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“The chief wonder of education is that it does not ruin everybody concerned in it, teachers and taught, alike...”

- Henry Adams

Harvard Class of 1858



Peer-Led Team Learning Workshops: Development and Implementation at the University of Rochester

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Problems in Teaching and Learning

- Passive learning environment
- Hard to engage with students
- Conceptual thinking can get lost
- Hard for students to engage with each other
- Hard for students to integrate
lecture, lab, recitation, & solo study
- Students get lost and/or lose motivation
- Retention can be an issue



Background Thoughts: How Do Students Learn Best?

- Early studies: matched high school students going to matched colleges displayed widely varying success upon graduation – why?
- Correlation: successful students tended to study together in small groups, while less successful students did not.
- Inference: such small-group cooperative approaches are valuable because of increased *engagement* with material (*active learning*).

Thus Were Workshops Born...

- Large introductory level lecture courses presented great challenges in overcoming “passive learning”.
- So, organized smaller study groups were formed, to tackle and re-organize text and lecture material.
- These functioned better with someone to guide them – a graduate TA, a senior undergraduate, perhaps a faculty member – relying on innate experience and subject knowledge.
- Sessions improved using designed “group-work” (PBL, case-studies, etc.) rather than when they were just used to answer homework problems.

Definitions of “Workshops” Differ, But Generally Include:

- Small assigned groups of 6-10 students
- Regularly meeting outside of lecture time
- Actively engaged in group problem solving

With optional components such as:

- Thoughtful tested “group-work” sessions or case studies, integrated with course
- Supervision/guidance by peer-leaders or senior personnel (TAs or faculty)

What Do They Do?

- Problems are at higher level than usual homework problems, tend to be integrative.
- Subgroups within each group can work on problems.
- Groups propose and discuss various solution strategies or make decisions.
- Leaders guide the process.

What Workshops Are



- ⊘ Homework Help
- ⊘ Exam Reviews
- ⊘ Recitations
- ⊘ Mini-Lectures
- ⊘ Supplemental Instruction
- ⊘ Remedial Support

If Workshops Are So Good, Why Aren't They Everywhere?

- Small groups on their own rarely gel
- Problems, PBL exercises, or case studies are difficult to prepare
- Where groups have assigned leaders, they are often minimally trained (if at all)
- Few faculty are up-to-date on effective new developments in the field of education

Teachers Tend to Be Made in Their Own Image

- Few academics at the college level have actually had formal training in how to teach, other than learning by observation of others.
- Our students, at most levels, including those who are marshaled out to help teach in our courses, face the same disadvantage.
- In both cases, those who come to excel usually excel at lecturing in classrooms, perpetuating the status quo.

But Teachers and Peer-Leaders are Made, not Born...at the U of R

- What if leaders were trained by a mentoring model, rather than by a lecturing model?
- If, rather than following the dictates of a monolog, a dialog was established between mentor(s) and mentee?
- What if faculty were willing to learn new approaches from the professional learning specialists who exist on most campuses, though generally in subsidiary roles?

The Essential Elements of Workshops

- A subgroup of 6-10 students taking a course, and
- One student Workshop Leader, who has taken the course before and is trained and supported in group activities.
- This group meets every week for two hours.
- With guidance from well-trained Leaders, they address challenging problems developed by the instructor.
- The material is integrated into and coordinated with the lecture course.
- Workshop rooms are conducive to discussion and interaction

The U of R Workshop Program



A national leader in student-led problem-solving groups



The U of R Workshop Program

- Began with pilot programs in 1995 in chemistry
- Funded by NSF as part of a nationwide PLTL effort
- Has now expanded into 8 different departments
- More than 20 different courses and 15 faculty
- Over 150 Leaders and 2500 students annually
- Supported by Dean Vicki Roth and two other staff in the Learning Assistance Services unit
- Coordinated by an informal interdepartmental group of faculty and learning specialists
- The University of Rochester has become a national leader in development and implementation

What Courses Use Workshops at Rochester?

Biology 110 [6]

Chemistry 131[2], 171Q [3], 172Q [3], 173Q [2], 203 [9], 204 [7],
205 [6], 206 [5]

Biochemistry 250 [4]

Computer Science 171 [4], 172 [5]

Electrical and Computer Engineering 210 [1]

Economics 108 [1], 236[1]

Physics 100 [1], 113 [6], 114 [6], 121 [4], 122 [3], 141 [1]

Mathematics 162[1]

23 Faculty

[n] = # years given



A Typical Workshop at the U of R



- A measure of success: Who is the leader?

