Promoting Student Centered Learning with POGIL

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Overview

I. Introduction
II. Sample POGIL Activity
III. POGIL Concepts & History
IV. Our Experiences
V. Using POGIL in the Classroom
VI. Discussion

* All URLs repeated on last slide.

POGIL – Process Oriented Guided Inquiry Learning

- **HOW** students learn is as important as **WHAT** they learn

Process **O**riented

Guided **I**nquiry

Process **O**riented **G**uided **I**nquiry **L**earning

POGIL – PROCESS ORIENTED Guided Inquiry Learning

- **HOW** students learn is as important as **WHAT** they learn

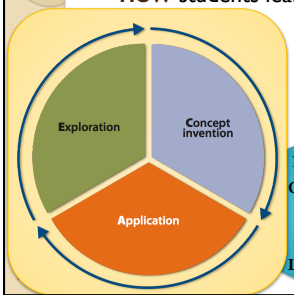
Process **O**riented
(Cooperative Learning)
Conscious commitment to development of important process skills

- Information Processing
- Critical Thinking
- Problem Solving
- Communication
- Teamwork
- Management
- Assessment

Process **O**riented **G**uided **I**nquiry **L**earning

POGIL – Process Oriented GUIDED INQUIRY Learning

- **HOW** students learn is as important as



Guided **I**nquiry
(Constructivism)
Learning Cycle Activities

Process **O**riented **G**uided **I**nquiry **L**earning

POGIL – Process Oriented GUIDED INQUIRY Learning

- Students work in groups
- Activities use Learning Cycle paradigm
- Students construct knowledge
- Students teach/discuss/learn from students
- Instructors facilitate learning

Sample POGIL Activity

1. Form teams of 3-4 people.
2. Fill out header of meeting minutes.
3. Start working through activity.
   (expanded copy is available on request)
4. Raise hand if you have doubts, questions, or meta-questions.

Sample POGIL Activity

Available at www.CSPOGIL.org

POGIL – Process Oriented Guided Inquiry LEARNING

Student

teaching-centered → learning-centered

- Wait passively for direction & information
- All arrive to same conclusion using same process
- Actively construct knowledge
- Gather and evaluate information
- Explore, discover, create unique solutions

POGIL – Process Oriented Guided Inquiry LEARNING

Professor

teaching-centered → learning-centered

- Content expert
- Directly disseminates information
- Source for all answers
- Total control of class
- Expert guide in the learning process
- Provides resources, organization, clear learning objectives
- Supporter, coach, collaborator

POGIL History

- David Hanson, Stony Brook University, 1994
- Originally in chemistry, spreading elsewhere
- Series of 20+ NSF grants
- Regular training workshops
- Useful resources & active community: http://www.pogil.org

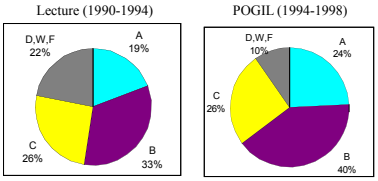
POGIL – Proven Effective

Data from multiple experiments:

- Lower student attrition
- Improved mastery of content
- Improved learning skills
- Better attitude & motivation

Grades Earned – General Chemistry at Franklin & Marshall College

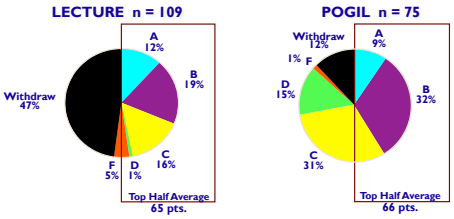
8 years of data (n = 905)



Data from classrooms of Moog, Farrell and Spencer
24 students / section

Farrell, J.J.; Moog, R.S.; Spencer, J.N. *J. Chem. Educ.* 1999, 76, 570.

Final Exam Grades – Organic Chemistry at a Large Public University

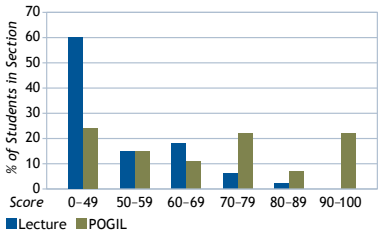


Withdrawals and Common Final Exam Scores - Fall 2000

Retention of Learning – Organic Chemistry at Large Public University

- Lecture vs. POGIL Organic 1
- Organic 2 Pre-quiz Results

Ruder, S.M., & Hunnicutt, S.S. (2008). POGIL in Chemistry Courses at a Large Urban University: A Case Study. In R.S. Moog, & J.N. Spencer (Eds.), *Process-Oriented Guided Inquiry Learning:ACS Symposium Series 994* (pp. 133–147). Washington, D.C.: American Chemical Society.



