Contents of the Findings Section of Report

I. Evaluation of Biology 405. Spring 2000, prepared by Larry Fish, Department of Health Behavior, University of Alabama at Birmingham, pp 1-18


Evaluation of Biology 405. Spring 2000

Contents

Introduction

Summary of the Instructor's Course Assessment Surveys
  Figure I: Full Text of Multiple-Response Items from Instructor's Course Assessment
  Figure 2: Responses to Multiple-Response Items from the Course Assessment

Summary of College Course Assessment Surveys
  Figure 3: Full Text of Multiple-Response Items from the College Class and Lab Assessment Surveys
  Figure 4: Responses to Multiple-Response Items from the College Class and Lab Assessment Surveys

Summary of open-ended Assessment Survey Responses
Summary of Focus-Group Interview

Conclusions

Verbatim Transcription of open-ended Responses from the Instructor's Course Assessment Surveys and from the College Course Assessment Surveys

Prepared by Larry Fish, Ph.D
Department of Health Behavior
University of Alabama at Birmingham
Birmingham, AL 35294-0022
Chapter 2 Evaluation of Biology 405 Spring 2000
Birmingham Southern College (BSC); Dr. Leo Pezzementi, Instructor

Introduction

Three sources of evaluation data were used in preparing this report: the instructor's course assessment survey, the official college course assessment survey, and the focus group interview with students. These sources and their findings are discussed separately below, then concluding remarks are provided. Each of the two assessment surveys included items soliciting open-ended responses; a literal transcription of these responses is provided at the end of this report.

As discussed in greater detail below, under "Conclusions," the course was very successful. Students found the content challenging, and they expressed some frustration at certain technical problems (mostly unavoidable) in the lab activities, but their overall assessment, expressed through survey questions and a focus-group interview, was positive, even enthusiastic.

Chapter 3 Summary of the Instructor's Course Assessment Surveys

Figure 1 gives the full text of the multiple-choice items from the Course Assessment. Figure 2 gives the range and mean for responses to the course survey questions. Each bar in Figure 2 represents the full range of responses given; for example, for item a, as for several other items, all responses were either 4 (agree) or 5 (strongly agree). The small square represents the item mean. There were only a few items for which even some students expressed neutral or negative responses. Though no student "disagreed" that the course "taught me how to work collaboratively" or "held my interest," a few were neutral; and not all agreed that the course was "relevant" to their "personal and career interests."

For a majority of the questions, however, all responses were at the high end of the scale (4 or 5), indicating that in general, students agreed that the course satisfied the objectives expressed by the several items. We cannot completely discount the possibility of a so-called "halo" effect -that is, a tendency of very satisfied participants to give consistently high ratings, without discrimination, to all questions about a program. This is not as serious a problem in evaluation as it may be in research, since a "halo effect" is by its very nature evidence for the participants' general satisfaction with the course.

Items h through o are of special interest, since they relate to the College's Expanded Paradigm, and the responses to most of these items show that this course played an effective role in this initiative. Even if these was a "halo effect," the participants were at least discriminating enough to give relatively lower (but still satisfactory) ratings to two items, "civic imagination" and "moral imagination." A third item in this section, "cross-cultural awareness," was the only one on which most students expressed disagreement. In general, highly technical, scientific courses of this nature cannot easily address moral and cross-cultural issues directly, though the instructor would be encouraged to consider ways in which these objectives might be better satisfied.

One further note: It may seem as if a course on cloning would easily lend itself to moral or ethical discussion. (Indeed, one student in the focus group interview suggested greater examination of ethical issues for the course, though this comment did not seem to elicit further consensus from the group.) However, a glance as the syllabus for Biology 405 will show that it is
quite packed with scientific content, and any unit on ethics comprehensive enough to do justice to the topic could be difficult to squeeze in.

Considering the success of this course in nearly all other evaluation criteria, including many of those specified in the Expanded Paradigm, and that no single course can "do everything," the instructor may want to consult with colleagues in the College on the importance of these two items of the Expanded Paradigm before making significant attempts to further accommodate civic, moral, and cross-cultural objectives in the course.

Figure 1

Full Text of multiple-choice Items from Instructor's Course Assessment

Response scale, a-o: Strongly disagree, Disagree, Neutral, Agree, Strongly agree

a. This course taught molecular biology in the context of the application of recombinant DNA
b. This course taught me how to read, present, and discuss critically scientific articles.
c. This course taught me how to design and perform genetic engineering experiments in the laboratory, and analyze the results of these experiments.
d. This course taught me how to present scientific results in a poster and in a scientific article.
e. This course taught me how to work collaboratively/cooperatively in both the theory and practice of science.
f. This course held my interest.
g. The course content was relevant to my personal and career interests.

Expanded Paradigm:
h. Collaborative learning: Students will develop the skills of working with others in the acquisition of knowledge.
i. Creativity and discovery: Students will be able to engage in the creative process as defined within a specific domain by producing a useful and novel product or solving a significant problem within that domain.
j. Teaching experience: Students will be able to communicate knowledge so as to enhance others’ understanding and learning of that knowledge.
k. Scholarship: Students will gain the skills necessary to discover, integrate, apply, and communicate knowledge. These skills include the ability to define clear goals and prepare for one's work, to use appropriate methods, obtain meaningful results, communicate results, and engage in reflective critique.
l. Information technology: Students will gain the skills necessary to make wiser use to technologies and to be able to adapt those skills to emerging technologies.
m. Civic imagination: Students will gain an awareness of the obligations that emerge from understanding ourselves as members of a community, however defined. With this awareness comes sensitivity to common problems within that community and an ability to conceptualize appropriate responses to those problems to enhance the well being of the community.
n. Cross-cultural awareness: Students will experience a culture other than their own and in so doing will gain an understanding of how culture in general influences thought, behavior, values, and attitudes.
o. Moral imagination: Students will gain the tools necessary to engage in a balanced meaningful dialogue on moral and ethical dilemmas so as to gain a deeper understanding of the art of civil discourse, as well as their personal belief systems.
Response scale, p & q: Much worse, Worse, The same, Better, Much better

p. Compared to other laboratories that I have participated in, the cDNA cloning laboratory was { much worse, worse, the same, better, much better}.
q. Compared to other laboratories that I have participated in, the site-directed mutagenesis laboratory was { much worse, worse, the same, better, much better}.

**Figure 2**

Full Text of multiple-choice Items from Instructor's Laboratory Assessment

Students completed an evaluation form prepared and analyzed by the college, which focuses on the competence and fairness of the instructor. Figure 3 gives the exact wording of the items, which were asked separately for class and lab, and defines the response scales. Figure 4 summarizes responses. (Seven students responded to the class survey, and eight to the lab survey.) The College Assessment Survey was provided for use "as is"; we are aware of the problems in interpretation resulting from the different styles and lengths of the response scales, and we also know that several of the items may have been redundant when asked for both class and lab. Nevertheless most students dutifully completed the surveys, and we present the results, which reinforce the inferences we have drawn from our other data sources.
The charts in Figure 4 give ranges and means for each item, and they show that on all items, responses clustered at the upper (positive) end of the response scales. (Note that for the first nine items, the response scale was five points; for the final five items, the response scale was only four points.) Results show that for nearly all course areas selected by the college for assessment, student reaction was very positive. This may be due in part to the "halo effect" discussed in the preceding section of this report. Responses tended to be slightly lower for the item asking students to assess their own work, yet even here, all responses were "average" or above. Not a single survey item received a negative rating from any respondent, but as noted, two students failed to respond to "Class" items, and one failed to respond to "Lab" items. We cannot ignore the possibility that these students would have provided more negative responses had they chosen to participate in the survey.