The U of R Workshop Program

- Supports large enrollment introductory lectures
- Broken into small Workshop groups (8-12 students)
- Cooperative problem-based learning/case studies
- Peer-led by students who have taken the course
- Partnership with learning specialists
- Leaders trained by faculty and learning specialists
- Training course and lecture course are concurrent
- Leader learning is therefore iterative
- Training sessions are both topical and pedagogical

What Contributes to Our Success?

- Integration of Workshop material with the course objectives and approaches
- Co-equal partnership between participating faculty and learning specialists
- A credit-bearing course for leader training (1½ hours weekly) that complements the paid efforts of leaders to run their weekly two-hour Workshop sessions
- This course integrates pedagogical and topical material equally,
- And thus provides iterative experience for the Workshop leaders on specific weekly themes

Synergy Plays a Large Role in Successful Workshops



Why is Leader Training Important?

- If leaders aren't effective, Workshops seldom succeed
- The Workshop is often a leader's first professional responsibility
- Group facilitation is not intuitive
- Without training, leaders “stand and deliver” rather than guide

Leaders: Carefully Selected, Carefully Trained



- A partnership between Learning Assistance & departments
- Weekly course session
- Half devoted to course content
- Half devoted to pedagogy & teamwork
- Leaders are the heart of the model
- Leader training is critical to leader success
- Partnership is critical to leader training



The Leader Training Course

- A Partnership* -

- Allotted 1 Workshop Leader/20 enrolled students
- Weekly meetings (1½ hrs) between the leaders, the faculty member, and the learning specialist
- 50% is spent debriefing the previous week's workshop and troubleshooting the next one.
- 50% is spent examining and discussing current theories in teaching and learning
- An on-line dialog (WebCT) with each individual leader supplements class discussions
- A weekly pedagogical theme focuses leaders on particular aspects of group learning each week

Sample Topics in Leader Training

- Multiple intelligences (Gardner)
- Motivation (Deci & Ryan)
- Stages of learning (Perry)
- Styles/taxonomies of learning (Bloom, Fink)
- Reflective questioning (King)
- Metacognition (Rickey & Stacy)
- Misconceptions (Comins)
- Diversity/Inequities (Staples)

The Research Topic

In addition to formal weekly sessions, the Workshop leaders also must undertake an original research study, often in groups of 2-3. Topics have included:

- Influence of Gender in Leader-Student Interactions
- Varied Approaches to Learning Chirality
- Memorization within Multiple Intelligences
- Studying in Song: Development and Importance of Musical Intelligence
- Effect of Learning Style on Workshop Usefulness
- External Factors Affecting Intrinsic Motivation
- The Jigsaw Technique Applied to a Pair-based Workshop
- Effectiveness of Cooperative Examinations

Research on Education

The research component of our leader training course enhances the pedagogical knowledge acquired by our Workshop leaders. Their initiation and implementation of projects

- (a) contributes to their experience
- (b) reveals insights into our understanding of teaching and learning
- (c) adds to their awareness of the value of research in education
- (d) helps validate the importance of assessment.

First Workshop Data:

Fall 1995 Organic Chemistry CHM 203

GPA Workshop n = 187	2.64
GPA Recitation n = 159	2.15
	sig. (2-tailed) .002

CHM 203 Organic I - Extended study

1992 - 1999 (exl. '95)	Mean total points	Success \geq C-
Workshop n = 1215	557.8 SD 132.7	77%
Recitation n = 942	474.7 SD 129.7 p<.01	66% p<.01

- Same instructor
- Equivalent exams
- Control for prior ability

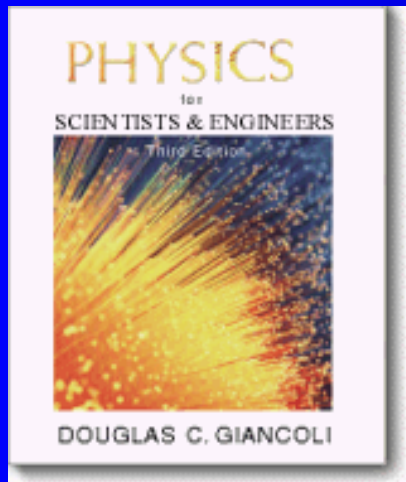
Tien, Kampmeier, & Roth (2002). Implementation of a peer-led team learning instructional approach in an under-graduate organic chemistry course. *Journal of Research in Science Teaching*. 39, 7, 606 - 632.

