Technology for Peer Instruction

Martin and Eric Mazur
Harvard University
AAPT Summer Meeting
Salt Lake City, UT, 9 August 2005

ILT: http://www.deas.harvard.edu/galileo
BQ: http://www.erskine.edu/bq
Register to the ILT

Interactive Learning Toolkit

To register for the Interactive Learning Toolkit, please complete all the information on this page. None of the information you supply will be made available to third parties.

E-mail: 
Name: First Last
Institution: 
Type: Please select: 
Department: 
Position: Please select: 

Register
Login

Interactive Learning Toolkit

The Interactive Learning Toolkit helps you implement innovative teaching ideas, such as Peer Instruction and Just-in-Time-Teaching, and to monitor your students' learning. Our goal is to help you focus on teaching by streamlining the organizational work that accompanies the teaching of a course. Select materials for class use from a large class-tested database and organize (and possibly share) your own materials. Administer your courses, design course Web pages, and interact with your students online.

Access to the site is restricted to registered users; if you are not registered, please register now.

This site is supported by a grant from the National Science Foundation and by the Division of Engineering and Applied Sciences at Harvard University.
This page displays the main settings for your course. You can also edit these settings from this page. The sections marked yellow identify settings with no default value. You should set them to your required values. You can view what the students see by clicking the "Student view" tool. The quick links on the left also give you quick access to students and sections in your course (once you've added them). You must complete the yellow regions before you can move on.

<table>
<thead>
<tr>
<th>Edit settings for:</th>
<th>Modules</th>
<th>General</th>
<th>Student</th>
<th>Enrollment</th>
</tr>
</thead>
</table>

### MODULES
- **Lectures**
- **Reading**
- **Assignments**
- **E-mail**
- **PRS**
- **Forums**
- **Handouts**
- **Staff**
- **Sections**

Each module introduces different functionality to your course. When you remove a module in the middle of a course, you will delete all data associated with that module.

### GENERAL
- **Course name:** New faculty course (edit)
- **Course type:** Non-Harvard class, password login (edit)
- **Topic:** No topic set (edit)
- **Protection:** Course unlocked (lock)
- **Final grades:** Hidden (display)

### STUDENT SITE (student instructions)
- **URL:** http://www.deas.harvard.edu/galileo/students/?courseID=268
- **Home page text:** none (edit)
- **External URL:** none (edit)
- **External Email:** none (edit)

### ENROLLMENT
- **0 students enrolled. Enrollment open**
- **Dates:** not set (edit)
- **Enroll from login page:** disallowed (allow)
Create calendar-based lecture schedule

Set the start and end dates for your lecture. Select the days of week of your lecture. Add a header that will show up in the student view of the lecture. You can also set when the students can access the lecture content. Select the time, whether it is to be available before or after the start of the lecture. You can also change the enrollment dates for the students.

Start date: Sep 10 2003
End date: Jan 31 2004
Lectures on: Wed, Fri
Lecture start: 9:00 am
Lecture duration: 1 Hrs : 30 Mins
Student Access: 1 hours after start of lecture

Lecture header:

Enrollment dates: Sep 1 2003 - Sep 7 2003
Create
Select ConcepTest Q’s from database

1. Consider two identical resistors wired in series. If there is an electric current through the combi...
   1. equal to
   2. half
   3. smaller than, but not necessarily half

2. A CuSO₄ solution is placed in a container housing coaxial cylindrical copper electrodes....
   1. positive.
   2. negative.
   3. both positive and negative.

3. A battery establishes a steady current around the circuit below. A compass needle is placed successi...
   1. P, Q, R.
   2. Q, R, P.
   3. R, Q, P.
Create your own ConcepTest Q’s
Lecture page

Introductory Mechanics

This page lists the ConceptTests in your lecture. You can generate slides for this lecture using the "Generate slides" link on the left. You can also add CTs from database or create a new CT for yourself. You can move, delete, copy CTs from this lecture to another. Click "Edit header" to add more information for this lecture. Use the "Upload PRS data" to review the student responses in class to the CTs.

1. An astronaut floating weightlessly in orbit shakes a large iron anvil rapidly back and forth. She
   1. The shaking takes no effort because the anvil has no inertial mass in space.
   2. The shaking takes no effort but considerably less than on Earth.
   3. Although weightless, the inertial mass of the anvil is the same as on Earth.

2. Consider a weight suspended from a stretched spring. On being released, it travels up to a certain
   1. \( F_{\text{net}} = 0 \).
   2. \( K_{\text{kinetic}} = 0 \).
   3. \( F_{\text{net}} = 0 \) and \( K_{\text{kinetic}} = 0 \).

3. You're on a boat in the center of a lake, and you drop a rock into the water. The rock sinks to the
   1. It goes up.
   2. It goes down.
   3. It stays the same.