Figure 3
Items from the College Class and Lab Assessment Surveys

Response scale, except where noted otherwise:
1=Poor, 2=Fair, 3=Average, 4=Good, 5=Excellent

a. The course’s influence on my critical thinking and reasoning ability was:
b. How would you evaluate the professor's ability to facilitate comprehension of complex ideas?
c. How would you evaluate the professor’s ability to facilitate comprehension of complex ideas?
d. How would you rate your work in the course?
e. How do you perceive the professor's evaluation of your work in the course?
   {Consistently unfair, Usually unfair, Neutral, Usually fair, Consistently fair}
f. The professor motivated me to work hard in the course. {Rarely, Infrequently, Neutral, Usually, Always }
g. How would you rate the professor's openness to your questions and comments?
h. Were the professor's comments on tests, papers, or other assignments helpful?
i. There are a number of instructional strategies used in courses ranging from collaborative learning activities to lecture presentations, Regardless of the strategy used by the professor in this course, the professor's overall teaching effectiveness was:
j. Did the instructor present oral instructions for the laboratory and/or field trips? {Never, Not applicable, Sometimes, Always }
k. The quality of the written instructions including lab manuals and handouts was: {Poor, Fair, Good, Excellent}
l. Was the instructor available for individual assistance in the lab/field when needed? {Never, Not applicable, Sometimes, Always }
m. Was the individual assistance helpful? {Never, Neutral, Sometimes, Always}
n. What is your overall evaluation of this laboratory/field experience in teaching this discipline and its techniques? {Poor, Fair, Good, Excellent}
Figure 4
Responses from the College Class and Lab Assessment Surveys

Class:

Laboratory:
Chapter 6 Summary of Open-ended Assessment Survey Responses

[Note: A literal transcription of open-ended survey responses appears at the end of this report.]

Chapter 7 Open-ended or anecdotal responses provide program participants with an opportunity to address favorable or problematic issues unanticipated by the structures-response items. Open-ended responses must be interpreted with some caution, since they usually are provided only by those participants who have both something definite to say, and the inclination to put it into words. Furthermore, open-ended responses are difficult to generalize, and a passionately worded opinion can make an inordinately strong impact on the reader, even if no other participant shares it. Often the best use of anecdotal commentary is for formative evaluation - it can help project directors make improvements.

With these cautions in mind, we can draw a few general inferences from the open-ended responses to the three surveys. None of the negative comments expressed extreme dissatisfaction or disappointment; no one expressed regrets over taking the course. A few of the negative comments were "par for the course," so to speak, for a challenging project such as this; for example, "We didn't fully understand everything that was going on"; "It's difficulty"; "Stuff not working." Most of the more explicit negative comments focused on technical problems, some of which could not be helped and were anticipated in advance; for example, "Better facility, more instruments, more room, and more resources!"; "Sequencing - we never found out how it was done. It's probably hard to go to UAB [University of Alabama, Birmingham] and watch, though" (referring to the lack of equipment at BSC, and the resulting need to have certain procedures performed at UAB).

Chapter 8 Summary of Focus-Group Interview

May 11, 2000, 8:00-9:00 am, 8 participants

The following commentary was written by the focus-group moderator on the afternoon following the interview. In the moderator's judgment, what follows is a complete and accurate summary of the students' comments.

"The instructor and his teaching style were rated very favorably. Relevant comments included: he was "relaxed," never taking it amiss when something had to be explained twice; he was always available to help with problems; and he clearly put a great deal of work into the course.

No objections to the group-teaching approach could be found, despite my several attempts to probe for it. The general enthusiasm for this approach was apparent. Not even my attempt to create a more welcoming environment for possible dissenters by expressing my own personal dissatisfaction with group-learning experiences succeeded in eliciting dissent. Students stated at various points that the group reading and discussion was both "enjoyable" and "helpful" (their own words), and all agreed, when I asked, that it was necessary for a course of this level. No student expressed a preference for a more individual approach at any of the occasions when I probed for contrary opinions. More than one commented that he or she would not have been able to handle these papers without the insights gained from the group discussion. One student commented that group writing (as opposed to discussion and lab-work) took some adjustment, but this did not appear to be a major concern for her.

The "minimal lecture" style was rated well by the group, without dissent. Students pointed out that the instructor's "relaxed" style (in the words of one participant), and his willingness to "be there" (in the words of another) for his students, helped make this successful (indicating, perhaps, that in the hands of another instructor this style may not be as successful).
The course web site was received very well by the entire group; one commented, without any dissent, that it was "the best thing he could have done." One student commented on the amount of work the instructor had put into creating and maintaining the site.

Positive evidence for the development of critical scientific thinking surfaced without my having to probe for it. At one point, a student pointed out how he had begun to notice apparent shortcomings in the scientific articles the class was reading, such as meaningless charts, biased conclusions, alternative inferences which the authors failed to consider (to "punch holes" in the paper, in his own words). Most other participants agreed that they, too, had become aware of these things, even though in many cases these apparent shortcomings would be resolved in class discussions. One student- without my probing for it - commented that the course had helped him learn "how to read" (his own words) scientific articles; another commented how this course had shown him that not everything one saw in print was necessarily reliable. (The students assured me that the instructor had not "clued" them in advance to the shortcomings, real or apparent, in the papers they read.) One student commented that as a result of the course he felt more comfortable with scientific papers, and one or two other students agreed.

One student pointed out that his ability to write papers had been enhanced by this course, especially by the class readings, and there was assent from other students at this point. One, in his own words, explained that he was learning "not to make the same errors" as some of the authors of the class papers.

Despite my several attempts to probe for them, no serious failings or shortcomings were cited. For the record, the only shortcoming identified was the bare adequacy of the college's technical facilities. Also, one student would have liked more discussion on the ethical issues of cloning, though I did not get the impression that there was a strong consensus on this.

It was clear that the success of the course stemmed not just from the pedagogy on which it was based, but from the qualities of the instructor himself. If there is any note of caution to be inferred from this discussion, it is that the style of this course may not work for everyone, or in every class. The patience, enthusiasm, and hard work of the instructor, which have been alluded to above, appear to have been essential determinants of success. For a professor without as much time or interest to devote, a course like this may not succeed. The students also agreed that the class size -nine -was probably ideal. Though no one can know for certain how a larger class would have worked out, there was a consensus that the maximum allowable enrollment, 16, would have been too many. Also, it was helpful, according to one student, that the students had been acquainted with each other before the course.

It is worth noting that a few students referred at various times to the inherent interest of the course subject itself; that is, cloning, a cutting-edge issue in science and ethics. One student, with assent from one or two others, commented that this course provided background helpful in understanding the issue better when it appears in the popular media."

Chapter 9
Chapter 10 Conclusions

All evaluation data show that in the spring of 2000, Biology 405 achieved all of its goals, and played an important role in the college's Expanded Paradigm. Furthermore, the course satisfied several generally accepted pedagogic criteria. It was well organized; it was challenging, but not so challenging as to leave students frustrated; and it successfully incorporated collaborative learning strategies. The focus-group interview reinforced the generally positive
assessments the students provided in their written surveys, and also provided evidence for what is normally very difficult to measure; namely, the development and practice of critical thinking skills.

Two cautions, however, are in order: First, only eight of the nine students responded to surveys, and attended the focus-group interview. There was, then, one student of the original nine who, we must presume, would not share the high regard in which the other students held the instructor and the course.

Second, we cannot tell at this point how well these findings may generalize to future implementations of this course. Though this class was not intended to be a demonstration project, two observations are worth noting for the event that this course is considered for replication, at BSC or elsewhere:

1) The number of students (nine) was very small. Several speculated that had the course been larger -indeed, had it enrolled the allowable maximum (16) -it would not have been as successful.

