Creating and Managing Successful Groups

John Sangster

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Creating and Managing Successful Groups

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Assistant Professor, Department of Civil Engineering
University of Nebraska at Lincoln
March 30, 2017
Content for Today

• Why is group work an essential component of our classes?
• What are the standard practices in forming groups, and what are the outcomes from this practice?
• What does the research say about forming successful groups?
• Case Study: group work in senior-level road design course
Working in Groups as Civil Engineers

Scholarship Imitating Life

• The Accreditation Board for Engineering and Technology (ABET) sets required skills for engineering graduates, commonly referred to as “a-through-k”
Working in Groups as Civil Engineers

Scholarship Imitating Life

• Some parts of ABET “a-through-k” are straightforward:
  • (a) an ability to apply knowledge of mathematics, science, and engineering
  • (b) an ability to design and conduct experiments, as well as to analyze and interpret data
  • (c) an ability to design a system, component, or process to meet desired needs with realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
  • (e) an ability to identify, formulate, and solve engineering problems
  • (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
Working in Groups as Civil Engineers

Scholarship Imitating Life

• Other parts of ABET “a-through-k” are harder to implement in a classroom environment:
  • (d) an ability to function on multidisciplinary teams
  • (f) an understanding of professional and ethical responsibility
  • (g) an ability to communicate effectively
  • (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and social context
  • (i) a recognition of the need for, and ability to engage in life-long learning
  • (j) a knowledge of contemporary issues
Group Formation Standard Practice

• Most group projects start in a familiar way:

  • Step 1: Students form their own groups
  • Step 2: Remaining students are assigned groups at random
Typical Group Process

• The process for completing the work also follows a familiar pattern:

  • Step 1: One person takes leadership of the group, and splits the work into equal parts.

  • Step 2: The day before it’s due, everyone sends back what they’ve done on their part.

  • Step 3: The person in charge sees that the work done by their peers is unusable, and completes the project by themselves.
Typical Group Results

• From the department’s perspective:
  • A satisfactory project is submitted
  • Everyone in the course receives good marks
  • The department can demonstrate to ABET that the goals are being met

• From the student’s perspective
  • Student resentment due to unequal efforts
  • Only some of the students have achieved the learning outcomes
Typical Group Results
From Teaching Assistant Experience
Literature on Group Work
Engineering-Specific Resource

  
  • Chapters of interest on this topic include:
    • 8: Problem-based and Project-based Learning...
    • 10: Curriculum Design in the Middle Years
    • 20: Research-guided Teaching Practices...
    • 24: Studying Teaching and Learning in Undergraduate Engineering Programs...
    • 29: The Science and Design of Assessment...
Literature on Group Work
Selected Reading


Case Study
Context

• Speaker appointment is 30% teaching, with a load of one course per semester (for now)

• Courses taught thus far categorized as “design” technical electives
  • Senior/graduate overlap
  • Significant project components with groups arriving at unique solutions
  • Hands-on with standard software used in consulting
Case Study
Context

- CIVE 462/862 – Highway Design
  - Five individual homework assignments
    - Median time spent per person (on all five): 21 hours
  - Six group project assignments
    - Median time spent per person (on first four): 22 hours

- CIVE 463/863 – Traffic Engineering
  - Eight individual homework assignments
    - Median time spent per person (on first five): 20 hours
  - One group project assignment
    - Median time spent: unknown
Case Study
Context

• CIVE 462/862 – Highway Design Projects
  1. Identify problems around town (intersection, interchange, and roadway alignment)
  2. Redesign of interchange using planning-level analysis tools

Roadway Alignment Project

  3. Horizontal alignment
  4. Vertical alignment
  5. Cross-sections and limit of work
  6. 30% completion plan set
Case Study
Outcomes of Group Management

• By making informed decisions when creating groups, we can:
  • Maximize the percentage of successful groups

• By helping manage the time spent during the project we can:
  • Maximize the learning outcomes of each student in the class
  • Minimize the percentage of imploding groups
  • Calibrate both student efforts and project scopes
Case Study
Group Formation

• We hold these truths to be self-evident... that **not** all students are created equal!

• That all students have unique goals in the class
• That all students have unique time commitments outside of class
• That all students have unique background experience related to the topic
Case Study
Group Management Software

• Preferred group management software: www.catme.org
  • 28 parameters to choose from
  • Weighted as similar or disparate for group formation
  • Ability to pair or separate students/groups
  • Recently introduced a fee to use
### Case Study

**Group Management Software**

- Sub-set of 8 parameters chosen for Highway Design class

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(Showing percentage of students busy by hour)

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<td>9%</td>
<td>3%</td>
<td>5%</td>
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### Case Study

**Group Management Software**

- Group formation can be re-run multiple times. Produces slightly different results each time and can be fine-tuned.

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<th>GPA</th>
<th>Schedule</th>
<th>Pct Busy</th>
<th>Credits</th>
<th>Year</th>
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<th>Software</th>
<th>Writing</th>
<th>Commitment Lvl</th>
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- GPA: Grade Point Average
- Schedule: Weekly meeting schedule
- Pct Busy: Percentage of busy hours
- Credits: Total credits for the course
- Year: Year of study
- CIV Sub: Course in view
- Software: Level of software used
- Writing: Level of writing proficiency
- Commitment Lvl: Level of commitment
- Tot (Max 25): Total score out of 25
Case Study
Ongoing Group Management

• Setting groups up to be successful isn’t the end of the story, it’s the beginning

• Six one-week-long projects over the duration of the semester.

