Problem-based Learning Boosts Retention and Excitement

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Modern science is not an accumulation of facts. It's the process of solving problems that explain the mysteries of the physical universe.

So, why should much of college teaching be an accumulation of facts memorized from textbooks? Problem-based teaching is a natural way to effectively teach the true nature of scientific inquiry. This teaching strategy is a successful method for training business professionals and reinforcing decision-making skills in attorneys, medical practitioners and policy makers.

What is it?

Problem-based teaching does not use the traditional lecture presentation approach to educating students. It relies on students interacting with each other and faculty in problem-solving situations. The process can be blended together with lecture and laboratory sessions to provide students with a comprehensive understanding of science. Problem-based teaching improves content retention in college sciences students and improves the students' abilities to solve open-ended queries.

Foremost, a successful problem-based activity applies recently-covered information from the lecture and the textbook to a contemporary issue. Later

problems can build on information covered earlier in the course. It can even incorporate the content from prerequisite science classes. Plus, it should require students to investigate some aspect of the scientific method to resolve the problem. The problem should be limited to a small number of variables to reduce confusion and permit students to focus on the main goal without too much distraction. Complex problems can be used as students become proficient at problem solving.

Special considerations

It is important to convey grading criteria to students on the syllabus and project worksheet. Reinforce understanding with a discussion followed by a brief question-and-answer session. It is helpful to provide introductory students with a sample of a good project. This should be delivered before the first hand-in activity is due. Any hand-in work should be evaluated for the accuracy, appropriate focus, breadth of reasoning, clarity and depth of detail.

Under-prepared students

A factor affecting problem-based teaching is the amount of help students receive who are not skilled in the basic college-level reading, math and writing skills required for the problem they seek to solve. Problem-solving activities can be successfully carried out by unprepared students. However, it takes much more intervention by the other students and faculty.

Student maturity

Another factor affecting problem-based teaching is the educational maturity of the students. Students exposed primarily to traditional lecture-based education will find problem-based activities unstructured. They will have difficulty initiating the activities and may even dissent out of frustration. This problem can be handled by providing faculty instruction that directs students through one problem-solving activity.

Students must be reminded not to focus on failure just because the activity appears difficult and insurmountable. Show them that the process is a real-world skill needed for further success in college and accomplishment in their careers.

Problem-based instruction is rewarding—it improves student learning and you are inculcating real-world skills that can be generalized to a variety of situations. Students can work alone or in groups, the projects can be conducted in class or as take-home assignments.

Sample problem-based lesson

A sample problem-based lesson outline is attached.

References

Egan Demers N. 2003. Issues in science and technology: Student-driven inquiry directed by the scientific process. *Journal of College Science Teaching*. 32(5):332-337,

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Paul R. and Elder L. 2002. *How to Improve Student Learning*. Dillon Beach, CA: The Foundation for Critical Thinking.

Sample Problem-based Lesson Outline

This example can be used in college-level biology and environmental science courses for non-science and science majors.

Problem:

- Find a strategy to reduce the probability of global climate change.

Introduction:

- Ask students to research the causes of global climate change.

Background Search:

- Greenhouse gases.
- Greenhouse gas origins.
- Role of greenhouse gases in nature.

Problem Resolution:

- Greenhouse gas reduction.
- Biological uptake of greenhouse gases.
- Chemical uptake of greenhouse gases.
- Mechanical uptake of greenhouse gases.

Experimental Confirmation:

- Design controlled experiment to show that an approach to the problem is feasible.
- Provide expected results to confirm or reject the approach.

Problem Evaluation:

- Design a way to measure the feasibility of a proposed approach.

References

The Power of Problem-Based Learning, A Practical "How To" For Teaching Undergraduate Courses in Any Discipline, edited by Barbara Duch, Susan Gron, and Deborah Allen, Stylus Publishing, LLC (2001), 256 pages
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Chronicle of Higher Education Reading List (4/3/2001): A Practical Guide to Problem-Based Learning

Exploring Quantity Food Production and Service through Problems, 2nd ed. Elizabeth Lieux and Patricia Luoto, Prentice Hall (2000), 134 pages
ISBN 0-13-083534-X, paper, ~$26