2) The success of a collaborative-learning approach depends to a great extent on the personalities of the participants. It is too early to tell whether the success this teaching strategy enjoyed in the present course is entirely attributable to the strategy itself, or at least in part to a fortuitous mix of personalities (the "luck of the draw," so to speak). Though the collaborative learning approach was very successful here, its viability in a larger class, with a different student mix, is still an open question.

3) The success of the course appears to be due as much to the dedication and ability of the instructor, as to the content of the course itself. We cannot be certain that the course would have been as successful if under the supervision of an instructor with less time or interest to devote.

The reservations expressed above are not intended to detract from the general conclusion of this report: Biology 405 as implemented in the spring of 2000 was successful in its own right, met its stated objectives, and as a model for future courses, it probably could not have been implemented much better. Had this report been written to support a simple "go--no go" decision on future implementations, the conclusion would be a clear "go."

In future implementations of this course, the assessment burden on the students should be reduced, if possible. The present evaluation required each student to complete three long assessment forms: the instructor's form, plus two identical college forms, one for the class, the other for the lab. With a shorter assessment task, students may put more time and thought into each question individually. The focus-group interview yielded some interesting insights, and should probably be retained.

Verbatim Transcription of Open-ended Responses from the Instructor's Course Assessment Surveys and from the College Course Assessment Surveys

There follows an exact transcription of students' written responses to open-ended evaluation questions. Questions appeared in both the instructor's and the college's course assessment surveys, and were asked separately for class and lab. In these transcriptions, square
brackets enclose "best guesses" at poorly written words or phrases. The symbol [ ...?] indicates an illegible passage; [?] indicates an illegible word.

The brief text at the beginning of each anecdote, to the left of the diagonal slash, is coding used primarily for data management, and consists of question number, data source, and respondent ID. For example, "2 Assessment 1" is read "Question 2, Instructor's Assessment survey, Student I." These codes can be ignored when interpreting the anecdotes.

Responses to Open-ended Items from the Instructor's Course Assessment

2 Assessment 0/ Please explain your answer [comparing cDNA cloning to other laboratories].

2 Assessment 1/ The lab was very relaxed and we were allowed oftentimes to work on our own - i.e., start early, do lab a different day, etc.

2 Assessment 2/ (1) I enjoyed the laid back yet serious atmosphere presented in the laboratories. (2) We were able to use techniques which were merely touched on in earlier biology courses. This course integrated these techniques into our everyday experience in lab. This was a hot topic which should be studied.

2 Assessment 3/ It was better than most, but the same as comparative anatomy. I like the small class size, personal attention, trust on the professor's part, and working in groups.

2 Assessment 4/ It was more interesting [ ...?] You start caring about the project. 2 Assessment 5/ I like the long-term projects and group work.

2 Assessment 6/ Lab was very interesting because all of the work led to one ultimate goal. Labs in most classes have no logical progression.

2 Assessment 7/ I like doing experiments where you don't know what the outcome is going to be; where your results are going to differ from everyone else's, and where a minimal amount of time in lab is wasted. That was definitely the case for this lab. Also, the lab paralleled the course material temporally, so it was helpful in learning.

2 Assessment 8/ I understood what we were doing before I finished and had to write the paper.

3 Assessment 0/ What was the best part of the exercise [cDNA cloning]?

3 Assessment 1/ Running experiments that could have given us anything and actually getting results.

3 Assessment 2/ Again, the atmosphere helped with the enjoyment of the class. I also liked the fact that the class was able to work together on the poster presentation.

3 Assessment 3/ Group work, people's strengths helped others' weaknesses. If you felt lost someone besides a professor could help you out.

3 Assessment 4/ I thought the process as a whole was the best. It really allows you to understand the process.
3 Assessment 5/ Learning a new form of science.

3 Assessment 6/ Having our DNA sequenced by UAB was fascinating.

3 Assessment 7/ The best part of the exercise was actually finding out what the random clone was - what protein, what it did. Also, doing the poster as a group was great.

3 Assessment 8/ Finding results and putting it in posters.

4 Assessment 0/ What was the worst part of the exercise [cDNA cloning]?

4 Assessment 1/ We didn't fully understand everything that was going on.

4 Assessment 3/ I enjoyed our lab - the only time I felt frustrated was when something went wrong which is because of chance.

4 Assessment 4/ the worst part was when the two [primers?] did not work for the PCR.

4 Assessment 5/ Its difficulty.

4 Assessment 6/ I honestly enjoyed it all.

4 Assessment 8/ Sequencing - we never found out how it was done. It's probably hard to go to UAB and watch, though.

5 Assessment 0/ What could be done to make this laboratory exercise better [cDNA cloning]?

5 Assessment 1/ Try different libraries - animal/human etc.

5 Assessment 3/ Better facility, more instruments, more room, and more resources/ Dr. Pez did a fabulous job with the resources he had available.

5 Assessment 4/ Spend a couple more weeks on the project. 5 Assessment 5/ Good question. 5 Assessment 6/ Nothing.

5 Assessment 7/ Maybe try to do this in vitro [?] with the clones.

5 Assessment 8/ More emphasis on results - what [our?] clone means.

7 Assessment 0/ Please explain your answer [comparing site directed mutagenesis to other laboratories].

7 Assessment 1/ Time to work on our own.

7 Assessment 2/ This was an interesting means for studying genes and their products. I had no real previous experience with site directed mutagenesis.

7 Assessment 3/ It was challenging. It made you explore other areas of research.
7 Assessment 4/ I thought the theory and procedure were more interesting than most of the [other?] labs.

7 Assessment 5/ Teamwork. Pez was there to help whenever we needed him.

7 Assessment 6/ I had a greater sense of accomplishment upon completing this lab, basically for the same reasons as before.

7 Assessment 7/ This lab was much better than most because we got to choose the [mutants?] we wanted to create, and because we got to use small pieces of the results as we moved along.

7 Assessment 8/ Well explained- plus there were people who knew what was going on.

8 Assessment 0/ What was the best part of the exercise [site directed mutagenesis]?

8 Assessment 1/ Getting results that we could plot and attempt to explain.

8 Assessment 2/ Working with my group on the paper allowed me to better understand what was going on. Without them, I would not have done as well as I have in the lab.

8 Assessment 3/ Same as previous. [Group work, people's strengths helped others' weaknesses. If you felt lost someone besides a professor could help you out.]

8 Assessment 4/ It helps you understand site-directed mutagenesis work. 8 Assessment 5/ Teamwork.

8 Assessment 6/ Working with cells in the food was fun [?] I had never done it before.

8 Assessment 7/ Discussing cholinesterases and discussing the design of the lab before it began. This really helped in understanding what we were doing.

8 Assessment 8/ Theory behind the mutations and [cleft?].

9 Assessment 0/ What was the worst part of the exercise [site directed mutagenesis]?

9 Assessment 1/ Not knowing everything that was going on.

9 Assessment 3/ Same as previous. [I enjoyed our lab - the only time I felt frustrated was when something went wrong which is because of chance.]

9 Assessment 4/ When the wrong [primers?] were used for our mutagenesis, so we had to work with another one.

9 Assessment 5/ One of my lab partners.

9 Assessment 6/ The [Qiagin?] [modifying?] was [long and tedious?].

9 Assessment 7/ The Ellmans Esterase assay (and the tiny volumes you have to pipette).

9 Assessment 8/ Stuff not working. Long assays.
10 Assessment 0/ What could be done to make this laboratory exercise better [site directed Mutagenesis]?

10 Assessment 1/ Class presentation of data.

10 Assessment 3/ Same as previous. [Better facility, more instruments, more room, and more resources/ Dr. Pez did a fabulous job with the resources he had available. ]

10 Assessment 4/ Spend a couple [ ...?] Gets congested at the end.

10 Assessment 5/ Spread out the people that have done this kind of stuff before among the group evenly.

10 Assessment 6/ Nothing.

10 Assessment 8/ More refined methods.

Responses to Open-ended Questions regarding the Class, from the College Course Assessment Survey

I Class 0/ What has your professor done especially well in teaching this course?

