

Student Satisfaction with the Studio Format Method of Teaching Introductory Biology

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In 2000 the Department of Biology at Centenary College of Louisiana abandoned the teaching of Biology 101 and 102 (*Principles of Biology I and II*) in a traditional lecture-laboratory format and created two new courses, Biology 101 (*Principles and Methods of Biology*) and Biology 202 (*Structure and Function of Organisms*) taught in studio format. The studio-format model integrates lecture and laboratory material into a seamless classroom experience in which students have an opportunity to learn using multiple modalities. Here we describe the format of this course and discuss some of the learning outcomes we have observed to date.

Keywords: foundational course, studio format, course design

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Introduction

In 2000 the Department of Biology at Centenary College of Louisiana abandoned the teaching of Biology 101 and 102 (*Principles of Biology I and II*) in a traditional lecture-laboratory format and created two new courses, Biology 101 (*Principles and Methods of Biology*) and Biology 202 (*Structure and Function of Organisms*) taught in studio format. The studio-format model integrates lecture and laboratory material into a seamless classroom experience in which students have an opportunity to learn using multiple modalities. We chose to convert our introductory classes to this format for three major reasons:

- 1) Dissatisfaction among students with the traditional format demonstrated by complaints on teaching evaluation forms and loss of students to other introductory science classes,
- 2) Disparity in college preparedness among students which led to diverse attitudes and abilities among students in the course,
- 3) Desire of the biology faculty to raise the science competency of both science and non-science students to an approximately equal level.

Our goals for the courses were to:

- Teach biology as a process
- Use hypothesis-driven, guided-inquiry laboratory exercises

- Incorporate technology into the learning experience
- Generate a high level of competence and interest among all students in the course.

The basic course design and activities include:

- Two weekly sessions of 2 hours and 45 minutes (330 minutes/week)
- Limit of 24 students in each section
- Enrollment available to all students, regardless of year in school or major
- Classrooms designed to accommodate both lecture and group laboratory work (Fig. 1)
- Ten-point short-answer quizzes given at the beginning of every period (except on test days)
- Five examinations plus a comprehensive final exam (combination of objective material, short essays, and practical material)
- Design and completion by groups of 3-4 students of independent research projects presented orally to the class at the end of the semester
- Topics covered in *Principles and Methods of Biology* deliberately narrowed to include “universal phenomena,” i.e., phenomena that occur in most, if not all, prokaryotic and eukaryotic organisms (Table 1)

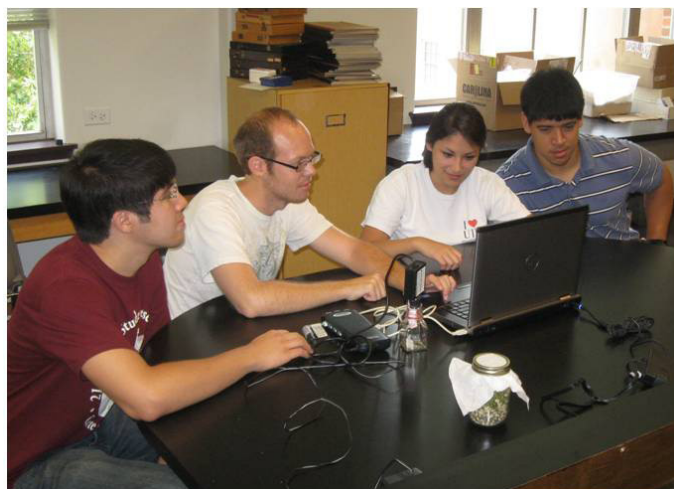


Figure 1. Design of studio-format classrooms. Six tables face a whiteboard and projection screen. The semi-oval table design is conducive to collaborative group laboratory work.

Table 1. Topics covered and number of class periods devoted to each topic in a studio-format introductory biology course. Topics were deliberately narrowed to include “universal phenomena” i.e., phenomena that occur in most, if not all, prokaryotic and eukaryotic organisms.

| Topic | Number of Class Periods |
|--|-------------------------|
| Life, scientific method, organic molecules | 4 |
| Cell membranes, movement of molecules | 2 |
| Cellular respiration | 1.5 |
| Photosynthesis | 1.5 |
| DNA replication, protein synthesis | 3 |
| Cell division | 1 |
| Molecular techniques, biotechnology | 1 |
| Inheritance | 3 |
| Population genetics | 1 |
| Evolution | 2 |
| Biodiversity | 6 |
| Ecology | 2 |