Physics 114 General Physics

1999 split class experiment:

41 students assigned to workshops

110 assigned to recitations



B- or better →

>5 workshops = 93%

recitation+(<6 workshops) = 63%

BIO 110 General Biology

Success and Retention analysis, \geq C-

2000, 2001,2002	Minority	Majority	Female	Male
Workshop	73%	91%	88%	90%
	n = 51	n = 339	n = 298	n = 188
Recitation	55%	78%	75%	74%
	n = 42	n = 277	n = 192	n = 200
	p < .10	p < .01	p < .01	p < .01

Students Value Workshops

1998-1999 Student Assessment of Learning Gains survey, CHM 203 n = 282
1 - 5 scale

Survey item: How much did each of the following aspects of the class help your learning?	M
1. Workshops	4.4
2. Workshop problems	4.4
3. Text readings	4.2
4. The previous exams	4.2
5. Quality of contact with the Workshop leader	4.0
6. Working with peers	3.9
7. The way this course was taught overall	3.9
8. How the lecture, reading, problems, & WSs fit together	3.8
9. Personal support of the Workshop leader	3.7
10. Text problems	3.7
11. Quality of contact with teacher	3.5
12. Lectures	3.3

Tien, Kampmeier, & Roth (2002).

Implementation of a peer-led team learning instructional approach in an undergraduate organic chemistry course. *Journal of Research in Science Teaching*. 39, 7, 606 - 632.



Advantages To Workshop Students

- Chances to:
 - Reflect, share, present, and defend proposed solution strategies and answers,
 - In a comfortable, non-evaluative atmosphere.
- Improved Course Performance
 - Learn and apply varied learning approaches.
 - Increased confidence due to leader support
 - Better grades due to active learning approach
- Learn to work with others
 - Appreciate the value of diverse contributions

Leaders Value Our Workshops

Survey of 200 former UR chem 203 workshop leaders – data organized by Leo Gafney

IMPACT ON LEARNING

For each of the following please indicate the degree of impact on your learning when you were in college. 5= very strong impact; 4 = strong impact; 3 = limited impact; 2 = very little impact; 1 = no impact

	Mean	Rank
Acting as a peer leader for workshops	4.3	1
Studying assigned work alone	4.2	2
Participating as a student in peer-led workshops	3.9	3
Attending lectures	3.8	4
Acting as a recitation leader	3.7	5
Acting as a tutor	3.6	6
Working with a friend, study partner, or small group	3.5	7
Independent projects	3.2	8
Participating in a research project	3.2	9
Participating in a recitation led by a graduate student	2.9	10
Laboratory work	2.9	11
Individual consultation with professors	2.8	12
Receiving assistance from a tutor	2.0	13

Advantages To Workshop Leaders

- Opportunities
 - Learn by teaching
 - Learn about learning
 - Develop leadership skills
 - Work closely with faculty and education specialists
- Results
 - “Issues in Group Leadership” is a 2 credit course
 - Valuable review of course material
 - Receive mentoring of professional behavior
 - Citation for Leadership in Education

Citation for Achievement in College Leadership

This new program (2004) recognizes those students who have developed leadership skills through specific academic study coupled with specific practical application. Students need to complete at least three different leadership experiences. Each leadership experience has two components:

1. An academic course (2 credit minimum) to prepare students for specific leadership work
2. A specific leadership practicum to implement ideas from the preparatory course.

Completion of the Citation will appear as a notation on the transcript.

- From the CCAS (College Center for
Academic Support) web pages

What Investment Does a Faculty Member Make?

- Time:
 - Decide to use Model.
 - Obtain Funding for Leaders and LAS Support.
 - Advertise For and Select Leaders.
 - (Help) Find Rooms for Workshop Sessions.
 - Assign Students to Sessions.
 - Write Workshop Problems.
 - Partner with Learning Specialist to Run Leader Training Course.

What Rewards Should A Faculty Member Expect From Workshops?

- Improved student performance.
- Structured way for students to model advanced and professional behavior.
- Leaders review material and get training (and experience) in leading and teaching.
- Can actually decrease “hand-holding” time while increasing satisfaction.