I Class 1 -I like the integration of lecture and lab. -I liked the teaching method of chalkboard lectures vs. his cell/molec power-point lectures. -Journal discussions were interesting to see how this all applies. - I think the class should be capped at a certain number. I do not think it would be as effective with more people.

I Class 2/ Dr. Pez was always willing to help with lab and class work. -He presented a new style of class experience with the evaluation of current [?] .-He also used the board more this time instead of power-point.

I Class 3/ I liked the organization of the course, when the second half was discussion-oriented. The group effort in lab was good.

I Class 4/ -Enjoyed discussions -good preparation for grad school. -Good class size -any more would be too many.

I Class 5/ He taught both lecture and lab very well. I liked the article discussions.

I Class 6/ Explanations of lab procedures were very clear, as was the classroom material. Complex ideas were explained very well. The [class?] has also been kept very interesting.

I Class 7/ I enjoyed the class. Keep the small enrollment. You were always available for [?], lab [?], etc. (even when it was our fault we had to [ ...?]) [ ...?] That makes this kind of class worth taking. Also, the teamwork was nice, but I think the lab groups should be [rearranged?] a couple of times a semester. Certain lab [partners?] aren't desired.

I Class 8/ -Lots of individual assistance. -Interesting topics.
2 Class 0/ List those things which you think might be done to improve the teaching of this course.

2 Class 1/ Change time slot.

2 Class 2/ Don't have the senior level class at 8 am!

2 Class 3/ Maybe encourage more discussion from everyone.

2 Class 4/ -Interesting paper/theory portion of the class. -make lab more percentage of grade. - Switch groups around often.

2 Class 5/ A little more course material before the article discussions, may give people a better background.

2 Class 6/ Not [?]. I have been impressed with everything.

2 Class 7/ Teach it later in the day. This material was extremely difficult for me to understand. I think that if there was a [fairly?] advanced prerequisite to this class ([?] than cell mole/[genetics)] I might have [?] more.

2 Class 8/ More interesting articles. 3 Class 8/ Yes [?] figures.

3 Class 0/ Did you find the textbooks used in the course helpful? Why or why not?

3 Class 1/ Yes -easy to reference -good figures. I like the open book tests as well- it makes you learn the material for understanding and not memorization.

3 Class 2/ For the beginning of the course, the book was helpful.

3 Class 3/ The textbook was definitely helpful, but it was usually more helpful after class than before.

3 Class 4/ Yes -not the best read, but good reference material for lab/lecture.

3 Class 5/ The text cleared up many things, especially when reviewing an article.

3 Class 6/ Yes, but I thought it was somewhat hard to read.

Responses to Open-ended Questions regarding the Laboratory Sessions, from the College Course Assessment Survey

I Lab 0/ What has your professor done especially well in teaching this course?

I Lab 1/ Dr. Pez has put so much time and effort into this lab. He is always available and puts complex ideas into simple terms effectively.

I Lab 2/ -Always available to help. -Will help to understand complex ideas.
I Lab 3/ I like that everything -including the [poster?] and the paper -is group work. Working together actually forces you to understand what you're doing better -it causes you to be more aware.

I Lab 4/ -Always around when we needed help -above and beyond call of duty -Well thought syllabus and schedule. -Preparation excellent.

I Lab 5/ The labs were enjoyable and well thought out. Even when things went wrong, we were able to work things out.

I Lab 6/ Lab website is very well prepared. All information is easily accessible. Dr. Pezzementi helped to make some very complex ideas clear and easy to understand.

I Lab 7/ Lab was great. Great [instruction?]. He knew the procedure well, was more than willing to help. Also he was there after and before lab time for assistance.

I Lab 8/ Individual help is very good.

**2 Lab 0/ List those things which you think might be done to improve the teaching of this course.**

2 Lab 2/ Classwise, another format should be found for discussion of articles. I understand the reason for the format but class was not as interesting/exciting as I would have liked. 2 Lab 4/ Corrected methods/streamlined.

2 Lab 5/ Spend more time on the side-directed mutagenesis lab.

2 Lab 6/ Not much. I thought everything was run extremely well.

2 Lab 7/ Those students with prior knowledge of the techniques should be present in each of the groups if possible, which it was not since there were 3 of them [... ?]

**3 Lab 0/ Did you find the textbooks used the course helpful? Why or why not?**

3 Lab 1/ Web site was great -easy to access.

3 Lab 2/ Text and handouts were very helpful. Lab protocols were, for the most part, very clear.

3 Lab 3/ The lab protocols were very helpful- very clear instructions and explanations. Having them posted on the web was great -there was no lab book to forget or lose.

3 Lab 4/ Lab notes were helpful when annotated. 3 Lab 5/ Yes it explained things clearly.

3 Lab 6/ We had no textbook. However, lab instructions posted on the internet were clear and easy to use.

3 Lab 7/ Lab text was [?]!
Chapter 11 Summary of Peer-Review Simulation

Six of the eight participating students wrote scientific abstracts of their research in publishable style, and had those papers reviewed by qualified post-doctoral fellows in biology at the University of Alabama, Birmingham. There were three purposes for this exercise: to give students practice in scientific writing, to provide them with positive feedback (where merited) from sources other than the instructor, and to permit them to experience, as closely as possible the process of academic publication.

The reviews were generally very favorable. The table below gives the ratings assigned by the reviewer to five quality criteria. All ratings, for all five quality criteria, and for all papers, were either Superior or Good; the rater never felt cause to use the options Fair or Poor.

Quantitative reviewer ratings

<table>
<thead>
<tr>
<th>Quality Criteria</th>
<th>Superior</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Originality</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Soundness</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Quality of methodology</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Clarity</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Organization</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Furthermore, the reviewers provided thoughtful narrative commentary for each paper, in the style of professional peer review. Most of the criticisms concerned writing style and format. Two reviews, for example, included a long list of suggested editorial changes. Similar comments included the following:

"All data presented as figures or tables should be discussed in the Results section. Sometimes figures were included without discussion as results."

"The first paragraph of the results section is not necessary and may be omitted."

Of the weightier scientific criticisms (in the opinion of this evaluator), one concerned the reliability of the results:

"Does the data represent that average of three experiments? ...the manuscript did not provide an n for the experiments. therefore, although the data supports the conclusions made by the authors, without knowing that the data is reproducible, I cannot make a definitive conclusion about its reliability."

The other touched on the scientific concept of falsification:

"You may bring up points [in your discussion] that reviewers will use to criticize the manuscript. They may even require experiments to prove or disprove your speculations."

Many of the other more critical comments advocated greater clarity in discussions of technical scientific points. Otherwise, comments regarding the general scientific quality of the abstracts were favorable. Here are some examples:
"The written manuscript clearly and concisely presents relevant information for understanding the purpose of the study, and offers sufficient speculation on the mechanism by which the mutations affect enzymatic function."

"This is an informative and well-written manuscript dealing with an interesting question. Each section is laid out in a very organized manner that is easy to follow."

"However, this abstract accomplishes everything that it should. Overall, it is an excellent abstract."

The reviewers' ratings do credit to the students and, by extension, to the instructor, and they show that through a combination of course instruction and personal ability these six students produced scientific papers of superior quality. They also reinforce the success of the course in promoting critical scientific thinking. (In the opinion of this evaluator, the reviews might have been too good; the students were spared what might have been a salutary introduction to the "rough and tumble" of academic peer review!) For the purpose of this evaluation, however, the real importance of this exercise was the opportunity it provided for students to "replicate" the experience of academic publishing; that is, to prepare papers of publication quality, to have them reviewed in a professional manner, and to study the opinions of knowledgeable critics from outside of the classroom.

