Portfolio for Deanna Soper

Background Information

Student demographics

Students in Q201 are all elementary education majors. They range from freshman to senior and have a wide variety of scientific backgrounds. Many students in this class are fearful of the class and have negative preconceptions of science. This course is designed at the 200 or sophomore level for non-major students. The class includes a lecture section taught by a seasoned professor and several smaller correlated lab sections taught by graduate students from the biology department. The goal of this class is to teach students general biological concepts at a college level but also to encourage them to think about how they will teach similar concepts at an elementary level. This is not an educational methodology course, but it is a biology course where they learn important biological content that will pertain to concepts taught in elementary schools. (For a lab syllabus see Appendix A)

Objectives

Learning objectives include understanding major biological concepts and development of ideas for implementation in the elementary classroom. Currently, labs consist of a short lab introduction which is to serve two purposes: lab safety and linking concepts addressed in lab to those discussed in lecture. I have taught this course in two previous semesters. Based on student evaluations, I discovered the students were not seeing the value in class discussions prior to lab. My objective was to determine why they were not seeing the value in pre-lab discussions and also to evaluate other methods for discussion effectiveness. It is important for students to understand how the lab and practical application applies to concepts taught in class. If students are able to cognitively link content and lab activities they will be more likely to make the same connections as teachers.

Implementation

Since students were having difficulty in understanding the importance of the lecture/discussion at the beginning of the lab, I felt I needed to do something differently to link what they were learning in lecture with lab activities. Initially, I decided to write the parts of the lab on the board and discuss lecture topics under each section title of the lab. Soon after I began this modification, we had a TEAGLE meeting. During the meeting, we each were allowed to talk about our teaching/learning difficulty and how we were addressing it. After I explained my situation and my current solution to the problem, discussion focused on educational practices. Members and professors of TEGALE questioned the placement of lecture/discussion and brought up the possibility of placing it at the end of lab. Inquiry-based educational research has suggested it is better for students to manipulate a concept, in this case through lab, and then discuss the concept and learn vocabulary. I continued to think about our discussion and decided to test this theory to see if students would see the value in discussion/lecture more after they had manipulated concepts as opposed to before. I created three methods for the experiment. Each method will be discussed below; benefits and disadvantages of each will be addressed.

Method 1
Discussion questions were developed for students to discuss when they finished their lab. (See Appendix B) Two lab pairs of students were placed together to discuss what each lab group had found and answer the questions provided. Students waited for everyone else to finish their lab and discussion questions. Groups then placed their answers on the board. The entire class discussed what each group had concluded (See board pictures below).

Method 2

In this lab, students were given lab safety information, informed they would be stopped at a pre-determined time to have a class discussion, and then released to do the lab. Students were stopped when most of the lab was completed and results from two of the three activities were obtained. A summary page, which had already been built into the lab (See Appendix C), was discussed as a class. I placed answers that students came up with on the board. Students recorded the information placed on the board in their labs.

Method 3

This method is the traditional approach to Q201. Associate instructors give a ten to fifteen minute presentation of lab activities linking them to major biological concepts and lab safety information. Students are then released to do the lab. When students finish the lab, instructors check to make sure they did not skip any parts and they are allowed to leave the lab. Typically, students finish at different times and leave when they are finished. This method does not allow for any discussion or lecture at the end of the lab.

Assessment

I used surveys the following week to determine, (i) how well students understood concepts and (ii) student evaluation of varying methods from both a student’s perspective and an educational perspective. (See Appendix D for surveys) I assigned a value of six points to each of the content sections to evaluate how well students learned the material presented. I averaged student scores to determine impact of methodology on student learning. Student evaluation of pedagogy was looked through and example comments from the general feeling from the class will be presented below.

Understanding of Concepts

Methodology one had an average of 3.4 out of 6 points for the class. This value was lower than the averages for methodology two (4.4) and methodology three (4.3). The graph below shows the averages and one standard error bars for each methodology.
Student Evaluation of Methodology

Method One
Some students liked having discussion after lab because it gave them an opportunity to discuss and tie together the topics they had learned in lab. This was evident through comments such as: “I like having discussion after lab because it reinforces what we learned so we understand it better.” and “I liked how it basically summarized what we did during the lab.” Many students also said they disliked this method but most cited the reason either was waiting for other groups to finish or feeling rushed to get done. This was evident through comments like: “I did not like the time issue – because we all got done at different times and we had to wait.” or “I felt very rushed because other groups got done before us.”