Where POGIL Has Been Used

- Large universities with hundreds of students
- Small liberal arts colleges
- High schools
- Graduate programs

How We've Used POGIL

- Scientific Computing
- Soft Computing (graduate course)
- CS 2
- Software Engineering
- An activity for one class period in other classes

Scientific Computing

- CS 1 for science majors
- Team taught with chemistry faculty
- Taught in Python, < 20 students
- POGIL activity in every class
- 2 hours classes, twice a week

Scientific Context	Computational Focus
Unit conversions	Introduction to python
Coordinate systems	Writing functions
Newton's method	While loops
Bioinformatics	Sequences
Molecular databases	File input/output
Molecular Modeling	Vector Operations

Scientific Computing

- Every activity includes a pre-activity due at the start of class
- Groups of 2-3 students
- Each activity consists of models with programming examples, critical thinking questions, and programming exercises
- Some team homework
- Some individual homework

Scientific Computing

Computational Focus: Writing Useful Functions

MODEL 1: MATH LIBRARY

In Python's math library, you will find a number of useful predefined functions. To use this library it needs to be imported:

```
>>> import math
>>> x = math.cos(0)
>>> print x
>>> print math.cos(x)
>>> x = math.pi
>>> print math.pi
>>> print math.cos(x)
```

CRITICAL THINKING QUESTIONS

3. Describe two ways using a function from the python math library differs from using one of Python's built-in functions.

TEAM PROGRAMMING:

1. In a file called `12team.py`, define a function called *degrees2radians* that prompts the user for the value of the variable degrees. This value is converted to radians using the following relationship

$$\text{rad} = \frac{\pi}{180}\text{deg} \quad (5)$$

Save the new value in a variable called radians and print a user-friendly statement that specifies both the input angle value in degrees and converted value in radians.

Soft Computing (in India)

- 2009-2010 Fulbright-Nehru Scholar, India
- ~18 master's students
- POGIL was a radical change from lectures
  - Skeptical, then enthusiastic
- Activities presented using PowerPoint
  - Less paper, more flexible, manage pace & "reveal"
- Fluent in English, prefer local language(s)

POGIL reduced language barriers

CS2 (Java), Software Engineering

- POGIL used in ~1/3 of class meetings
- Mixture of activity formats
  - Paper handouts, presentation slides, etc
- Small classes, less formal processes
- Encourages students to collaborate
  - Extra motivation for 8AM classes
- Revised activities available at cspogil.org

Use POGIL as Little as Once

Compilers course:

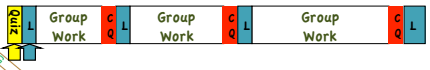
- One POGIL activity on graph coloring
- Students first experimented with a short expression and small number of registers
- Built up to graph coloring approximation algorithm
- No programming in activity

Tips on Using POGIL

- Facilitation is harder than it looks!
- Attend a POGIL workshop.
- Start small & simple
  - Experiment with existing activities
  - Try one POGIL activity
- Take notes on what you do, and where teams succeed or struggle.
- Limit grading – don't try to do too much!

POGIL at a Large Public University

- Retain all lectures but convert recitations with POGIL sessions
- Replace one lecture/week with a POGIL session
- Replace all lectures with POGIL sessions
  - Start with quiz on last session's material
  - Follow-up with overview of previous class



Guided Inquiry for High Schools

- Exploring CS course for 10-12 graders
- Not POGIL, but similar emphasis on guided inquiry
- Entire curriculum available at:

  http://www.exploringCS.org/curriculum

- Each day's lesson includes objectives, teaching strategies, and supplemental resources.

Exploring Computer Science

Regional Workshops

- July 10-12, 2012:
  - Hamden, Connecticut
  - Seattle, Washington
  - Richardson, Texas
  - Salt Lake City, Utah
- July 23-25, 2012:
  - St. Paul, Minnesota
  - Greensboro, NC

Resources

- www.POGIL.org
  - Instructor's Guide to POGIL
  - HSPI Implementation Guide
- www.CSpogil.org
  - CS 1, CS 2, Software Engineering activities
- www.exploringCS.org
- Sign-up sheet to be added to mailing list
- Email us:
  - hhu@westminstercollege.edu
  - clif@kussmaul.org