Conclusions

All evaluation data show that in the spring of 2000, Biology 405 achieved all of its goals, and played an important role in the college’s Expanded Paradigm. Furthermore, the course satisfied several generally accepted pedagogic criteria. It was well-organized; it was challenging, but not so challenging as to leave students frustrated; and it successfully incorporated collaborative learning strategies. The focus-group interview reinforced the generally positive assessments the students provided in their written surveys, and also provided evidence for what is normally very difficult to measure; namely, the development and practice of critical thinking skills.

Two cautions, however, are in order: First, only eight of the nine students responded to surveys, and attended the focus-group interview. There was, then, one student of the original nine who, we must presume, would not share the high regard in which the other students held the instructor and the course.

Second, we cannot tell at this point how well these findings may generalize to future implementations of this course. Though this class was not intended to be a demonstration project, two observations are worth noting for the event that this course is considered for replication, at BSC or elsewhere:

1. The number of students (nine) was very small. Several speculated that had the course been larger—indeed, had it enrolled the allowable maximum (16)—it would not have been as successful.

2. The success of a collaborative-learning approach depends to a great extent on the personalities of the participants. It is too early to tell whether the success this teaching strategy enjoyed in the present course is entirely attributable to the strategy itself, or at least in part to a fortuitous mix of personalities (the "luck of the draw," so to speak). Though the collaborative
learning approach was very successful here, its viability in a larger class, with a different student mix, is still an open question.

(3) The success of the course appears to be due as much to the dedication and ability of the instructor, as to the content of the course itself. We cannot be certain that the course would have been as successful if under the supervision of an instructor with less time or interest to devote. Since this course was not proposed as a demonstration project, this observation is not of high importance for this evaluation.

      The reservations expressed above are not intended to detract from the general conclusion of this report: Biology 405 as implemented in the spring of 2000 was successful in its own right, met its stated objectives, and as a model for future courses, it probably could not have been much better implemented. Had this report been written to support a simple "go-no go" decision on future implementations, the conclusion would be a clear "go."

      In future implementations of this course, the assessment burden on the students should be reduced, if possible. The present evaluation required each student to complete three long assessment forms, the instructor's form, plus two identical college forms, one for the class, the other for the lab. With a shorter assessment task, students may put more time and thought into each question individually. The focus-group interview yielded some interesting insights, and should probably be retained.
Evaluation of Biology 405- Spring 2001
Birmingham-Southern College (BSC)
Dr. Leo Pezzementi, Instructor

Table of Contents

Executive Summary 20

Introduction 21

Summary of the Instructor’s Course Assessment Surveys 22
  Table 1.1: Responses to Multiple-Response Items from the Course Assessment 23

Summary of College Course Assessment Surveys 24
  Table 2.1 Responses to College Course Assessment Survey (Classroom) 24
  Table 2.2 Responses to College Course Assessment Survey (Laboratory) 25

Summary of Open-Ended Response to Instructor’s Course Assessment Survey 26

Summary of Open-Ended Responses to College’s Course Assessment Survey 27
  Table 3.1: Responses to Open Ended College Assessment Survey - Item 1 (Class) 27
  Table 3.2: Responses to Open-Ended College Assessment Survey - Item 2 (Class) 27
  Table 3.3 Responses to Open-Ended College Assessment Survey - Item 1 (Lab) 28
  Table 3.4: Responses to Open-Ended College Assessment Survey - Item 2 (Lab) 28

Summary of Focus Group Interview 29

Summary of Major Field Achievement Test (MFAT) 31
  Table 4.1: 2000 Results of Major Field Achievement Test 31
  Table 4.2: 2001 Results of Major Field Achievement Test 31

Summary of Peer Review Simulation 32

Conclusions 34

Prepared by Joy F. Johnson
for UAB Center for Educational Accountability
Birmingham, Alabama
July 2001
Executive Summary

Multiple methods were used to evaluate the second year of an inquiry-based biology course on recombinant DNA at Birmingham-Southern College (AL), a small, private liberal arts college. Biology 405 was taught by the chairperson of the department. The second cohort consisted of twelve students who enrolled in the course during the spring of 2001. Students were asked to complete several course evaluations administered by both the instructor and College. Students also participated in a focus group interview on the last day of class.

Evaluation data are consistent and positive across both years of the course. Only in a few cases do the ratings given by or assigned to students slightly decrease. The objectives outlined for Biology 405 were met. Students learned to read, present, and discuss scientific articles in-depth, work collaboratively in small teams, and perform genetic engineering experiments. Students also submitted papers of “original research” for peer review by post-doctoral fellows at a nearby, major research university. Major Field Achievement Test (MFAT) results show that both cohorts of Biology 405 students outperformed all biology majors on both the molecular biology/genetics sub-test and the biology field test. Students believed that the instructor exhibited supportive personality traits that helped students “unlock the language of genetics” and feel like colleagues. Small class sizes and students’ motivations for participating in the course are also considered.
Introduction

Multiple methods were used to evaluate the second of a two year evaluation of Biology 405, an inquiry-based course in molecular genetics, offered at Birmingham-Southern College [AL]. The course was taught by the chairperson of the department and included an integral independent laboratory field experience. The spring 2001 cohort consisted of twelve biology and bio-psychology majors attending the private, liberal arts college. Students completed several course evaluations administered by both the class instructor and College and participated in a focus group interview conducted on the last day of class.

Student survey and interview responses indicated that the students were generally pleased with the course. Students’ optimistic comments were consistent with those of the prior year and demonstrated that the course continued to be a success in the current year as well. Although a few students expressed some initial difficulty with understanding the expectations of their roles as students in an inquiry-based classroom, most were satisfied with the breadth of classroom discussions and excited about the topic of recombinant DNA. The collaborative processes elicited by the course helped students construct a classroom community of student scientists and develop new conceptions of themselves as “contributors” and “colleagues.”
Summary of the Instructor’s Course Assessment Surveys

All students completed the Instructor’s Course Assessment by indicating the extent of agreement to statements which inquired about the efficacy of Biology 405 to meet objectives outlined for the course and for the College’s Expanded Paradigm. Overall, survey responses for Spring 2001 reflected students’ general positive orientation and indicate that the course was successful in meeting the objectives. The mean response to items on the instructor’s course assessment survey were very consistent across both years of the project. Table 1.1 shows that the overwhelming majority of survey items received a mean rating of at least 4.00.

Students learned to read, present, and discuss scientific articles in-depth, work collaboratively, and perform genetic engineering experiments. These positive survey responses are well-supported in the narrative of the focus group, as discussed below. For example, the majority of students expressed that the course required that they grapple with scientific terms and move beyond the surface skills of “skimming” scientific research. Although no student disagreed, a few students did indicate a neutral response to the relevance of the course content to their personal and career interests.

