the transformation of Physics 315

James Day and Vladimir Hinkov

Carl Wieman Science Education Initiative
Department of Physics and Astronomy
University of British Columbia
Provided with the opportunity to teach the same course for a second consecutive year, the instructor was keen on improving upon his past performance.

While his best effort was put forth the first time, an improved effort was desired the second time; he wanted his students to learn more and better. To help achieve this goal, the instructor worked with an STLF.

- support implementation of certain teaching techniques
- objective classroom observations
- formative assessments of instruction
- qualitative and quantitative measures of progress
the course

*Phys 315, The Physics of Materials*, is an elective course. Its general aim is to give students a broad overview of different material classes and a physical intuition of how materials behave, with little emphasis on formal derivations.

Its prerequisites are ONE of *Phys 203, Phys 313, Chem 201, Chem 206*; its corequisite is *Math 215*.

the students

A rather heterogeneous population of ~20 students enroll in this course each offering. Most are 3\textsuperscript{rd} or 4\textsuperscript{th} year *Physics* students; a few are *Chemists, Engineers*, or are general science students.
the changes

189 learning goals
- 4 at Bloom's level 6
- 2 at Bloom's level 5
- 25 at Bloom's level 4
- 17 at Bloom's level 3
- 66 at Bloom's level 2
- 75 at Bloom's level 1

- clicker questions
- group activities
- pre-readings
- lecture video taping
- lecture time-stamping
- weekly observations
- weekly planning/de-briefing meetings
formative feedback

6 weeks into the course, students completed a feedback survey.

5-point Likert scale questions revealed some successes.

1 (strongly disagree) 2 (disagree) 3 (neutral) 4 (agree) 5 (strongly agree)

I think the clicker questions have helped with my understanding of some challenging concepts.

4.03

I feel like I benefit from listening to classroom discussions.
3.88

I feel like I benefit from participating in classroom discussions.
4.12

7-point ranking scale revealed student impressions of component effectiveness.

1 (most useful) 2 3 4 5 6 7 (least useful)

1. clickers (3.13) 2. lecture (3.31)
T3. groupwork (3.56) T3. pre-readings (3.56)
5. VISTA quizzes (4.44) 6. homework assignments (4.69)
7. group assignments (5.31)

positive comments
“pre-readings are valuable”
“clickers keep you thinking”
“group discussions solidify ideas”

constructive criticisms
“some clickers are too long”
“more group discussions in class”
“limit the group homeworks”
At the end of the course, students completed UBC's *Teaching Evaluation Survey*.

<table>
<thead>
<tr>
<th>Example survey items</th>
<th>Apr 2011</th>
<th>Dec 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>The instructor made it clear what students were expected to learn.</td>
<td>3.6 ± 0.2</td>
<td>4.4 ± 0.1</td>
</tr>
<tr>
<td>The instructor communicated the subject matter effectively.</td>
<td>3.4 ± 0.3</td>
<td>4.2 ± 0.2</td>
</tr>
<tr>
<td>Overall, the instructor was an effective teacher.</td>
<td>3.8 ± 0.3</td>
<td>4.3 ± 0.1</td>
</tr>
<tr>
<td>This course promoted conceptual understanding.</td>
<td>3.9 ± 0.2</td>
<td>4.2 ± 0.2</td>
</tr>
<tr>
<td>The learning activities helped me to succeed in this course</td>
<td>3.4 ± 0.2</td>
<td>4.2 ± 0.2</td>
</tr>
<tr>
<td>Summary of Results</td>
<td>3.8 ± 0.1</td>
<td>4.3 ± 0.1</td>
</tr>
</tbody>
</table>
scores comparison - assignments

repeated questions on assignments

question #

score

original
transformed
scores comparison - exams

repeated questions on midterm

<table>
<thead>
<tr>
<th>Score</th>
<th>Question #</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>50</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

repeated questions on final

<table>
<thead>
<tr>
<th>Score</th>
<th>Question #</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>40</td>
<td>2</td>
</tr>
<tr>
<td>50</td>
<td>3</td>
</tr>
</tbody>
</table>

overall scores on final exam

<table>
<thead>
<tr>
<th>Score</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td></td>
</tr>
</tbody>
</table>
summary

★ students like the transformed course, better than before; much greater student participation and interactivity

★ signs of improved conceptual understanding; no measurable effects on formal aspects dealing with calculations