Integrating Study Skills and Writing Exercises into Introductory Biology Laboratory Activities

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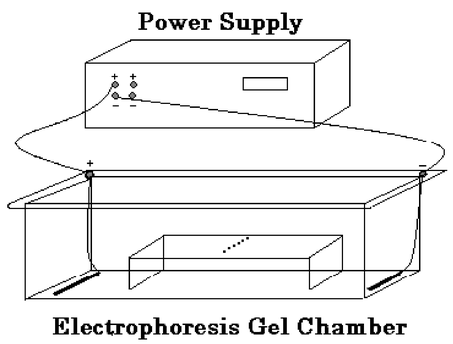
Introduction

Principles of Biology (BIOL 1010 and 1011) is a large introductory science course of 750-800 students, and consists of lecture and laboratory components. Instructors develop and supervise weekly 2 hour laboratory sessions for 33-36 groups of 24 students, taught by a team of teaching assistants. The majority of our students are registered in the Faculty of Science, although significant numbers of students from other faculties take the class as well. Many are new to university and may not be equipped with the study skills needed to learn large volumes of new concepts for university-level exams, nor are they always well-prepared for academic writing. During the 2008-09 academic year, we focused on developing these skills, by integrating short activities on learning and writing into existing lab exercises. These activities were intended to help students meet learning and writing expectations of upper year courses by demonstrating how these skills are applied, by allowing the students to practice these skills in their lab assignments, and by encouraging students to reflect on their own learning.

Methods

We decided which skills should be taught in the fall and winter terms, developed short exercises highlighting each of the skills, and integrated them into the Learning Objectives written for each week's lab (Table 1). The study skills exercises were designed to help students become conscious of their learning and studying techniques, and were introduced from the first week of labs. As many of our students are in their first term of university, we hoped that these exercises would allow students to consider their studying techniques and learning styles when preparing for their first midterm tests. As well, at the end of each lab students were asked to reflect on their performance on the Learning Objectives from that week's lab, and students were encouraged to use the Learning Objectives to guide their studying for the lab exam.

Beginning in the first term labs, students also learned how to avoid plagiarism in their lab assignments, and were introduced to paraphrasing in a short prelab activity that was not graded. In the winter term labs, the focus on original writing and proper use of sources intensified with a series of graded exercises integrated into the 1011 labs from the first week of labs. Students moved from paraphrasing single-source paragraphs to integrating information from two sources, as well as locating credible web sources and properly acknowledging source material using APA documentation style. The writing exercises were designed to help students become aware of the elements of good science writing in advance of presenting a poster projects late in winter term.



1. Create mnemonics to help you remember the following about this gel apparatus:

a) The colour of the wires that connect to the anode and cathode.

b) The charge of the anode and cathode.

Figure 1. Mnemonics study skills exercise. This exercise was integrated into *Lab 6: Agar Gel Electrophoresis*, in BIOL 1010 (fall term). Students learned about mnemonics, and then applied this technique by creating mnemonics to help them recall details of electrophoresis equipment setup. Drawing of power supply and gel chamber © 2005 Elizabeth Welsh (used with permission).

Table 1: Summary of integrated study skills and writing exercises.