Of particular interest are the items related to the College’s Expanded Paradigm. Items related to “civic imagination,” and “cross-cultural awareness,” deserve special attention. As is the case for Spring 2001, these are the only items that did not receive a categorical mean response of agree or strongly agree, perhaps indicating a lack of exposure to course content related to the area. It is also plausible that the subject matter of the course makes it difficult to align specific course objectives with those of the Paradigm.
Table 1.1
Response to Multiple-Response Items from the Course Assessment

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.89</td>
<td>.33</td>
</tr>
<tr>
<td>2</td>
<td>4.89</td>
<td>.33</td>
</tr>
<tr>
<td>3</td>
<td>4.33</td>
<td>.50</td>
</tr>
<tr>
<td>4</td>
<td>4.44</td>
<td>.53</td>
</tr>
<tr>
<td>5</td>
<td>4.00</td>
<td>.71</td>
</tr>
<tr>
<td>6</td>
<td>4.44</td>
<td>.53</td>
</tr>
<tr>
<td>7</td>
<td>4.11</td>
<td>.93</td>
</tr>
<tr>
<td>8</td>
<td>4.78</td>
<td>.44</td>
</tr>
<tr>
<td>9</td>
<td>4.33</td>
<td>.50</td>
</tr>
<tr>
<td>10</td>
<td>4.33</td>
<td>.50</td>
</tr>
<tr>
<td>11</td>
<td>4.11</td>
<td>.33</td>
</tr>
<tr>
<td>12</td>
<td>4.33</td>
<td>.50</td>
</tr>
<tr>
<td>13</td>
<td>3.67</td>
<td>.71</td>
</tr>
<tr>
<td>14</td>
<td>2.89</td>
<td>.33</td>
</tr>
<tr>
<td>15</td>
<td>4.56</td>
<td>.73</td>
</tr>
</tbody>
</table>

Response Scale: 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree
Summary of the College’s Assessment Survey

Results of the College Assessment Survey for both the class and laboratory are presented in Tables 2.1 and 2.2. The majority of the items focus on student perceptions of the competence of the instructor. Spring 2001 students rated several items on the survey lower than Spring 2000 students, albeit only slightly, but no items are rated lower than Average. As is consistent in the prior year, students reported that the course had a positive influence on their critical thinking skills. Also, the instructor explained complex material and remained open to student/instructor interaction.

The results in Table 2.2 show that students were very positive about the “Lab” items and believed the Lab to be a success. All items were rated as good; in fact, the items related to critical thinking and instructor’s openness clustered at the upper (positive) end of the response scale. One issue raised in the 2000 Evaluation Report was the extent to which the “halo effect” played a role in the positive ratings students gave the course. This certainly did not appear to be the case in year two when we examined how students answered items for Class and Lab. In fact, students appeared to be quite discerning. The contrast between student’s more positive reaction to the Lab warrants closer attention. Students were clearly more satisfied with the “Lab” than the “Class.” Since survey results for the Lab are consistent across both years, reflection the “Class” items that yielded lower ratings (at least for a few students) (i.e. what accounted for these differences) may be valuable in future implementations of the course.

Table 2.1
Response to College Assessment Survey (Classroom)

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Influence of course on critical thinking and reasoning ability</td>
<td>4.25</td>
</tr>
<tr>
<td>8.</td>
<td>Organization of the course</td>
<td>3.75</td>
</tr>
<tr>
<td>9.</td>
<td>Professor’s ability to facilitate comprehension of complex ideas</td>
<td>4.84</td>
</tr>
<tr>
<td>10.</td>
<td>Students’ self-rating of their work</td>
<td>3.59</td>
</tr>
<tr>
<td>11.</td>
<td>Professor’s evaluation of your work</td>
<td>3.50</td>
</tr>
<tr>
<td>12.</td>
<td>Professor motivated me to work hard</td>
<td>3.59</td>
</tr>
<tr>
<td>13.</td>
<td>Professor’s openness to questions and comments</td>
<td>4.17</td>
</tr>
<tr>
<td>14.</td>
<td>Professor’s comments are helpful</td>
<td>3.75</td>
</tr>
<tr>
<td>15.</td>
<td>Professor’s overall teaching effectiveness</td>
<td>3.75</td>
</tr>
</tbody>
</table>

Response Scale: 1=Excellent 2=Good 3=Average 4=Fair 5=Poor
Table 2.2
Response to College Course Assessment Survey (Laboratory)

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Influence of course on critical thinking and reasoning ability</td>
<td>4.75</td>
</tr>
<tr>
<td>8.</td>
<td>Organization of the course</td>
<td>4.75</td>
</tr>
<tr>
<td>9.</td>
<td>Professor’s ability to facilitate comprehension of complex ideas</td>
<td>4.67</td>
</tr>
<tr>
<td>10.</td>
<td>Students’ self-rating of their work</td>
<td>4.42</td>
</tr>
<tr>
<td>11.</td>
<td>Professor’s evaluation of your work</td>
<td>4.25</td>
</tr>
<tr>
<td>12.</td>
<td>Professor motivated me to work hard</td>
<td>4.25</td>
</tr>
<tr>
<td>13.</td>
<td>Professor’s openness to questions and comments</td>
<td>4.92</td>
</tr>
<tr>
<td>14.</td>
<td>Professor’s comments are helpful</td>
<td>4.50</td>
</tr>
<tr>
<td>15.</td>
<td>Professor’s overall teaching effectiveness</td>
<td>4.64</td>
</tr>
</tbody>
</table>

Response Scale: 1=Excellent  2=Good  3=Average 4=Fair  5=Poor
Summary of Open-ended Responses to Instructor’s Course Assessment

The instructor’s survey solicited feedback from students on two laboratory experiences: cDNA cloning and the site-directed mutagenesis. Highlights of the written responses are below.

Student comments focused on the challenges faced in understanding the rationale behind the laboratory process. Students were eager to know what was taking place [with their experiments]. This suggests that students had to perhaps raise more questions and field possible answers from team members than they were accustomed to in other labs. By contrast, lab procedures were not “pre-packaged,” “mundane”, or necessarily confirmatory. This is to say that the outcome of any particular experiment could not be known in advance. In fact, compared to other laboratories, students admitted that “it required more work” and forced them out of an instructor-initiated comfort zone and into one where students took more responsibility for the success of the course.

Students enjoyed the real world applicability of lab techniques and welcomed the opportunity to present status reports on their individual experiments to the whole class, especially when the results were positive. The exploratory and discovery aspects of the labs appeared to be well-received. For one student, [the cDNA laboratory] was the “first time I had seen a genetic sequence for DNA” obtained from an experiment he or she conducted.

Many students were uncomfortable with the time constraints of laboratory work, often expressing this imposition as “downtime,” “incubations” or “waiting around [for results].” Delays due to technical problems with software and equipment occurred but were minor. Interestingly, student accolades about the efficiency of the lab protocols and layout show that students could understand that waiting was a realistic part of the laboratory process. The high frequency of comments related to downtime called for the instructor to integrate more class discussion to explain what is happening during slow periods. However, there is the possibility that the instructor may have purposefully structured the course in such a way that students come to play the role of investigator, learning to deal with the awkward “silences” of the experiment.
Summary of Open-Ended Responses to Instructor’s Course Assessment

Assuming that student responses to open-ended items express to a large extent what students believed to be most prominent or striking about the course, the following tables are intended to serve as a self-evaluative tool for the instructor wishing to learn from his practice or continue the course in the future. The small sample size of ten presents some limitations. A larger population would certainly substantiate the distribution of frequencies into each category and lend more credibility to such a modest technique. Student responses were simply categorized into themes and counted. Tables 3.1 and 3.2 correspond to the class surveys and reveal themes derived from student responses for two of three items on the survey. Tables 3.3 and 3.4 correspond to those of the lab survey. Consider the possibility that “no responses” may actually be a positive indicator of student satisfaction.

Table 3.1
Responses to Open-Ended College Assessment Survey (Class)

Item 1 - Strength of professor in teaching the course.

<table>
<thead>
<tr>
<th>Category</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simplified complex ideas/ explained material</td>
<td>5</td>
</tr>
<tr>
<td>Taught us how to present arguments</td>
<td>4</td>
</tr>
<tr>
<td>Exhibited favorable personality characteristics</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3.2
Responses to Open-Ended College Assessment Survey (Class)

Item 2 - Suggestions for improving the teaching of this course.

