



A 12-Year Journey into Cooperative Learning Methods in a Large Organic Chemistry Class

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Overview

- Starting in 1993, we began to apply cooperative-learning methods in a large class of prepharmacy and pharmacy students.
- Ideas “matured” by 1997
- Continued “tweaks” and assessment efforts to the present
- This talk presents—
 - the methods used
 - assessment of attitudes and effects



The Challenge

No additional resources available!

The Message

Many cooperative-learning elements can be introduced into a large organic chemistry class without a large increase in resources.

This approach has benefits for a significant number of students.



Preliminary Data (1993)

- Control (lecture, 185 students) and study-group (SG) section (40 students) were taught.
- Students in two sections were cross-paired by three criteria: gender, grade in general chemistry, and pharmacy status
- Students were integrated into one large lecture course (MDCH 205) in the *following semester*.



Preliminary Data (1993)

2nd Semester (S1994), taught by others

Grade	Study-group students	Other students
%A	34	16
%B	34	47
%C	29	25
%D	2.9	1.2
%F	0	1.8
Avg points	402	376 ($\Delta = 26$)

Point spread = 392 ($100\Delta/392 = 6.7$; about 0.5 LG)



Evolution

(We describe 2006, 2008, 2009 aggregate data)

Class composition and methods used were stable by 2006.

- Composition of class
 - 230–310 prepharmacy students (and a few others)
 - 69% female, 31% male
- GPA prerequisites
 - No one admitted with $\text{GPA} < 2.5$
 - No one admitted with standing Ds or Fs in general chemistry
 - Avg GPA ≈ 3.4 – 3.5



Elements of Our Approach

- Class seated in groups of 4–5
- In-class problems (2–5 per class)
 - Can't cover everything
 - Students would rather that you lecture
- Think/Pair/Share (Felder BCCE 19)



Elements of Our Approach (contd)

- Study-group exercises for extra credit
 - More sophisticated problems that require discussion
 - One group paper
 - First exercise is a group contract
 - Everyone in group starts out with the same credit
 - Mutual evaluation at the end of the course determines group grade.
- On-line homework for extra credit (collaboration allowed, but a majority worked alone)

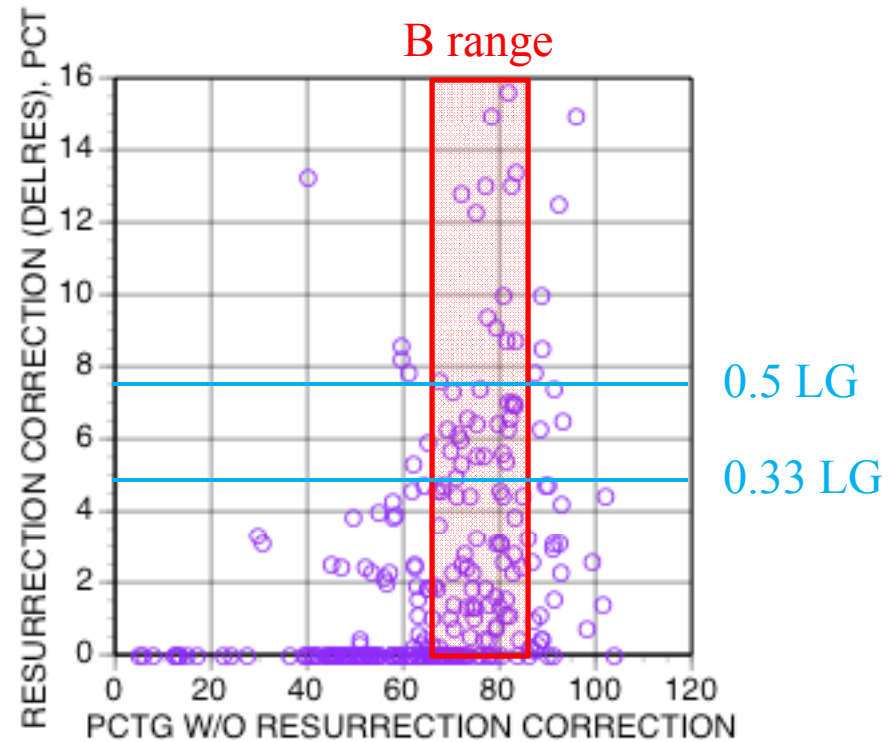
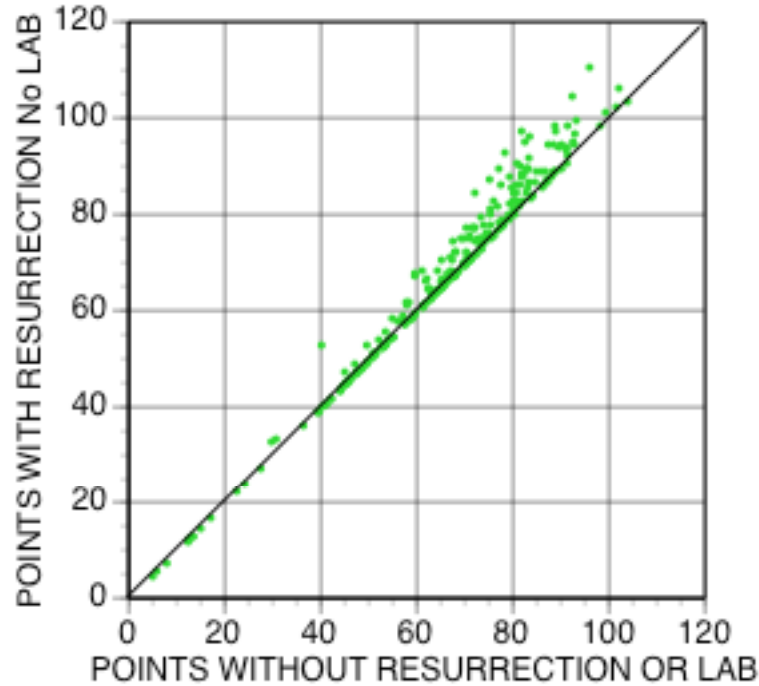


Elements of Our Approach (contd)

- Hour Examinations
 - 50–55% individual, 45–50% group
 - Students can collaborate on group part but must answer it individually
 - The group part requires short discussion
- Weekly quizzes are individual
- Final exam is individual. *The Resurrection Effect applies!*



The Resurrection Effect: Whom Does It Help?



