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Communication by Writing: A Basic Part of Science Education

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Introduction

No responsible educator would deny that an educated person should have the ability to express himself in writing. One must not lose sight of this basic idea when teaching science. Far too often, science students communicate through definitions, symbols and technical terminology without making the attempt to combine a series of meaningful phrases which communicate an individual's understanding of science in a comprehensible way (1). The responsibility for teaching communication by writing in science rests clearly with the science teacher, who must develop strategies within the framework of the discipline to involve students in the process of writing.

The basic model for writing activities is outlined in Figure 1 below.

Student Takes: →	**Applies to Them:** →	**To Produce:** →	**And Must Avoid:**
facts, data, beliefs and general truths	qualifications and limitations	valid claims, generalizations and inferences	invalid claims, conclusions and generalizations

Figure 1. Model of Discourse.

An Experiment

During the 1980-81 academic year, two laboratory sections of non-science majors, enrolled in Introductory Life Science (freshman biology) were utilized as an experimental group in an attempt to include writing instruction in a science class. These groups were given carefully designed writing problems related to their daily laboratory experiences. The writing problems were based upon the perceived components of message generation illustrated in Figure 2.

Each of the nine parts in Figure 2 lend themselves to the design of specific writing activities related to a laboratory activity. One example will be given, an example related to "audience needs." This assignment was given during a laboratory activity dealing with living specimens representing the three major phyla of worms.

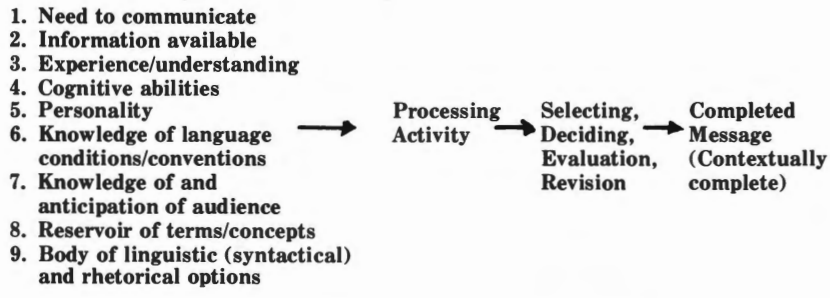

Figure 2. Components of Message Generation

Assignment: When you complete today's lab, you will have gained some experience with and information about various types of worms. If you were asked to tell someone in writing about this laboratory experience, one thing you must do is identify your audience. For whom would such information be useful? Who would need such information? What kind of audience would profit from information of this kind? Try to think about and anticipate needs of others.

To do: Identify two such audiences. Clearly, in two or three sentences, explain who the people are that you could be communicating to. Also explain in two or three sentences why you think this audience would be interested in this topic.

NOTE: *Do not* write a paper telling about the lab!

In our study, similar assignments were given dealing with the other "components of message generation," thus the students were guided through the various steps of composition via assignments related to experiences they had in lab. This removes much of the problem students have when they are given abstract assignments dealing with topics they have very little knowledge about or direct experience with.

After these preliminary activities, more comprehensive assignments were given, such as: a) a position paper regarding recombinant DNA research, b) a discussion of the complimentarity of structure and function of the kidney tubules, c) a comprehensive written report of a plant growth project conducted by each student.

Evaluation

Evaluation of this writing improvement project was accomplished as follows. The most important, yet least quantitative, evaluation was done by continuous oral feedback from students each time writing assignments were given and returned — following instructor evaluation. The biology professor evaluated the papers for content and the English professor evaluated papers for communicative value. As might be expected, students greatly appreciated the instruction. They were especially excited that an English teacher would take an interest in the biology labs, actually appear in the biology class, and even participate in some of the activities.

A second form of evaluation was a pre- and post-test utilizing the *Personal Report of Communication Apprehension Scale (PRCA)* and the *Written Apprehension Test (WAT)* developed by James McCroskey of the University of West Virginia. Upon completion of the first semester of involvement in this study, the two experimental groups exhibited scores on PRCA and WAT that were significantly better than the mean scores of other students enrolled in the non-experimental sections of life science. The writing instruction did seem to reduce both writing and communication apprehension for the experimental groups.

A third and different form of evaluation involved the provision for an optional written final exam. This option was given to all 180 students enrolled in the nine sections of Introductory Life Science. The normal final exam was an objective-type test, utilizing true-false, multiple choice and matching items. Sixty-one students (34 percent) elected the essay final exam. Twenty-two out of 42 (52 percent) in the two experimental groups, as opposed to 39 out of 138 (21 percent) of those not involved in the writing instruction experiment, selected the essay final. This indicates that those students involved in the experimental writing activity had a different attitude towards and considerable confidence in their ability to express themselves in writing on the final exam.

Discussion

Responding to questions in writing is not always an easy task for students. This is because they have been conditioned by many years of education that there is one best right answer to every question. When questioning moves away from memory or convergent thinking, students find it difficult to generate responses that reflect genuine thought which is both divergent and evaluative. However, we do believe that these latter values are what science instruction should be about.

Successful writing depends on the exercise of a number of skills. Not only do the writers need to have a command of the content of their subject, he or she must also have the ability to organize this content into significant structures that can be encoded in language that will make sense to the reader. This ability in itself is a complex of subsidiary skills. The writer must have a command of vocabulary appropriate for the subject; must have a repertoire of thought that makes up whole discourses. Students must be able to express themselves in what has come to be known as the *elaborative code* (2). The *elaborative code* is that form of discourse which we use to communicate ideas to others when those we are writing or talking to do not share the knowledge we have about the subject. It consists of definitions, examples, explanations, comparisons, contrasts, analogies, descriptions and narrations. It is the utilization of a wide range of strategies for making clear to the reader whatever it is that needs to be transmitted. The process is sometimes referred to as *creating intersubjectivity* — creating a shared universe of experience (3). A large number of our students have been conditioned to provide relatively simply responses to questions (true-false, multiple choice,

single word or brief phrasal replies); thus, they are ill-prepared to create elaborate discourses (4).

We must add a final note directed specifically at teachers. Our experience has shown that although students lack many of the skills mentioned above, when given a chance to improve these skills a very high percentage tried very hard and did make improvements. We have also discovered that we made many serious errors in creating the writing assignments. It appears that this is a universal situation: most teachers simply do not make good assignments for writing activities. It remains to be seen whether or not teachers, given suggestions and ideas for improvement, will try to make significant improvements in creating effective writing assignments. Writing is everyone's responsibility — writing in science can be an innovation (5).

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Acid Rain School Twinning Project

> ". . . It has been called a silent crisis with no equal; a ticking time bomb set to destroy the human and environmental health of the planet. . . . It is acid rain; at once the most pressing, paradoxical and sensitive environmental problem facing North America in the remainder of the 20th century."
>
> — M. Munro, *Ottawa Citizen*

National Survival Institute, a non-profit, charitable organization whose goal is to create public awareness of environmental problems and their solutions, announces the Acid Rain School Twinning Project for Grades 5 through 8.

The aim of the project is to twin school classes in Canada and the United States for the purpose of exchanging information, project ideas and points of view. An Acid Rain Education Kit will be provided free to participating teachers. The kit contains fact sheets, resource information and project ideas as well as a coloring poster for each student.

To involve your students in this project, and for more information, contact the National Survival Institute, 229 College Street, Third Floor, Toronto, Ontario, Canada (416) 593-1299.