular tables maximized interactions between team members and between teams.

- Numbered tables; 3 teams per table labeled A, B, and C
- Each team has huddle board, laptop, and lab equipment
- Instructor can specify a specific team (3C), divide class into thirds (all A teams do part 1, B teams do part 2, ...), or divide the class in half (even numbered teams do part 1, odd numbered teams do part 2).
- After each activity, student teams present results to class & then lead class wide Q&A

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References

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