Method Two
Feedback from this method was very positive as only one student out of fifteen stated they didn’t like it. There were some comments for improvement with the positive feedback. Comments from a few sample students are:

- “I liked the class discussion and the timing worked well because we were all at the same place.”
- “I liked it because it allowed us as a class to discuss the important concepts from the lab to make sure we understood what was happening.”
- “I like that we were able to ask questions/contribute as well as the fact that you stopped at a designated time to complete the discussion.”

Some students also provided feedback on additional adjustments to the lab structure...

- “I liked that everyone knew more information and could contribute more in class... maybe find a balance of both open-ended in the beginning with questions from class and more teacher oriented at the end.”
- “I liked that we were able to give input and ask plenty of questions. Realistically, if we always had the time, it would be nice to have an introduction and then closing discussion at the end to bring it together.”
- “I still also like having information at the beginning but talking at the end really helped me to know if I knew exactly what happened in the lab and helped with the lab quiz this week.”
Method Three
Students also liked this method overall. Many did produce the caveat they felt they went into this lab better understanding the material ahead of time from lecture than the lab from method two. Most were indifferent between method two and three. Student comments reflect these results:

- “I feel I learned more and better understood the lab when we had discussion at the beginning of lab. Although, we can’t review what we did or were supposed to learn from the lab.”
- “I can utilize the information we talked about better when I use it again in the lab. There is nothing I don’t really like about having information at the beginning. I did remember more from the lecture at the beginning because I could connect that information to the lab once I completed it.”
- “The lecture at the beginning helped me to understand what was going on before we started and I better understood why we were doing the experiment. I feel like I learned the same amount from both labs, the knowledge just clicked at different times of the procedure.”

I must note in the last comment this student realized that there was a difference in when the information was retained in her brain but that she felt in the end there was no difference in how well she learned the information.

Reflection

Benefits of this method 1

Through this activity, I was able to uncover misconceptions students had about related topics because the discussion was at the end of the lab. This was beneficial because students may accumulate misconceptions during the lab and clearing those up prior to the student leaving is important to reducing misunderstanding of material. Students also had insights into each other’s thinking and I liked they felt more prepared to contribute to discussion.

Disadvantages of method 1

Students who finished early were frustrated at having to wait for other students working slower. Students who worked slower were frustrated at feeling rushed to finish since they knew their peers were waiting for them. I have concluded the frustration inhibited students from fully discussing topics and prevented learning from occurring. This method also takes more physical time since students had to discuss questions independently and then together as an entire class. During this particular week this method was time allowable; however, during weeks that have time constraints this would be an issue.

Benefits for method 2

Use of this method allowed students to manipulate concepts prior to discussion; therefore, students had concrete activities upon to build their vocabulary and knowledge. This was reflected in the survey feedback from students. Many students commented they better understood what was being talked about using this method after they had completed most of the lab. The timing of the discussion was better than in method one. I set a specific time at which the discussion would take place and told students they should be to a particular spot by that time. Through communicating my expectations and setting a specific time for discussion, students were able to focus on the discussion without feeling the pressure of being done at varying times. I felt this method allowed students to take their time in
discussion and concurrently summarize events of the lab and as a result an increase in learning occurred compared to method one.

**Disadvantages for method 2**

During this method no concept discussion occurred prior to students working on lab activities. Students were less prepared for the activities and ideas that were being presented during the lab. Through use of the survey students described feeling more confused while performing experiments. During the discussion, it was mostly directed by myself and varied from method one, which was student directed. Through having teacher facilitated discussion student misconceptions did not have the ability to surface like they might have during a student directed discussion or activity.

**Benefits for method 3**

Method three provided students an opportunity to learn about concepts first and provide them with background information prior to doing the lab. This resulted in extra preparedness during lab and for some individuals assisted them in learning and retaining information addressed in lab. It is easier for the lab instructor to structure the lab in this way because when students complete the lab they are allowed to leave. Placing discussion at the end requires lab instructors to be aware of lab timing so that most of the lab was done; therefore, using method three is a simpler more straight-forward technique.