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LG before final	Avg. (per student) Resurrection Effect, $\Delta\text{Pct} \pm \text{S.D.}$	No. with LG after Final
A ($N = 41, 16.9\%$)	3.9 ± 4.0	$N = 68, 28.0\%$
B ($N = 98, 40.3\%$)	3.4 ± 3.8	$N = 80, 32.9\%$
C ($N = 64, 26.3\%$)	1.5 ± 2.2	$N = 57, 23.5\%$
<C ($N = 40, 16.5\%$)	1.4 ± 2.4	$N = 38, 15.6\%$

(Data from 2009)



Formation of Groups

- Groups of 5
- Use “tennis seeding” approach
 - Sort class into 3 groups: top 50, lowest 50, middle 150 (for a class of 250)
 - Each group contains 1 top, 1 lowest, 3 middle
- No groups with 4 males/1 female
- Racial diversity



The Class from Hell

- Classes take on individual characteristics.
- We had a class in one year that “gamed the system” and cheated so frequently that this experiment failed.
- This class proved to be unique.
- The message: Don’t be surprised or discouraged if this happens occasionally.



Performance vs. Group Experience; How student grades are reported

- Students reported their grades on survey prior to final.
- Students receive points for survey; 93% response.
- Comparison of student-reported grades and actual grades at the same point for students who took survey:

Grade	Actual No.	%	Reported No.	%
A	89	13.3	102	15.2
B	255	38.1	274	41.0
C	208	31.1	221	33.0
D/F	117	17.5	72	10.8
Total	669	100.0	669	100.0

2006–2009 aggregate data



Performance vs. Group Experience: How study-group functionality (SGF) is reported

1. Highly functional and useful
2. Functional and somewhat useful
3. Functional but not very useful
4. Not very functional and not very useful
5. Essentially dysfunctional and useless



Performance vs. Study-Group Functionality (SGF): (Aggregate data 2006–2009)

N (total) = 669

Note: Grades are reported as A = 1, B = 2, C = 3, etc.

SGF	N	Avg RG \pm SD	SGF	N	Avg RG \pm SD	Δ (RG)	p
1	142 (21%)	2.20 \pm 0.83	≥ 3	181 (27%)	2.58 \pm 1.06	0.38	< 0.001
1 or 2	488 (73%)	2.38 \pm 0.92	≥ 3	181 (27%)	2.58 \pm 1.06	0.20	0.01

The effect is likely underestimated because of grade decompression caused by the Resurrection Effect.



Performance vs Prior Grades: No correlation of Study-Group Functionality with prior grades.

(Students “binned” prior grades on course survey; “bins” are 0.3 GPA wide; lower grades are better.)

SGF	<i>N</i>	Avg. Prior GPA	Avg. Prior Chem GPA
1	142	2.03 ± 1.12	1.99 ± 1.10
1 or 2	488	2.01 ± 1.11	1.99 ± 1.15
≥3	181	1.98 ± 1.18	1.86 ± 1.16

Correlation is—

- Not statistically significant
- In the wrong direction



Students' Perception of Their Role in Study Groups

Role	N	Study-Group Function =			Total
		1	2	≥ 3	
Teacher	193 (28.9%)*	19.2%	46.1%	34.9%	100%
Active	355 (53.1%)*	25.1%	55.5%	19.4%	100%
Passive	102 (15.3%)*	14.7%	49.0%	36.3%	100%
Total	650 (97.3%)*				

* % of total respondents, 2006–2009



Student Attitudes about “Goldbrickers”

The question: I believe that it is possible for someone to pass this course merely by “sponging” off of other group members. (5,4 = strongly agree, agree; 3 = not sure; 2,1 = disagree, strongly disagree)

Sponging Response	N (%)	Reported Grade \pm SD	Δ (RG)	<i>p</i>
4,5	156 (23%)	2.08 \pm 0.83	0.47	<0.001
1,2	418 (63%)	2.56 \pm 0.98		

- 37% of “group teachers” agree; 18% of “non-teachers” agree.
- 46% of those who agree identified themselves as “teachers.”
- No gender effect on this attitude.



Would Students Like to Have More Classes Using Study Groups?

Year	% Agree	% Disagree
2006	68.3	14.6
2008	59.5	15.3
2009	52.6	22.4
Aggregate	59.8	17.5

- 50.8% of “group teachers” agree.
- 23.8% of “group teachers” disagree.



Conclusions

- A study-group format has been developed for a large organic chemistry class and has been practiced for > 12 years.
- The practices described do not require additional resources.
- Study-group functionality correlates with reported course performance. The effect reported may be smaller than the real effect.
- Study-group functionality does *not* correlate with overall GPA or chemistry GPA.
- About 60% of students indicate that they would like this format for future classes; 18% indicate that they would not like this format.
- Students who identify as “group teachers” are somewhat less satisfied with the class format.
- High achievers more than others believe that it is possible to pass the course by “sponging” off of group members.