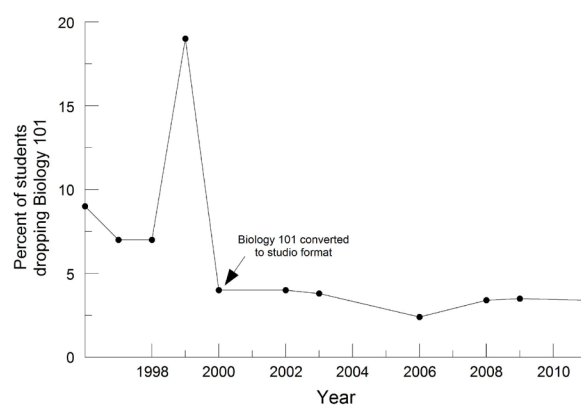


Figure 2. Percent of students dropping Biology 101 when it was taught as a lecture-laboratory course (prior to 2000) compared to percent dropping after conversion to studio format (after 2000). Data for some years are missing.

Notes for the Instructor

Methods and Results

When first developing this course, we anticipated that we would 1) lower the high drop rate that was inherent in the course and 2) replace time spent lecturing with additional time for students to engage in hands-on, minds-on activities. During the first year that the course was taught in studio format, a senior biology major attended every class and recorded the amount of time spent in different activities (Table 2). We also recorded the number of students dropping the course for academic reasons and compared the data to previous years when the course was taught in the traditional lecture-laboratory format (Fig. 2). When drop rates from the years 1996-1999 (traditional lecture and laboratory) are compared to drop rates from seven years of studio-format teaching, there is a significant decrease in rates after the advent of studio-format instruction (ANOVA; $F_s = 11.13$; $p = 0.009$; Fig. 2).

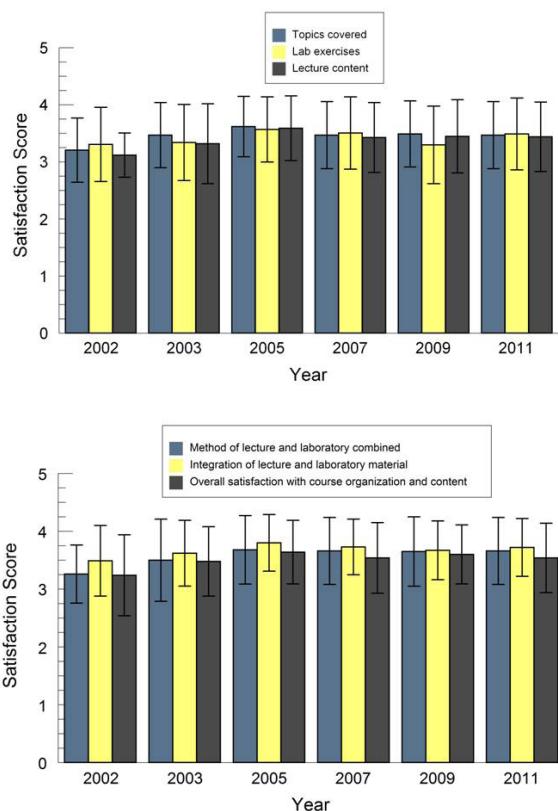


Figure 3. Components and average values of Biology 101 rated by students enrolled in the course. Students were asked to choose a number that best fit their opinion of the course characteristic under consideration (1 = poor, 2 = fair, 3 = good, 4 = excellent). Error bars represent standard deviations.

Table 2. Percent time spent in different activities in a studio-format course meeting continually for 165 minutes.

| | |
|-----------------------------|-------|
| Lecture | 31.0% |
| Laboratory Activities | 43.4% |
| Other (Q&A, testing breaks) | 25.6% |

Student Satisfaction Survey

We initiated a student satisfaction survey in 2002, two years after Biology 101 was converted to studio format. No data on student performance and/or satisfaction had been maintained by the department prior to 2002, so we are unable to compare the data to satisfaction with a traditional lecture-laboratory course. As the studio-format course evolved (e.g. changing textbooks, not using a textbook, adding a student-response system), some of the questions on the survey changed. Therefore, we are reporting on a core of six questions asked of the students each time the survey was distributed (2002, 2003, and every other year since 2003; Fig. 3). The survey was distributed at approximately mid-semester and was linked with a quiz so we received 100% return rate on the survey. Data were then collated, and averages and standard deviations for each of the questions were calculated.

Students generally indicated high satisfaction with course content and structure regardless of year. There were no significant differences in satisfaction scores among years or among components (Fig. 3). The scores ranged from a high of 3.8 (out of a possible 4) in 2005 for Integration of Lecture Material with Laboratory Exercises to a low of 3.12 in 2002 for Lecture Content. Overall the scores were lowest in 2002, the third year of teaching the course in studio-format style, but they have remained consistently high for the past decade.

