Incorporating Worksheets to Enhance Active Learning in a Laboratory Course

Zakiya S. Kelley
*Western Michigan University, zakiya.kelley@wmich.edu*

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Incorporating Worksheets to Enhance Active Learning in a Laboratory Course

Zakiya S. Kelley  
Department of Biological Sciences, Western Michigan University  
STEM Instructional Program 2019-20

Objective

- To improve student participation and information retention when completing laboratory experiments in the classroom  
- To emphasize key points of the topic being explored

Study Goals

To create worksheets that would aid the students in properly completing the required experiments and challenge them to do more than just follow the instructions. Each week there were often multiple experiments to be completed and pre-made samples to be observed within the class period. By providing the worksheet, I ensured the students completed all tasks and comprehended the covered material before class ended.

Classroom Structure

Worksheets were utilized in a biology laboratory course geared towards non-majors. This course fulfilled a university science requirement which meant that a wide range of majors were present in the classroom (e.g. political science, art, etc.) creating a unique learning environment. A new topic was covered each week, starting with building basic laboratory skills such as handling a microscope and data collection. The main goals of the course were to introduce students to an array of biology topics and emphasize the influence science has on their everyday lives.

Acknowledgements

Thank you to Celene Jackson, my course supervisor, for allowing me the flexibility to incorporate new teaching methods into the classroom. Thank you to the program organizers and speakers for providing insight and instruction into how to improve student learning experiences within a STEM course. Thank you to fellow participants for the mutual support and encouragement as we improved our effectiveness as instructors.

Literature Review


Contact Information

Email: zakiya.kelley@wmich.edu  
Alternative: zakiya.kelley@gmail.com

Traditional Classroom

Methods

Worksheet format varied depending on the experiments that would be taking place.

Each worksheet contained some of the following:

- List of required activities  
- Space for drawing images  
- Space to record observations (if not already provided in lab manual)  
- Open ended questions about results  
- Emphasis on key points

![Worksheet example](image)

Results

<table>
<thead>
<tr>
<th>Pre-worksheets</th>
<th>With worksheets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portions of experiment were skipped</td>
<td>All activities were completed</td>
</tr>
<tr>
<td>Majority of experiments completed by one student</td>
<td>Tasks were divided among group members</td>
</tr>
<tr>
<td>Little opportunity for ungraded assessment</td>
<td>Constant informal assessment during class</td>
</tr>
<tr>
<td>Few practice questions available in lab manual</td>
<td>Additional exercises for practice with answers online</td>
</tr>
<tr>
<td>Presentation slides main study guide</td>
<td>Key points were easily identifiable for easier studying</td>
</tr>
</tbody>
</table>

Conclusions

- Though active learning occurs each week due to hands-on experiments, the worksheets provided an additional push to think outside the pages instead of only focusing on the experiment.  
- The worksheets were a helpful informal assessment of comprehension for the students and myself.  
- In comparison to previous years, worksheets have greatly improved the flow of activities and increased involvement by each member of a group.

Student Comments

- "My favorite lab was the dissection lab because it was cool to be able to try it out on our own, especially the sea star. The inside was fascinating."  
- "My favorite lab was botany because I got a lot of useful information about how plants react to sun and how the root system works."  
- "I learned that I really like science, it's really interesting."  
- "A fun fact that I learned from this class would be how well our body adapts to our surroundings. I had a lot of fun with the human senses lab and my guesses for what I thought was going to happen were completely different than what the outcome was. Your sense of smell adapts faster than I would have imagined!"  
- "My favorite lab was the agarose gel electrophoresis. I had never done an experiment like this one before and it was a challenging yet fun experiment to participate in."