**Disadvantages for method 3**

The major disadvantage to this method is that students may not retain as much information especially if they are unfamiliar with the content. Allowing students to manipulate concepts first and then summarize and discuss after provides a framework for students to use when learning new material. Method three also does not provide any student discussion besides that which takes place within lab partner groups. Summarizing and discussing at the end of lab provides students an opportunity to contribute and hear their peers discuss the topics. In addition, by listening to my students discuss topics, create concept maps, diagram concepts, and answer questions I am able to informally evaluate their learning and identify misconceptions.

**Student Evaluations**

Student evaluations increased in positivity and I received the best comments I have had in three semesters of teaching the course. I was a little unsure how performing educational experimentation on them would affect their evaluations but in the end I feel students recognized my willingness to make the lab section better. Hopefully I also modeled good educational practice for future teachers, doing experimentation and reflective teaching practice is essential to every teacher. Below are some representative sample comments from course evaluations:

- “She does an excellent job at explaining information clearly and answers all my questions. She is enthusiastic and can see passion for science! She is understanding and willing to help all students... She is really the best science teacher I have ever had!”
- “I love that she is always available for questions and doesn’t get frustrated when we don’t understand. She understands that we aren’t all biology majors and need lots of help. She’s very willing to spend time out of class meeting with us too, or holding study sessions.”
• “What I like most about my AI is that she does a mini-lecture at the beginning. She also has answered every question I have asked of her.”
• “Very thorough when explaining material, group discussions helped a lot.”
• “I liked how the AI held review sessions for lecture exams. I like how she was extremely helpful during labs – always answering questions and explaining.”
• “She gives a lesson before the lab so that everything is clearer and the lab is easier to understand.”

Conclusions and Next Steps

After evaluation, I feel the best methodology is a split design; a 10 minute discussion at the beginning of the lab, mostly reviewing lab safety information and when needed doing a quick review of major concepts for each lab activity, as well as doing a more student directed summary activity towards the end of lab not to exceed a ten minute time frame. I do not feel putting the summary activity at the very end would allow for student learning to reach maximum potential due to the stress students experienced. This methodology would result in only a five minute increase in discussion time from the current structure and would allow for positive outcomes from both methodologies. Both methods two and three had positive results from student comments and also content analysis (shown in graph above) proved no difference between methodologies. The lower overall score for methodology one was the result of student stress experienced by placing discussion at the very end of lab. Labs should be reconstructed so that this structure is implemented into all lab sections and becomes part of the Q201 lab culture. Through standardization, none of the lab sections will feel they are being “held over” or have extra work to do – both ideologies which may also inhibit the learning process.
**Appendix A**

**Laboratory Manual:** (REQUIRED):  

**Please purchase the lab manual BEFORE coming to your first lab. Be sure to complete the Pre-Lab Assignment and Readings BEFORE lab each week!**

### Q201 Laboratory Schedule Spring 2009

<table>
<thead>
<tr>
<th>Date</th>
<th>Lab</th>
<th>Exams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-15</td>
<td>Introduction to the Scientific Method</td>
<td></td>
</tr>
<tr>
<td>20-22</td>
<td>Monera</td>
<td></td>
</tr>
<tr>
<td>27-29</td>
<td>Protists</td>
<td></td>
</tr>
<tr>
<td>Feb.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-5</td>
<td>Plants</td>
<td>Lee Exam 1</td>
</tr>
<tr>
<td>10-12</td>
<td>Invertebrate Animals and Classification</td>
<td>Fri., Feb. 6th</td>
</tr>
<tr>
<td>17-19</td>
<td>Vertebrate Animals</td>
<td></td>
</tr>
<tr>
<td>24-26</td>
<td>Biological Chemistry</td>
<td>Lec. Exam 2:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>March</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-5</td>
<td>Photosynthesis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+You will write a lab report on this week’s lab. (50 pts)</td>
<td></td>
</tr>
<tr>
<td>10-12</td>
<td>Respiration in Animals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+Rough draft of lab report due in lab this week.</td>
<td></td>
</tr>
<tr>
<td>17-19</td>
<td>SPRING BREAK!! No Lecture or Lab!!</td>
<td></td>
</tr>
<tr>
<td>24-26</td>
<td>Genetics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+Rough draft of lab report given to peer reviewer this week.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar. 31-Apr. 2</td>
<td>Biotechnology</td>
<td>Lec. Exam 3:</td>
</tr>
<tr>
<td></td>
<td>+Peer reviews due in lab.</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-9</td>
<td>Evolution I: Mechanisms of Evolution</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+Peer review of lab report and rough draft returned to author this week.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Portfolio due in lab this week (40 pts.)</td>
<td></td>
</tr>
<tr>
<td>14-16</td>
<td>Outcomes of Evolution</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+Final draft of lab report due in lab this week.</td>
<td></td>
</tr>
<tr>
<td>21-23</td>
<td>Principles of Ecology **Independent Project due in lecture and at Turnitin on Monday, April 20th.</td>
<td></td>
</tr>
<tr>
<td>28-30</td>
<td>Ecology: Human Effects on the Biosphere</td>
<td></td>
</tr>
</tbody>
</table>