Activity: Stated Learning Objective	Integrated into Lab	Details
Study Strategies Survey	1010 Lab 1: Microscopy	Students discussed and listed various study strategies with benchmates .
Bloom's Taxonomy and Multiple-Choice Questions: "Understand how test questions are designed to assess learning at a range of levels."	1010 Lab 2: Cell Structure	Students examined several types of multiple choice questions covering cell biology material and discussed with the TA how to identify question types and assess the challenges posed by each .
VARK Learning Modes: "Identify your learning style, a study strategy that might work for you, and one area that might need practice."	1010 Lab 4: Genetic Material	Students identified VARK mode (Fleming, 2006) in pre-lab exercises; in lab exercises students applied learning style to remembering distinction between leading and lagging strand DNA synthesis .
Study Strategies Reflection: "Reflect on the usefulness of your midterm studying strategies in preparation for the final exam."	1010 Lab 5: Mendelian Genetics	Students reflected on the success of study strategies used so far and planned for future studying .
Mnemonics: "Use mnemonics to memorize facts that are otherwise hard to remember."	1010 Lab 6: Agar Gel Electrophoresis	Students created two mnemonics to help them remember the colour and charge of anode and cathode (see Figure 1).
Introduction to Paraphrasing: "Properly paraphrase a passage from a published source and provide an in-text citation."	1010 Lab 7: Using Molecular Biology to Study Evolution	Students learned about homology and analogy in evolution through paraphrasing and providing an in-text citation for a paragraph from their textbook in an ungraded, prelab exercise.
Assessing and Citing Websites and Articles: "Write proper citations for a web page and a scientific article." ; "Gather information from various internet sources, and learn to recognize university and government websites as academically credible web sources."	1011 Lab 1: Fruits and Vegetables: an Expansion of Knowledge	Students were expected to find high-quality internet sources about their assigned fruit or vegetable, and to cite and paraphrase them properly.
Paraphrase it Twice!	1011 Lab 2: A Survey of the Plant Kingdom with an Emphasis on Reproduction	Students paraphrased a paragraph about symbiosis in early plants, generating two new paragraphs that were each distinct from the original and from each other while still communicating the same essential information. This was a TA-graded exercise .
Moving Beyond Paraphrasing: "Write an original paragraph by combining pieces of information from different sources."	1011 Lab 3: Photosynthesis	Students identified key points from two paragraphs taken from a textbook and a scientific article about photosynthesis, organized the information logically, and wrote a new paragraph, with in-text citations to indicate the source of each piece of information (see Figure 2).
Ecology and Animal Biology Poster Presentations	1011 Labs 6 and 7	A long-standing project in BIOL 1011 (Bishop et al., 2008b) in which students present the information from pre-selected scientific articles, and provide a reference to the article. This year, students were required to obtain their chosen article through the Dal Libraries website, and to provide APA in-text citations.

Stage I: Make your research notes.
It's best to keep your notes in short point form, instead of copying down important phrases. If you do copy down a phrase, remember to put quotes around it so that you know to rewrite that phrase later. 1. List at least 3 pieces of information from each of the following paragraphs (your sources).

Stage II: Organize your points.
Take the notes you made from both sources and place them in an order that makes sense to you. For example, you'll probably group all your identical points together, and group other similar points together.

Stage III: Write your paragraph.
Your sources were written in different styles of writing, and this paragraph will be written in your own style of writing. Use your outline to write new sentences with a consistent tone and style – yours!

Figure 2: Outline of Moving Beyond Paraphrasing exercise. This exercise was integrated into *Lab 3: Photosynthesis*, in BIOL 1011 (winter term). Directions for each stage of the exercise are shown; for the final paragraph students were expected to include APA in-text citations and references.

Discussion

Students appeared to be more aware of study skills resources: Attendance improved at workshops and coaching sessions held by the Biology Studying for Success coach (H. Moors).

Students appeared concerned about avoiding plagiarism and citing sources throughout the year. In particular, in the weeks leading up to the poster projects, students asked a large number of sometimes quite complex questions about how to properly cite sources.

Further development is needed to emphasize weekly reflection activities as a valid learning strategy: students often did not consider these questions to be meaningful or useful.

Students were introduced to APA citation format, but needed an opportunity to learn about the elements of a formal citation.

Students were able to locate journal articles using the Dal Libraries website, but needed an opportunity to learn more about the structure of scientific journal articles and the purpose of each section of the article.

Integration of study skills and writing exercises with traditional lab content could be strengthened, by including more direct applications of these skills.

These exercises are led and graded by TAs. In order to maximize the success of the skills integration strategy, more training and discussion with TAs about the teaching and marking of such activities will be necessary.

A central aim of introducing these activities was to help students become aware of the learning and writing skills that will allow them to succeed in upper-year courses. In future years we hope that feedback from upper-year instructors will help us to gauge the effectiveness of this strategy and to identify other key skills to emphasize.

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