DOCUMENT RESUME

ED 399 166 SE 058 840

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TITLE Writing To Facilitate Learning in Microbiology.
PUB DATE May 96
NOTE 8p.; Paper presented at the American Society for Microbiology Undergraduate Microbiology Conference (Baton Rouge, LA, May 17-19, 1996).
PUB TYPE Reports - Descriptive (141) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Educational Strategies; Higher Education; Instructional Improvement; *Microbiology; Science Instruction; *Writing Across the Curriculum

ABSTRACT

This paper describes a microbiology course that utilizes writing to facilitate learning of complex concepts, for communicating experimental results, and as a diagnostic tool for the instructor in monitoring the students' understanding of material on an on-going basis. In-class writing assignments that summarize subject units are accompanied by a series of group and individual projects that include writing about how science is reported to the layperson, comparing magazine or newspaper articles with primary journal articles on the same topic, and analyzing and writing about a microbiology topic of choice as presented in the scientific literature. (DDR)

WRITING TO FACILITATE LEARNING IN MICROBIOLOGY

by

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WRITING TO FACILITATE LEARNING IN MICROBIOLOGY
American Society for Microbiology Undergraduate Microbiology Conference
Louisiana State University
May 17-19, 1996

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Traditionally, undergraduate science courses use writing to produce "formal" laboratory reports or papers in scientific style on experiments done in class. Writing, though, is a much more powerful tool. It is important not only for communicating experimental results, but in facilitating learning of complex concepts. It can serve as a diagnostic tool for the instructor in monitoring the students' understanding of material on a on-going basis. In my Microbiology course writing is used in each of these ways. The class begins with an observation and writing exercise. Students write 5-6 "microthemes" in-class, 5-10 minute summaries of subject units, and also out-of-class, individual or group overnight assignments on broad concepts to be covered on exams.

In a series of assignments, the students write about how science is reported to the layperson, and compare magazine or newspaper articles with primary journal articles on the same topic. Finally they analyze and write about a microbiology topic of their choice as presented in the scientific literature.

Used in these ways, writing becomes a means of learning rather than an end in itself.

Although writing-across-the-curriculum has been a part of the academic requirements at many universities for a number of years, this campus came into the writing-across-the-curriculum movement quite late. Because of that, however, we began with a series of retreats--one in my department and several held campus-wide--as a way of getting and sharing ideas. Many faculty hesitated to include more writing than a single paper or formal lab report because of the work involved in grading it. Of all the ideas that were discussed during the writing retreats the one that was most liberating was the notion that all writing does not have to be graded for it to be a valuable aid in teaching.

With this one notion in mind it was possible to be a lot more creative in designing assignments. Reading student writing takes much less line when a grade does not need to be assigned.

In my Microbiology course writing is used as a learning tool more than as an end in itself. My students are mainly microbiology, biology, and biochemistry concentrators. They are usually juniors before they take the course (occasionally sophomores), and, therefore, should have had several courses in biological and physical sciences as well as in composition. The fall term course offering generally has about 40 students; during the double-paced Spring term another 20 students take the course. Variations of several of these writing tools, however, have worked successfully in a much larger (about 90 students) introductory cell/molecular biology course.

Four types of writing assignments are used in the class. The first one is used during the first class meeting as a kind of "ice breaker". With the **Introductory Group Observations** the goals are to introduce the students to the instructor and to each other, to begin group interactions and concensus-making, and to exercise observational skills. Before class, dishes or tubes of differential and selective culture media have been inoculated and incubated under the appropriate conditions with bacteria that cause easy to see color changes. The tubes or plates should be sealed with Parafilm® following incubation to prevent leaking. Alternatively, photographs or color scans of the culture dishes

can be used. The class is divided into groups of three. Each group picks 3 different cultures (or pictures). One person in each group is designated the recorder, one will introduce the group members to the class, and the other reports observations to the class. The group members are allowed about 15 minutes for introductions and writing down individually a description of each of the three cultures. Then each group takes about 5 minutes to agree on a concensus description which the recorder writes down. The group should decide which descriptive details they feel are relevant and which are likely to be inconsequential. One group member introduces each person and the reporter describes the group's cultures. It is good for the instructor to avoid comment until the entire class has finished so that no one is reluctant to discuss their observations for fear they have a "wrong" description.

Microthemes are short writing exercises of no longer than a page in length. They can be done either in class or out of class. Microthemes are used as a means of writing to learn, identification of unclear concepts (on the part of the student and of the instructor), and study aids for exams. They also provide practice in critical thinking and a format for comparing and contrasting concepts. In-class microthemes are used as a means of summarizing in 15 minutes the important concepts that have been covered in a study unit. The instructor should read them and write comments if needed and return them to the students

by the next class meeting. The microthemes are not graded, though a small number of points is awarded if a microtheme is turned in. These summaries can be very helpful to the instructor in assessing whether or not the students understand the concepts that have been presented. They also help the students organize the information they have read and heard. Out-of-class microthemes are assigned at the end of one class period and are due the following class meeting. Group collaborations on these microthemes are encouraged. They often focus on critical thinking or on making comparisons and contrasts of unit topics. Two examples of out-of-class microthemes follow:

> Energy transfer occurs in a variety of cellular activities. Explain how the processes of fermentation, active transport, and chemiosmosis involve energy transfer. Explain how ATP is involved in each process.
>
> Based on what you know about the characteristics, types of metabolism, and by-products produced by the following list of organisms, create an ecosystem in which all could live. You may either write out a description of the ecosystem in paragraph form, or you may put your answer in the form of a diagram. Indicate why you placed the organism in a particular ecological niche by showing what metabolic product(s) or physical conditions (*ie.* sunlight, heat, etc.) it produces or needs for survival.
>
> purple non-sulfur bacteria
> klebsiellas
> purple sulfur bacteria
> green sulfur bacteria
> *Pseudomonas*
> sulfate reducing bacteria
> *Bacillus*
> *Clostridium*
> cyanobacteria
> algae
> yeasts

Again, out-of-class microthemes are not graded. Comments are included where appropriate, and returned to the students the following class period. Each microtheme is the subject of

approximately 10% of the points on course unit exams.

The **Analytical Writing Series** is a more typical use of writing. The aims of these assignments are to encourage the students to read about microbiology critically, and to work on the process of reading, summarizing, and analyzing primary journal articles. Each part of the series is a short paper of 2-3 pages length. In the first assignment in the series students analyze critically an article about microbiology that has been published in the popular press (non-scientific magazine, newspaper, etc.). The second assignment uses a microbiology-in the-news supplement published as a joint effort between the textbook publisher (Prentice Hall) and *The New York Times*. A similar supplement could easily be made using articles from the science section of your local newspaper. Students use clues in the newspaper to identify the primary journal article (if possible) on which the newspaper article was based or a primary article on a similar subject. The students can then use the newspaper article as an aid in reading and analyzing the primary article. Finally, using the newspaper as a source for ideas, students pick a topic and complete an analysis of several primary articles on that subject.

The final use of writing in this course is the **Independent Project Poster**. The goal of this assignment is to allow students to present results of an independent laboratory investigation in a traditional poster format. Students work in small groups to

devise and carry out independent projects. The students give a brief oral presentation to the class describing their work and write about the results in a poster. The poster contains all of the components of a formal laboratory report (title, introduction, materials and methods, results, and discussion), although it is generally more graphic with photographs or other visual aids commonly used.

Taken together, these various writing assignments facilitate students' learning of the subject matter in a general microbiology course.

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