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Using Research Projects in Undergraduate Class to Involve Students in Learning

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Since some students may not be interested in the subject material being taught, it is important to engage these students and to help develop an interest. One of the most useful means of developing students' interest on a given topic is to offer them real life experience. Chemistry students were given the opportunity to play the role of a research scientist and develop their research projects. Students were motivated, worked in cooperative groups, and were responsible for their learning. I will present a technique that has been used in my class including data from student surveys. Attendees will learn: 1) how the project was structured, 2) what were students’ perceptions about learning, 3) what were the benefits of teaching using research projects compare to traditional labs. The audience will be invited to share their experiences and ideas. Overall, participants can expect to learn about the importance of introducing research projects in undergraduate education.
Introduction

Two of the five major issues that the 1992 task force of the American Chemical Society Division of Chemical Education defined as central to the reform of chemistry curricula are “teaching science as it is practiced” and “developing more cooperative, interactive models of learning” (1). Furthermore, there is evidence that learning is enhanced as more of the learning stages are being used (2) and according to Dr. Smilkstein the natural human learning stages can be summarized as: motivation, practice, creativeness, refinement, and mastery (3). Using research projects in chemistry class we use all learning stages and offer important collaborative, realistic approaches. Introducing students to the format of a scientific article early in their chemistry education can provide students with an interesting and essential introduction to the discipline (4) and can promote students’ interest in subject and research (5).
A Traditional Experiment or Project versus Research Project

Traditional or verification experiment teach students how to follow experimental directions to confirm knowledge learned during the lecture. Helping students understand lecture material.

Research project or inquiry driven project let the students choose their own procedures and investigate the outcomes. Allowing the students to be responsible for their own learning, finding answers to their own questions, and investigating the outcomes. Illustrating the process of science.
The Purpose of Using Research Projects in Undergraduate Classes is to develop Motivation, Cooperation, and Education.
Realistic Approach to Student’s Research Projects

The research project gave second year Organic Chemistry Lab students at an open access two-year college the opportunity to form research teams, propose small research project of their interest, conduct their own research and write scientific articles. These articles were anonymously reviewed by other students, according to specific guidelines. Reviewers had a choice to recommend the papers for publications with minimal or extensive revision. Responses to the reviewers’ comments were provided and the revised articles were presented to class. Selected articles were submitted to a local conference.
General Structure of the Project

- **Researchers**
  - Literature Review, Writing Summaries
  - Training, Topic Selection
  - Research Proposal
  - Lab Work
  - Writing
  - Rewriting
  - Class Presentation
  - Peer Review

- **Seasons**
  - Fall
  - Winter
  - Winter 2005
  - Spring
As Research Scientists Chemistry Students Could:

• Attend a library research presentation
• Learn about reading and writing scientific articles
• Write article summaries
• Participate in an online session on documentation
• Take an online quiz about plagiarism
• Conduct literature searches
• Develop a hypothesis
• Conduct laboratory research
• Write a journal article
• Submit scientific articles for review
• Revise articles based on advice from peers
• Write a response to the reviewers
• Give a presentation on their project in Organic Chemistry lab
Methods of Assessing Student Learning in the Courses:

- Comparing pre and post surveys
- Analyzing peer reviews
- Analyzing revisions of articles
- Interviewing student focus groups at the end of the courses
- Observing students’ presentation of their research at the end of the course
Chemistry Students’ Knowledge of Subject Matter Increased

- Paper reintegrated student knowledge by connecting chemistry to another subject matter
- Presentations were clear. Students demonstrated deep understanding of the subject matter
- Presentations were engaging and provided enrichment opportunities for other students
- Students were able to correctly answer any questions related to their research
Feedback from Organic Chemistry Students:

- Most of the students felt that they learned a lot in this course and gained the experience in writing scientific articles.
- They realized that conducting a review of literature is essential to developing a hypothesis.
- They noted that the ability to conduct a literature search and use proper English skills were as important as good lab skills.
- Students realized the importance of writing skills in science.
- Students realized the importance of proper documentation and fair use of scientific articles.
- They recommended continuation of this type of project, because it exposed them to the practice of “real” scientists.
Some Students’ Comments on the Question: Would you recommend to do research project in this class in the future?

• “Yes, it applies what knowledge is learned in lab.”
• “Yes, because it gives us an idea what it would be like when we graduate.”
• “It’s a good learning experience.”
• “Yes, most students taking o-chem are majoring in a field requiring frequent scientific writing.”
• “Very beneficial and fun.”
• “Yes, because it gives the student creative control and makes the lab more interesting.”
Lab Work, Presentation, Peer Review, and Conference

Motivate

Cooperate  Educate
Benefits of Teaching Using the Research Project

• Engages the student as a member of a discipline
• Focuses on writing within a discipline as a means of understanding the way of constructing knowledge in the discipline
• Offers students a chance to act as scientists.
• Results in positive student feedback
• Gives a real-world lab experience
• Provides effective learning of scientific method
• Develops critical thinking skills
References