• The same groups throughout, with projects building on one another.
Case Study
Group Management - Time

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<th>Spring '14</th>
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**Group Estimated Workload for Project**
- Organizing: 0.25 hrs leading, 0.75 hrs supporting
- Site Visit: 27 hrs leading, 61 hrs supporting
- Drafting: 4 hrs leading, 4 hrs supporting
- Write-up: 4 hrs leading, 4 hrs supporting

Total: 36.25 hrs leading, 89.75 hrs supporting

**Draft Individual Workload Assignment for Project**

<table>
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<tr>
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<th>Organize</th>
<th>Train</th>
<th>Site Visit</th>
<th>Drafting</th>
<th>Write-up</th>
<th>QA / QC</th>
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**Supporting Hours**

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*Site Visit depends on time scheduling and availability of funding.*

**Post-Project Recording Worksheet - Group**

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**Individual Hours Spent on Project**

<table>
<thead>
<tr>
<th>Group Member</th>
<th>Organize</th>
<th>Train</th>
<th>Site Visit</th>
<th>Drafting</th>
<th>Write-up</th>
<th>QA / QC</th>
</tr>
</thead>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>2</td>
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<td>0.5</td>
<td>1.5</td>
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<tr>
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<td>0</td>
<td>0</td>
<td>2.5</td>
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</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1.5</td>
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</tr>
</tbody>
</table>

**Supporting Hours**

<table>
<thead>
<tr>
<th>Group Member</th>
<th>Organize</th>
<th>Train</th>
<th>Site Visit</th>
<th>Drafting</th>
<th>Write-up</th>
<th>QA / QC</th>
</tr>
</thead>
<tbody>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
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</tr>
<tr>
<td>4</td>
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<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Group Hours Spent on Project**

| Organizing | 0.5 hrs leading | Training | 0 hrs leading |
| Site Visit | 0 hrs leading | Drafting | 6 hrs leading |
| Write-up   | 8 hrs leading | QA / QC | 1.5 hrs leading |

Total: 16 hrs leading, 2.5 hrs supporting
Case Study
Management – Formative Feedback
Case Study
Outcomes – Calibration Needed
Case Study
Outcomes – Calibration Needed

Project Management Warning Signs

- Project 1
- Project 2
- Project 3
- Project 4
- Project 5

Time Spent by Individual Member

Average Time Per-Person in a Given Group
Case Study
Outcomes – Calibration Needed

![Graph: Personal Time Allocation vs. Time Spent on Software](image)
Case Study

Issues on the Table

• This data has thus far been utilized for formative feedback within the classroom setting.
  • It is time consuming, and provides good results, but the return on investment is questionable.

• How to leverage this information to generate papers and proposals?

• If not publishing pre-tenure, how can future data needs be anticipated so that post-tenure publications can incorporate multiple years of data?
Classroom Management
Random Data Results

Self-reported Time Spent by Category - Sorted by GPA Outcome
(Sample Includes 23 Domestic Undergraduate Students enrolled in CIVE 462)
Classroom Management
Random Data Results

**Hours/Credit Spent Outside of Class**
*(Sample Includes 23 Domestic Undergraduate Students Enrolled in CIVE 462)*

- × Technical (Median=1.7)
- ○ Non-technical (Median=0.7)

**GPA (self-reported)**
Classroom Management
Random Data Results

Amount of Time Invested versus Grade Received

Hours Invested in Course

Grade Received
Classroom Management
Random Data Results

Diagram showing various metrics such as Faculty Overall, Faculty is Accessible, Faculty is Prepared, Faculty Provides Feedback, Faculty is Enthusiastic, Good Use of Class Time, Students Feel Motivated, Students Feel Respected, New Concepts Explained Well, with data for different courses in 2017S, 2017F, 2016S, and 2015F.
Next Steps
Leveraging Content Mastery

• Draft syllabus prepared for: Foundations of Engineering Pedagogy
• Topics include:
  • History of Engineering Education
  • Motivation in Education
  • Learning Theories
  • Active Learning Strategies
  • Learning Styles, Individual Cognitive Development
  • Problem and Project Based Learning
  • Learning in Groups and Communities
  • Assessing Learning
  • Technology and Learning
  • Engineering Design
  • Freshmen to Seniors, and Everything In-between
  • Improvement in Engineering Education (and Barriers)
Next Steps

Formalizing Group Management Architecture

• Potential to formalize the group management work that I’ve done in a number of formats.
  • Projects are based on specific site, but with (a fair amount of) work could be generalized for any site.

• Formal lab book with the step-wise instructions.
• Applied textbook on the topic of the course, featuring a template for extensive project work in the class.
• Conference publications on outcomes from the methodology.

• None of this seems right for pre-tenure pursuit.
Next Steps
Leverage other classroom innovations

• Potential to leverage the “talking points” method I use for classroom active/passive engagement.

• Daily handout with a series of questions tied back to lecture slides that go beyond the content and seek the “why is this important” or “how is this applied in the real world” type knowledge.

• Reminds me to pause periodically during lecture.

• Lets students know that some interaction is expected every few slides.

• Gives students opportunity to anticipate question, and compose response ahead of time.
Next Steps
Leverage other classroom innovations

• Talking Points applications:

• Potential funding proposal to study impacts of passive classroom engagement.

• Examine contributing factors to learning outcomes of class:
  • Level of engagement with written (un-graded) handout.
  • Level of engagement with verbal communication.
  • Stated intention for engagement with course.
  • Standardized test scores.
  • Overall GPA coming into the class.
  • Etc.
Questions? Collaboration? Contact any time!

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