<table>
<thead>
<tr>
<th>Category</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover material in textbook more slowly</td>
<td>1</td>
</tr>
<tr>
<td>More focus on specific content (cloning)</td>
<td>2</td>
</tr>
<tr>
<td>Supplement teaching methods (videos)</td>
<td>1</td>
</tr>
<tr>
<td>Clarify inquiry-based grading criteria</td>
<td>2</td>
</tr>
<tr>
<td>Change nothing</td>
<td>1</td>
</tr>
<tr>
<td>No Response/ Not applicable</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 3.3  
Responses to Open-Ended College Assessment Survey (Lab)

Item 1 - Strengths of professor in teaching the course.

<table>
<thead>
<tr>
<th>Category</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simplified complex ideas/ explained materials, assistance</td>
<td>4</td>
</tr>
<tr>
<td>Respected students as colleagues</td>
<td>2</td>
</tr>
<tr>
<td>Exhibited favorable personality characteristics</td>
<td>3</td>
</tr>
<tr>
<td>Facilitated experiments</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3.4  
Responses to Open-Ended College Assessment Survey (Lab)

Item 2 - Suggested improvements for teaching the course

<table>
<thead>
<tr>
<th>Category</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide more opportunities to fill “down time” in labs</td>
<td>1</td>
</tr>
<tr>
<td>No improvements needed</td>
<td>2</td>
</tr>
<tr>
<td>Replace/ Update equipment</td>
<td>1</td>
</tr>
<tr>
<td>Discussion of specific course content/ Prefab review</td>
<td>2</td>
</tr>
<tr>
<td>No responses</td>
<td>4</td>
</tr>
</tbody>
</table>
Summary of Focus Group

On May 11, 2001, eleven of the twelve students enrolled in Biology 405 met with a focus group facilitator to discuss the impact and effectiveness of the collaborative and inquiry-based approaches to the study of recombinant DNA. Students met with the facilitator for one hour on the last day of class. The purpose of the focus group was to gain insight about the skills acquired in the course and implications for continuing the course in subsequent years.

“Students agreed that the course was clearly discussion-based and collaborative and believed the inquiry-based approach to be most attractive within an advanced course in genetics. Many students had taken the more traditional undergraduate level course in genetics from the same instructor).

The collaboration served the purpose of creating a classroom community of student scientists through which a forum developed for students to debate the “hot” and controversial topics of recombinant DNA and explore a variety of issues regarding the value of research in genetics. A notable example of how such collaboration presented itself occurred after the group facilitator asked students to provide him with a working, non-technical description of the class. After one student offered “a really in-depth survey of the current trends of molecular genetics,” a few students were quick to add similar statements in what appeared to be a tag-team approach. The instructor was credited with helping them to “unlock the language of genetics.” The ease with which the group arrived at a collective course description, here and at a later points in the discussion, served as an actual demonstration and evidence of the type of collaborative process that occurred throughout the course.

Students expressed a preference for the collaborative team approaches but noted the emphasis and balance with individualized assignments and reading. For example, students were required to select their own articles, make presentations to the whole class, and conduct experiments of their own choosing. One student believed that as a result of going through these processes, he now has a better grasp on how to “read through science” and a broader knowledge base of science. Another student believed that, as a group, “we can identify what’s wrong with experiments.” This evidence of acquired skills in critical thinking enabled students to think twice about blindly accepting the results of others. One student appreciated the opportunity to take on a sense of ownership in the class and credited the “nature” of the instructional approach of the course. Whether intended or unintended, students came to realize that negative results or none reactions were not necessarily indicative of a bad result or procedure. This uniqueness helped the course to be “interesting” and “fun.”

Peer interaction was described to be noncompetitive, however, students did make efforts to ensure that their respective teams appeared as competent and knowledgeable as possible. It was common for teams to meet outside of regular class time. The instructor’s grading criteria, which held each student accountable for the performance of the members of his or her group, did have an influence on the level of student preparation and interaction.

Students cited that recommendations of first cohort students, successful prior experiences in courses taught by the instructor, knowledge of the discussion-based format, and knowledge of the instructor’s straightforward teaching style influenced the decision to enroll in the course. The lectures that did occur were minimal and provided necessary foundation for course topics.

Very favorable comments and gestures were made about the professor’s teaching style. The majority of students believed that they were “treated enough as colleagues” and appreciated the instructor’s flexibility to provide guidance yet allow students to work autonomously in work groups and
labs. More poignant comments pointed out the professor’s ability to help students discover applications in works that students found interesting.

The nature of the inquiry discussion based class represented a departure from the traditional lecture format and yielded overwhelmingly positive responses. After several prompts for weakness or suggested areas of improvement, many students commented that, as a group, they were initially unclear about the manner in which student interactions would be graded. Even at the time of the focus group, students still expressed some ambivalence about their academic standing, or at least the final grade they expected to receive. Apparently, the grading criteria appeared to introduce new accountability issues for many students. Students also pointed out, however, that unexpected lower grades for discussion pushed all students toward more active participation in the second round.”
Summary of Major Field Achievement Test (MFAT)

The Major Field Achievement Test (MFAT) is a nationally administered test given to students in their senior year and is intended to assess students’ knowledge in their major field. For this evaluation, the percentile of the mean score for biology majors at the College are compared against the percentile of the mean score for biology and bio-psychology majors enrolled in the recombinant DNA course in an effort to determine plausible influences of the course on MFAT outcomes. Tables 4.1 and 4.2 show the collective percentile ranks for the five and eight senior students in the 2000 and 2001 academic years.

Table 4.1
2000 Results of Major Field Achievement Test - Biology

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
<th>Percentile</th>
<th>Subscore</th>
<th>Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 405</td>
<td>157.4</td>
<td>69th</td>
<td>62.4</td>
<td>86th</td>
</tr>
<tr>
<td>All Majors</td>
<td>154.8</td>
<td>57th</td>
<td>58.6</td>
<td>73rd</td>
</tr>
<tr>
<td>Biology</td>
<td>156.8</td>
<td>69th</td>
<td>58.7</td>
<td>73rd</td>
</tr>
<tr>
<td>Bio-Psych</td>
<td>150.8</td>
<td>33rd</td>
<td>58.3</td>
<td>67th</td>
</tr>
</tbody>
</table>

Table 4.2
2001 Results of Major Field Achievement Test - Biology

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
<th>Percentile</th>
<th>Subscore</th>
<th>Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 405</td>
<td>162.1</td>
<td>82nd</td>
<td>65.4</td>
<td>93rd</td>
</tr>
<tr>
<td>All Majors</td>
<td>157.9</td>
<td>68th</td>
<td>62.8</td>
<td>89th</td>
</tr>
<tr>
<td>Biology</td>
<td>160.7</td>
<td>80th</td>
<td>63.3</td>
<td>89th</td>
</tr>
<tr>
<td>Bio-Psych</td>
<td>151.5</td>
<td>29th</td>
<td>61.5</td>
<td>67th</td>
</tr>
</tbody>
</table>

On the most recent Major Field Achievement Test (Spring 2001), students enrolled in Biology 405 scored at the 82nd percentile (for a mean score of 162.1) and at the 93rd percentile (for a mean score of 65.4) on the molecular biology/ genetics subtest. When considering group differences between the subscores in genetics, biology 405 students scored approximately 2 points higher than all department majors.

In both years, biology 405 students obtained scores that ranked them at a slightly higher percentile than all biology majors. Biology 405 students also realized a seven point gain in percentile rank on the genetics subtest between year one and year two. However, we can not disregard the fact that any influence of Biology 405 on MFAT outcomes is nominal since all department majors realized a substantial percentile gain on the subtest, as well. In this case, caution is advised. We consider these small incremental gains with respect to those made by the department as a whole.
Summary of Peer Review Simulation

Biology 405 students met the challenge of writing “publishable” papers of “original research.” Ratings in each of the five criteria for the prior year (2000) were very positive, for all papers. In the current year, three out of the four research papers received similar positive ratings. The remaining research paper was more negatively critiqued due to serious problems in one or more of the quality criteria areas. A total of eighteen students enrolled in the course across both years and wrote scientific abstracts and received feedback from the reviewers. Below is a summary of the 2001 peer review.

