CS Content Academy: POGIL

Outline

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1. Introduction

What is POGIL?

POGIL stands for Process-Oriented Guided-Inquiry Learning.

POGIL is a team-based, active-learning technique that attempts to engage student's by having them do activities designed to help them master material and develop skills in learning, communication, problem-solving, working with others, and self-assessment of learning.

POGIL attempts to help students develop skills in the learning process as well as master content; hence the process-oriented portion of the name. It does this by having students work in learning teams that follow instructions guiding them through exploration of a topic, solving a problem, or creating an artifact. This accounts for the guided-inquiry learning part of the name.

History

POGIL began in college Chemistry departments in 1994. It was soon funded by the National Science Foundation (NSF), and has been adopted widely in Chemistry departments in the US. Adoption is spreading to the other sciences and engineering.

In Computer Science, teachers at many universities (like JMU) adopted POGIL some time ago. Recently, the NSF has now funded an effort to develop POGIL activities for Computer Science.

Objectives and Process

POGIL is based on five currently accepted beliefs about how people learn best, namely by

- connecting new material to prior knowledge and experiences;
- following a learning cycle of exploration, concept formation, and application;
- using multiple representations of ideas and connecting them in various ways;
- discussing and interacting with others;
- reflecting on their progress and assessing their performance.

POGIL attempts to exploit these learning techniques by having students

- Be actively engaged and thinking in classes and labs;
- Analyze data, construct or explore models, consider examples, build artifacts, and discuss ideas;
- Work in teams to understand concepts and to solve problems;
- Reflect on what they have learned and try to improve their performance;
- Interact with an instructor as a facilitator.

The POGIL process is characterized by the following seven techniques.

Learning teams—Students work in teams of 3 to 5 with well-defined roles and responsibilities.

Guided inquiry—Students follow a script that directs them to consider problems, answer questions, and so forth. Inquiry progresses from consideration of some stated material

(exploration), through extension of the material by problem solving or creative activity (concept formation), to use of the content to solve various kinds of problems (application).

Critical and analytical thinking—Questions encourage critical and analytical thinking in POGIL and are of three kinds: *directed questions* ask students to recount obvious aspects of the material and aim to draw attention to crucial points; *convergent questions* require students to make connections or apply what they have learned in a straightforward way, thus extending and applying their knowledge; *divergent questions* are open-ended and do not have unique answers, thus encouraging students to consider the range and applicability of the new material.

Problem solving—Students solve problems themselves rather than watching teachers solve problems, a more effective way to learn problem-solving.

Reporting—Students present their findings to the class or the instructor, orally, in writing, or both. This provides motivation and build communication skills.

Metacognition—Metacognition is thinking about thinking. Students are asked to manage their own learning, assess their progress, and improve their learning process, making them more responsible for themselves and encouraging them to be better learners.

Individual responsibility—Though students learn in teams, their learning is evaluated as individuals using homework, projects, tests, quizzes, and so forth.

There are **many** ways to realize these seven techniques in specific practices.

Evidence It Works

Many studies (mostly in Chemistry courses) have shown that POGIL is effective. For examples, the following table summarizes three studies of final grades in POGIL-based and lecture-based Chemistry courses.

Experiment	Format	%A	%B	%C	%D, W, F
1	lecture	19	33	26	22
	POGIL	24	40	26	10
2	lecture	20	20	27	33
	POGIL	29	35	24	12
3	lecture	12	19	16	53
	POGIL	9	32	31	26

Curriculum Considerations

POGIL can be and has been used by various instructors

- Occasionally
- Regularly (say once per week)
- Exclusively

POGIL can be used to

- Consolidate or extend material learned outside class (in a flipped classroom)
- Introduce entirely new material that students have never seen before
- Consolidate or extend material from traditional lectures

Challenges

POGIL activities do not cover material nearly as quickly as traditional methods

Writing POGIL activities is difficult and time consuming

Maintaining all the features of POGIL long term is hard

2. A POGIL Activity

This sample activity will illustrate the POGIL process.

Students would normally be assigned a preparatory reading or multimedia assignment (e.g., video lecture) prior to the activity that would introduce them to the topics addressed by the activity.

3. Discussion and Questions

4. Resources

www.pogil.org—Discussion and materials, but rather Chemistry-centric. An excellent guide to writing activities that is really a long explanation and justification of the entire approach.

cspogil.org—Mostly a collection of CS activities.

Various publications listed in the above sites.