**IMPORTANT:** Q201 Pre-lab handouts and online readings MUST be completed BEFORE coming to lab each week. Be sure to bring your lab materials to lab with you to your lab. The Q201 laboratory website and web readings are available online at: [http://courses.bso.indiana.edu/Q201_Hanratty/mainmenu.html](http://courses.bso.indiana.edu/Q201_Hanratty/mainmenu.html)

This will take you to the Q201 lab homepage. Click on the appropriate links for the background readings and lab materials.
Methodology One

Discussion Question List

Directions: Discuss the questions between your lab group and another. Write down your conclusions in the space provided. You will place your answers on the board.

1. How do invertebrates fit into the taxonomy (classification) in relation to: archaebacteria, eubacteria, plants, and protists? (Hint: think about the diagram used in class that stems with the three domains)

2. List some examples of animals from each of the invertebrate phylums studied today. Then next to each group place characteristics for each.

3. How could you modify these concepts so a second grader could understand what an invertebrate is? What activities could you do to get across these concepts?

4. Place your diagram from number one, your examples from number two, and a few words from number three on the board for a short class discussion.
Appendix C

Conclusions
When the above experiments have been completed, write your conclusions from each below. In writing the conclusions, look at each experiment and consider what it was set up to demonstrate. Remember to make your conclusions on the basis of your data. (i.e. say: I can conclude X because my data showed Y.)

1. Protein Digestion:

2. Lipid Digestion:

3. Starch Digestion:

4. Answer the following questions:
   a. What sort of reaction is used to create organic compounds?
   b. The process of digestion breaks apart organic compounds. Describe what the starting molecules and ending molecules are in a digestion reaction (the general terms) and what type of reaction is responsible for breaking apart the initial molecules.
   c. Thinking about the diffusion demonstration, why is digestion of proteins, lipids and starches necessary?

Appendix D

Survey for Methodology One

Content
1. What domain do invertebrates fit into?

2. List all of the major phylum of animals and give an example for each.

Methodology
1. Thinking from an educators perspective, which method do you think is better, lecturing and discussion before or after the lab?

2. Do you have any suggestions for linking content to the lab?
3. What did you like about having discussion at the end of lab? What did you not like about it?

Survey for Methodology Two

Content
1. Tell me the monomer(subunit) of each of the polymers below.
   Protein:
   Carbohydrate (starch):
   Lipid:
   Nucleic Acid:

2. Through the digestion experiments we discovered that enzyme function depends on several parameters or environmental conditions. What are three of those parameters?

3. How does the size of the molecule affect digestion?

Methodology
4. How did you feel about the way that the modification was done?

5. What did you like about the way that the discussion was handled?

6. What did you not like about it?

7. Any suggestions to make it different/better?

Survey for Methodology Three

Content
1. Write the photosynthesis equation below. (Tell me what goes into the process and what is produced as waste products)

2. Write the cellular respiration equation below. (Tell me what goes into the process and what is produced as waste products)

3. What organelle does photosynthesis occur in? What organelle does cellular respiration occur in?

Methodology
Last week I lectured at the beginning of the lab as opposed to holding a discussion towards the end of the lab. Please answer the following questions regarding this methodology.

1. What do you like about the lecture at the beginning of the lab?

2. What did you not like about the lecture at the beginning of lab?

3. Compare how much you felt that you learned during the photosynthesis lab (lecture at the beginning) to the biochemical lab (discussion towards the end of lab).