Students wrote and submitted scientific research papers for review by postdoctoral fellows in biology at the University of Alabama in Birmingham. Evident from the multiple authorship of each of the four papers, it is evident that students worked in research and writing teams under the guidance of the professor (whose name appears as the last author) and that each paper was reviewed by two authors.

The simulation of the process of preparing “publishable” scientific research papers for review met the instructional goals of this course. The purposes of the exercise remained the same for year two: to give students practice in scientific writing and to obtain an expert perspective as to the degree to which their work meet the standards of publication readiness in the field. The uniqueness of the course and this exercise, in particular, warrant some thought about the extent to which similar courses enable student work to undergo the rigors of review by outside sources at the undergraduate level.

The reviews were generally favorable. The table below gives the ratings assigned by the reviewers to five quality criteria. Reviewers were generally impressed with the originality of the papers, rating this criteria as Superior or Good, for all papers. For the remaining criteria, the ratings typically cluster around Superior and Good. One of the four papers received both a rating of Fair and Poor by a reviewer.

<table>
<thead>
<tr>
<th></th>
<th>Superior</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Originality</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Soundness</td>
<td>0</td>
<td>7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Quality of method</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Clarity</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Organization</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Reviewer commentary consisted of detailed and thorough comments about each section of the research paper and primarily provided suggestions for students to make format revisions and pay close attention to the technical usage of abbreviations and vocabulary. On more than one review, students were reminded to “not use figures and graphs in the introduction” and to “tell a story with the figures and illustrations.”

For example, reviewers generally encouraged students to explore the significance of their research and seemed satisfied when students, for example “appreciated the importance of using amphioxus and its relevance to vertebrates” or “did a good job of placing the problem into context with previous data…”
Another important element derived from the reviewer’s comments is the emphasis placed on the quality of student explanation and interpretations. Examples of these comments included:

“You should be more confident about your results while acknowledging the weaknesses.”
“Authors should provide ways to specifically test the weaknesses or eliminate them.”
It is “good to provide alternatives to why you think F-422 mutant is not functional…provide further experiments to test these possibilities.”
Conclusions

Biology 405 serves as a rich example of the level of work that motivated biology majors can accomplish in the discipline when nurtured and supported in the inquiry-based classroom. We find that the evaluation data for the current year (2001), with the exception of minor changes, are very consistent with that of the prior year (2000). In the few cases where comparisons between the prior and current year show that ratings fell, we found the second year ratings to be only slightly lower. Any differences in the data could likely be attributed to the different experience of a few students or one team reported in the data. Interestingly, the occurrence of a few students or a team reporting a different experience than all other students was not derived from focus groups or open-ended responses.

The course continued to meet its objectives and engage students in an in-depth survey of molecular genetics. The instructor used well-planned strategies to implement a course that was largely discussion-based, collaborative, and based upon principles of inquiry-based instruction. The evaluation plan emphasized the use of the multiple sources for data collection and ensured that data collection procedures across both years remained consistent. This forethought undoubtedly helped the evaluation team efficiently explore the data for cross-year comparisons. The synthesis of positive responses derived from survey data, focus group interviews, “expert” peer review of student research projects, and standardized achievement test results demonstrate that Biology 405 was met with a great deal of acceptance and success. This section attempts to highlight the most prominent factors accounting for the success of Biology 405.

First, class sizes were small; nine and twelve students participated in the first and second year of the course, respectively. Manageable class sizes facilitated student work in teams; for example, each research paper that underwent peer review was authored by a team of three students. The low number of students in each class was seen as optimal. In fact, in many areas, students suggested that future implementations of the course undergo no change or remain “as is.”

Students were optimistic about their experiences in the class and lab. In the first year, the overwhelmingly positive reports raised some concern about the possibility of a “halo effect” factoring in student’s positive appraisal of the course, which would make it difficult for students to be discerning in their ratings from item to item. Interestingly, mean (average) responses to the survey items administered by the instructor were positive and virtually identical. This is to say that items that received very positive ratings in the first year received very positive ratings in the second year. A slightly different pattern emerged on the College’s survey. Students in the first cohort were very satisfied with their “Class” and “Lab” experiences in which ratings ranged from good to excellent, but the second cohort of students were clearly discerning and favored “Lab” over “Class,” even though no ratings were below average.

It was evident that the ability of the instructor to make seemingly complex subject matter amenable played a major role in the success of the course. The high frequency of statements supporting the instructor’s influence was charted from student’s written responses. The supportive personality traits of the instructor were conducing to the creation of the “scholarly” classroom environment that students described. Certainly, an undergraduate level course that explores the topic of recombinant DNA can stand alone; that is, attract interested students because of its sheer popularity. But the instructor’s straightforward teaching style, demonstrated respect of students as colleagues, and willingness to yield his role as the lead discussant continued to emerge as one of the most influential factors in the success of the course. This emerged even when students believed they needed to clarify issues with the instructor.
relating to accountability in class discussions. Student’s initial lack of clarity with the instructor’s criteria for grading peer interactions suggest that students would benefit from an orientation into the types of accountability issues inherent the inquiry-based science classroom.

The nature of inquiry-based science classroom places special demands among the instructor and students electing to take the course. The evidence presented in the prior and current year’s report demonstrates that Biology 405 students were able to meet the demands outlined in the curriculum and the College’s Expanded Paradigm. Peer interactions were noncompetitive, yet motivated students to strive for competence. Students were taught to construct logical arguments and had ample opportunities to debate the “hot” controversial issues of recombinant DNA. Students were expressive and could articulate the value of genetic research.

Achievement data of Biology 405 students is also positive. While we exercise caution in drawing any definitive conclusions for reasons explained in an earlier section of this report, Major Field Achievement Test (MFAT) results show that both cohorts of Biology 405 students were at an advantage. Biology 405 students outscored all biology majors in the department on the molecular biology/ genetics sub-test and on the biology field test, as a whole.

In addition, by the end of the course, students had co-authored papers of “original research” and submitted them for review by post-doctoral scientists at a major urban university known for its advances in medical research. These accomplishments clearly validate student’s beliefs that they are, indeed, contributing to the field. We note, however, that the course’s relevance to student’s career interests is neutral and could have more of a long-term impact in the future.

Lastly, in contemplating the extent to which this course could be generalized to other college settings, we consider the characteristics of students electing to enroll in Biology 405. A 400 level course, Biology 405 was obviously advanced, and required a substantial time commitment. It is not surprising that the focus group data revealed that students had particular motivations for taking the course. For example, many students trusted the recommendations of students in the first cohort or recommendations of the instructor. Some expressed an initial interest in the discussion-based format (and a challenge, in general), an interest in the subject, itself, or “knew” the strong reputation of the instructor. At least one student initiated a conversation with the instructor about the nature of the course. These factors are presented here to demonstrate that as a group, these students were conscientious and aware. They ‘understood what they were getting into’ with regard to the inquiry-based classroom. Also, the level of student preparation appears to have played a role in student’s readiness for the course as well. In the current year, the majority of students had already completed a lecture-based course in genetics and recommended that course as a prerequisite for Biology 405.

Supported within the inquiry based classroom and laboratory setting, students participating in the course benefited from opportunities to engage in collaborative discussions focused on the social and ethical issues related to scientific research. At a broader level, students collectively explored the relationship of science and technology and honed critical thinking and research skills that will continue to have cross-disciplinary applicability. We are confident that with little changes in the structure of the course, Biology 405 would continue to be successful in meeting its objectives. Students would continue to rate the course positively.