Discussion

Centenary College requires all students to take a science course with a laboratory component as part of the core curriculum. Biology 101 has the highest enrollment of all the introductory science courses. Usually the six sections of the course offered every fall fill by the end of registration. We believe that one reason the course is so popular is due to its studio format design. The results of the student satisfaction survey indicate that students view their experience in the course in a positive light, and, anecdotally, student comments support the quantitative data (Table 3).

Table 3. Student comments about Biology 101. Students were given space on the satisfaction survey to add comments if they wished. Comments were taken from different years (2002, 2003, 2005, 2009, 2011).

| |
|---|
| <ul style="list-style-type: none"> • “I like the fact that the lecture is combined with lab because I am able to learn visually and hands-on at the same time.” |
| <ul style="list-style-type: none"> • “I’m not really good at biology but this class style has helped me pay attention.” |
| <ul style="list-style-type: none"> • “I am very satisfied with this class and feel as though I am learning more in this class than in other classes with labs.” |
| <ul style="list-style-type: none"> • “I liked having a lab to support the material as we go over it. This works really well.” |
| <ul style="list-style-type: none"> • “I liked the integrated lab and lecture. It helped to be taught something and immediately be able to apply it.” |
| <ul style="list-style-type: none"> • “I love the way this class is taught. It’s all inclusive which makes it easier to follow, instead of two separate classes.” |

Although the studio format appears to be an instructional method attractive to students, its effectiveness in improving biological literacy and critical thinking has not been fully demonstrated. For example, examination performance of students completing a larger (80 students/section) studio format class at Kansas State University did not differ significantly from students in traditional lecture-laboratory sections of the same course (Montelone *et al.*, 2008). To test critical thinking skills of students in the Centenary Biology 101 course, we began administering the Experimental Design Ability Test (EDAT) three years ago (Sirum and Humburg, 2011). For this test students are given a prompt about designing an experiment and allowed 15 minutes to write a response on the first day of class. Students are then given a similar post-test on the last day of class, and the two responses are scored on a 10-point scale (see Sirum and Humburg, 2011 for additional details). Our results indicate that completion of Biology 101 significantly increases student performance on the EDAT by an average of 0.68 ± 2.17 points (Student’s t-test; $p < 0.0001$). Additionally, when sections of the course are grouped based on pre-test scores, students in sections demonstrating a weaker initial performance (defined here by an EDAT score of < 2) increased their post-test score by an average of 1.91 ± 1.76 points. This is a significantly larger increase than that observed in the stronger sections (0.44 ± 2.17 ; $p < 0.00001$). Given that one of our objectives was to raise the performance of both science and non-science students to approximately equal levels, these data suggest that we are accomplishing this while making the course palatable to a wide variety of students.

To our knowledge, teaching introductory biology in studio format is not widespread. We found only two institutions mentioned in the literature that use this method, Kansas

State University with sections of approximately 80 students (Montelone *et al.*, 2008), and Randolph-Macon University, where the method was introduced to the university by a former member of the Centenary Department of Biology (*The Vespa*, 2005). Multiple factors may contribute to the lack of adoption of this method for introductory biology courses. First, it is not a common pedagogical method, and moving away from the traditional method of teaching introductory biology to adopt a method with little support in the literature may be perceived as risky. Second, it is more time consuming for instructors than a traditional lecture or laboratory. Not only is preparation for teaching the course more logistically challenging, but time management during the course is also critical and requires attention to detail and constant adjustment of course material. There is essentially no “down time” that occasionally occurs during traditional laboratory periods. Third, studio format teaching requires more instructional resources than a traditional introductory biology course. Whereas one instructor can lecture to several hundred students in a traditional course, and laboratories can be staffed with graduate students, a true studio format course requires a number of committed and energetic instructors to teach each section of the course. A department and/or an administration may be unwilling or unable to devote that level of instructional resources to the course. Institutions considering the adoption of studio format teaching must decide the costs and benefits of doing so. As instructors, we have been so pleased with the students’ satisfaction with the course and with the effect of the course on attrition that we are committed to continuing to teach in this manner. In fact, since the conversion of *Principles and Methods of Biology* (Biology 101) and *Structure and Function of Organisms* (Biology 202) to studio format, another studio format introductory course, *The College Brain* (Neuroscience 101), has been added to the departmental course rotation.

In conclusion, studio format instruction appears to facilitate minds-on, hands-on learning among students in an introductory biology course. Student satisfaction with this method of instruction has remained high for the 13 years during which the method has been used at Centenary College of Louisiana.

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Beth E. Leuck received her B.S. in zoology from Michigan State University and her M.S. and Ph.D. in zoology from the University of Oklahoma. She developed a keen interest in teaching introductory courses after managing the introductory zoology laboratories at the University of Oklahoma as a graduate student. She is currently a Professor of Biology at Centenary College of Louisiana.

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