Faculty Learning Community
Project Report Summary

Name:	**Dr. Amitabha Ghosh**
Course:	**EMEM 550 – Transport Phenomena**
Project Name:	**Development of Analytical Skills through Cooperative Learning**
Date:	**June 15, 2007**

Problem: Imparting abstract thinking and analytical skills into students has always been a challenging task for me in upper level classes in mechanical engineering. The root of the problem in our students lies in prior knowledge and readiness to learn these skills. This researcher has tried different approaches (including active learning techniques) to motivate students to become self learners. As a result, the dynamics of the classroom did improve. But the students still do not take ownership of the analytical problems.

Goal: To induce ownership of analytical problems in average students several things need to be accomplished early on in the ME curriculum. At this pilot, the objective is to gather some initial data to introduce appropriately designed tasks in future. The benefits of analytical and abstract thinking are enormous. It can

- Strengthen Comprehension
- Avoid Common Misconceptions
- Strengthen Analysis and Synthesis (2 most critical steps in Bloom's Taxonomy)
- Extend Solution Process of Engineering Problems to new and unexplored areas
- Strengthen Formulation Skills for Engineering Problems
- Foster Lifelong Learning in our students

Target Students: 4^{th} and 5^{th} year students in Mechanical Engineering

Hypothesis/Proposed Solution: At this pilot, the hypothesis was that dividing students into groups of 4 and giving them challenging problems would induce cooperative learning and ownership of analytical problems. Furthermore, discussion among group participants and groups teaching each other would assist comprehension of difficult topics. The following conditions were already satisfied:

- Total of 9 groups (of 4 students each)
- Groups were all balanced with group strengths in 3 different important areas
- A complete set of class-notes were already available on line (www.rit.edu/~angeme/550cd), and class discussions provided needed scaffolding
- After topics were introduced, students were given reading assignments and homework problems for inducing cooperative learning
- Common errors in individual work were corrected and hopefully understood better due a set of 9 class quizzes which were returned within 72 hours for a quick feedback

Progress Point: The course has never been taught in a group fashion. Focal point in the course was the Quiz No. 9. This quiz was the culmination of student work in the form of an Original Problem Posing in Transport Phenomena. Students were asked to record the original level of their understanding and changes resulting from group discussions and the evolution of the solution, demonstrating their understanding of course topics. The winning entry of the project was chosen as Quiz No. 9. The performance in the project and the quiz were tabulated and shared with the class.

Successes: Improved Home Work Performance
Improved Quiz and Test Performance
Ingenuity and Innovation in Quiz No. 9

Obstacles: Temptation to work independent of the group
Fear of losing ones edge and be treated same as others in the group
Competition can hinder motivation, but hopefully challenges will induce enough motivation to overcome the fear of loss. To reduce tension, the grading pattern has been changed from relative grading to absolute grading based upon quality of work.

Surprises: Improved class attendance
Dynamic classroom

Comparative Results: Prior years' course evaluation

Assessment: 9 Homework Assignments
9 Quizzes
2 Midterm Examinations
1 Comprehensive Final Examination
Outcomes of Quiz No. 9

Future Study: Extend this experience in a new elective course – Creative Fluid Mechanics, Group Analysis of Thermofluids Courses and Other Core Groups in ME

Resources – Faculty/Student Advisors: Prof. James Heliotis (CAST)
Prof. Carl Lundgren (CAST)
Prof. Elizabeth DeBartolo (KGCOE)
Prof. Edward Hensel (KGCOE)
Prof. Steven Weinstein (KGCOE)
Prof. Raluca Felea (CAST)
Courtney Walsh (ME)

Resources – People: Cortney Ross (ME)
Chris Natoli (ME)
Nathan Boyer (ME)

Resources – Conferences: **2006 Lilly Conference, Miami University**

1. Using Cooperative Structures to Promote Deep Learning – Barbara Millis
2. Using the Kolb Learning Style Inventory for Deep Learning – Laura Border
3. Top 14 Strategies to Measure Teaching Effectiveness – Ron Berk
4. Cognitive Apprenticeship in the College Classroom – Jim Eison
5. How Students Learn: Strategies for Teaching from the Psychology of Learning – Todd Zakrajsek

Resources – Readings:

1. A. B. Arons: A Guide to Introductory Physics Teaching, John Wiley.
2. R. M. Felder and R. Brent: Cooperative Learning in Technical Courses – Report
3. A. W. Chikering and Z. F.Gamson: Seven Principles for Good Practice in Undergraduate Education
4. T. A. Angelo and K. P. Cross: Classroom Assessment Techniques, Jossey-Bass.
5. R. W. Grossman: Discovering Hidden Transformations – Making Science and Other Courses More Learnable, College Teaching, Vol 53, No. 1.
6. A. Collins, S. Brown and A. Holum: Cognitive Apprenticeship, Making Thinking Visible, American Educator, Winter 1991
7. William Perry: Perry's Intellectual Scheme – Chapter on Understanding and Applying the Cognitive Development Theory
8. R. J. Kloss: A Nudge is Best, College Teaching, Vol 42, No. 4.

Appendices:

1. Transport Phenomena (EMEM 550) – Course Handout

2. Class Project Handout