Recent Developments

- 2003 Leadership Citation approval
 - For student leaders
 - Transcript recognition for leadership study/practice
 - Interdisciplinary
- 2003 Leadership in Education cluster approval
 - For faculty
 - Promotes teacher and faculty development
 - Interdisciplinary
- 2005 Jack A. Kampmeier Fund for Peer-led Workshop Education in Chemistry
 - Promotes development of Workshops
- 2005 Formation of informal Workshop Task Force
 - Coordinates individual efforts, shares information
 - Framework for institutionalization of Workshops

Acknowledgments

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- Tony Olek, Biology
- Ted Pawlicki, Computer Sciences
- Catherine Perez, Learning Assistance Services
- Nirmala Fernandez, Learning Assistance Services

Appendices

- Sample Workshop Questions
- Student Comments about Their Experience
- Selection of Workshop Leaders
- Essential Elements of Workshop Training

A Sample Workshop Question

Three separate transport systems (one of which is a Na⁺-glucose symporter), each with different characteristics, are required for the effective transport of candy-bar glucose from the lumen side (where it is after you eat it) of intestinal epithelial cells, into the bloodstream on the opposite side (where it must be delivered before you get your sugar “high”).

- (a) Diagram the interplay of these three systems, and mention the relevant characteristics of each (active vs. passive transport, and what kind of transporter, i.e. uniport, antiport, symport).
- (b) Describe how they work together to achieve the desired result, including the role of the electrogenic contributions.
[Hint: see Lehninger 4e, Fig. 11-44, p. 405.]

Another Sample Question

- (a) Why is it advantageous that the default mode of prokaryotic gene expression is “on” (vs. in eukaryotes, where it is “off”)?
- (b) Consider an *E. coli* cell that is diploid for the lactose operon (i.e. one chromosomal copy, and a copy carried on the plasmid-like F-factor). Explain why (generally) an operator mutation will be dominant, while a repressor mutation will be recessive, and relate this to cis-acting and trans-acting regulatory elements.
- (c) There are rare inactivating mutations of *lac* repressor that are nonetheless trans-dominant (called $lacI^{-d}$). Explain how this can be accounted for, since mutations that result in protein inactivation are usually recessive.

Some Comments from Physics Students

What are major strengths of this course?

“Workshops” (58 times)

“Workshops good” or “useful” (46 times)

“The workshops and workshop leaders. If it weren't for workshop I wouldn't know anything.”

“Workshops are an awesome teaching tool”

“The lectures do not seem to allow for information absorption. I do all my learning in workshop.”

Comments from SCOQ's - ECE 210

Workshop was
AWESOME!! The
best experience in a
workshop ever!

Workshops and labs
are well integrated.

Workshops were
excellent in
supporting material.

What are the major strengths
of this course?

Workshops. Fair tests and
grading.

Workshops

Workshops are good

Workshops were the one good
thing about this class.

Workshop!!! In class
demonstrations.

Workshop. Labs were decent.

Labs and workshops were very
helpful w/understanding of
material.

What are the major
weaknesses of this course?

Workshops do not need to be 2
hours long.

07.6.14



Motivation studies

- Students' perceptions of their leaders' support of their autonomy --> increases in self regulation.
- Increases in self regulation --> increased grades

Black & Deci (2000).

Overall Results

- Students LOVE Workshops@UR
- Leaders love Workshops@UR
- Faculty (who have used them) like Workshops@UR
- Student performance improved by Workshops@UR.

Leaders are carefully selected, carefully trained



- Leaders are the heart of the model
- Leader training is critical to leader success
- Partnership is critical to leader training 07.6.14

The essential elements of Workshops

- Problem-solving teams of 6 - 10
- 2-hr weekly meetings
- Led by well-trained leaders
- Challenging problems
- Integrated into overall course
- 47 Appropriate space



PHY 114 Workshop

Pedagogy training

Group dynamics	Observation & feedback techniques, rubric development
Team roles: Parker, Belbin	Hands-on learning: Hake, Sharma
Learning styles	Learning taxonomies: Bloom, D. Fink
Motivation: Deci, Ryan, Church, Black	Reflective questioning techniques: King
Algorithmic vs. conceptual learning: Nakleah	Ethics of group leadership
Diversity & cultural competence	Icebreakers
Student development models: Perry, Belenky <i>et al.</i>	Conceptual change models: Posner, Strike, Hewett