Biology 224 Outcomes

Student Scores

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>Percent Correct</th>
<th>2013 pretest</th>
<th>2014 posttest</th>
<th>p-value *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Literature Skills</td>
<td>59.0%</td>
<td>87.0%</td>
<td></td>
<td>0.000</td>
</tr>
<tr>
<td>Simple Dilutions</td>
<td>14.7%</td>
<td>68.3%</td>
<td></td>
<td>0.000</td>
</tr>
<tr>
<td>Using a Standard Curve</td>
<td>26.3%</td>
<td>77.8%</td>
<td></td>
<td>0.000</td>
</tr>
<tr>
<td>Quantitative Transfer with Microplate</td>
<td>2.0%</td>
<td>85.0%</td>
<td></td>
<td>0.000</td>
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<tr>
<td>Serial Dilutions</td>
<td>3.3%</td>
<td>64.7%</td>
<td></td>
<td>0.000</td>
</tr>
<tr>
<td>Total</td>
<td>19.9%</td>
<td>72.7%</td>
<td></td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 2. Details of Cellular and Genetic Systems Lab student learning outcomes

Student Perceptions

![Graph showing student perceptions](image)

Figure 2. Course Evaluation Ratings for Cellular and Genetic Systems (BIOL 224). *Exact p-values have been adjusted using the Bonferroni correction.

Quotes from SALG Survey

- **Control (2012)**
  
  "[The labs] were effective, but it often felt like a cookbook. I just followed steps 1-23 and then you are done." — response ID: [link]

- **Treatment (2013 & 2014)**
  
  "I didn't see much [connection between lecture and lab]. Because what we were doing in lab was so different than what we were learning in class, it made it more difficult to understand that lab. When we did use terms we had learned in class, it made it a lot easier." — response ID: [link]

"The learning goals were very clear, however there was challenge to keep up with the information every week because as it's lab, I didn't anticipate this much depth like in other labs" — response ID: [link]

"Not very clear. We were just told vaguely what we should do and what our end goal was. The big picture was often not emphasized enough." — response ID: [link]

Conclusions

- **After taking Biology 224, students made significant learning gains, but their perceptions of the course declined**
  
  - Possible reasons for declining perceptions:
    - Students may find inquiry-based lab to be frustrating and challenging. This has been documented in previous research (Brickman et al., 2009).
    - Implementation dip (Fullan, 2006): performance temporarily worsens when change is implemented.
    - Students perceived a lack of connection between lecture and lab — a source of frustration and confusion.
    - Students also noted lack of clarity in expectations and learning goals.
  
  - In contrast to 224, Biology 225 resulted in fewer significant learning gains, but student perceptions remained positive.
  
  - Students possessed 'surface knowledge'; however, when asked to apply the concepts to novel, more complex situations on post-test, unable to do so.
  
  - The curriculum in this part does not foster effective transfer of knowledge.

Future Goals

- **Biology 224**: Revise lab manual to clarify expectations & goals, and also establish connection between lab and lectures.

- **Biology 225**: Infuse curriculum with ‘contrasting cases’ pedagogy, which helps students think critically and go beyond surface knowledge.

- We have also prepared a manuscript based on our findings, which we plan to submit to various journals.

- We also plan to make our revised curricula available for instructors at other institutions to use for their needs.

Acknowledgements

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References