Private ConceptTest, not shared. Share
1. A charged object is brought near an uncharged metal object. Negative charges accumulate on the side of the uncharged object nearest to the charged sphere, positive charges on the opposite side. On the uncharged metal object, the potential is

1. largest on the positive side
2. largest on the negative side
3. largest in the middle
4. the same everywhere

Answer

2. A cylindrical piece of insulating material is placed in an external electric field, as shown. The net electric flux passing through the surface of the cylinder is
The LT3 package

Integration of Interactive Learning Toolkit (ILT) and BQ creates new software package:

Learning and Teaching Through Technology (LT3)
Prof. Mazur’s Physics 1b class at Harvard (165 registered students)

Peer Instruction used extensively (ca. 6-7 ConceptTests per class, most with pre- and post discussion polling)
Result: Two LT3 components

- Two parts:
  - Server-based content and course management system (ILT) (runs 24/7)
  - Server- or PC/Laptop-based Interactive Classroom
**New features of the LT3**

- Upload ConcepTests prepared within the LT3 server component (ILT) to the Interactive Classroom (BQ)

- Use a wide variety of communication devices to poll class (Details in next talk)

- Upload student responses back to the server
### CT responses in LT3 facebook

**Lisa Simpson**  
F11112222  
lsimpson@fas.harvard.edu

<table>
<thead>
<tr>
<th>Class:</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major:</td>
<td>economics</td>
</tr>
<tr>
<td>Registered on:</td>
<td>2/2/2003</td>
</tr>
<tr>
<td>PRS Unit ID:</td>
<td>0248</td>
</tr>
<tr>
<td>Final grade:</td>
<td>B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RA</th>
<th>CT</th>
<th>PT</th>
<th>L</th>
<th>PS</th>
<th>HE</th>
<th>OT</th>
<th>FE</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/6</td>
<td>1/1</td>
<td>2/2</td>
<td>9/10</td>
<td>40/40</td>
<td>20/35</td>
<td>5/5</td>
<td>39/40</td>
</tr>
<tr>
<td>6/6</td>
<td>5/6</td>
<td>2/2</td>
<td>9/10</td>
<td>25/35</td>
<td>14/35</td>
<td>15/15</td>
<td>18/18</td>
</tr>
<tr>
<td>6/6</td>
<td>5/6</td>
<td>0/2</td>
<td>9/10</td>
<td>35/35</td>
<td>25/35</td>
<td>15/15</td>
<td>18/18</td>
</tr>
<tr>
<td>6/6</td>
<td>5/6</td>
<td>2/2</td>
<td>9/10</td>
<td>35/35</td>
<td>25/35</td>
<td>15/15</td>
<td>18/18</td>
</tr>
<tr>
<td>6/6</td>
<td>5/6</td>
<td>2/2</td>
<td>10/10</td>
<td>35/35</td>
<td>25/35</td>
<td>15/15</td>
<td>18/18</td>
</tr>
<tr>
<td>6/6</td>
<td>9/9</td>
<td>2/2</td>
<td>35/35</td>
<td>25/35</td>
<td>15/15</td>
<td>18/18</td>
<td></td>
</tr>
<tr>
<td>6/6</td>
<td>8/11</td>
<td>2/2</td>
<td>35/35</td>
<td>25/35</td>
<td>15/15</td>
<td>18/18</td>
<td></td>
</tr>
<tr>
<td>6/6</td>
<td>5/5</td>
<td>2/2</td>
<td>35/35</td>
<td>25/35</td>
<td>15/15</td>
<td>18/18</td>
<td></td>
</tr>
<tr>
<td>6/6</td>
<td>10/10</td>
<td>2/2</td>
<td>35/35</td>
<td>25/35</td>
<td>15/15</td>
<td>18/18</td>
<td></td>
</tr>
<tr>
<td>6/6</td>
<td>2/2</td>
<td>35/35</td>
<td>25/35</td>
<td>15/15</td>
<td>18/18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6/6</td>
<td>7/7</td>
<td>35/35</td>
<td>25/35</td>
<td>15/15</td>
<td>18/18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6/6</td>
<td>11/11</td>
<td>2/2</td>
<td>35/35</td>
<td>25/35</td>
<td>15/15</td>
<td>18/18</td>
<td></td>
</tr>
<tr>
<td>6/6</td>
<td>9/9</td>
<td>2/2</td>
<td>35/35</td>
<td>25/35</td>
<td>15/15</td>
<td>18/18</td>
<td></td>
</tr>
<tr>
<td>6/6</td>
<td>8/8</td>
<td>2/2</td>
<td>35/35</td>
<td>25/35</td>
<td>15/15</td>
<td>18/18</td>
<td></td>
</tr>
<tr>
<td>6/6</td>
<td>13/13</td>
<td>2/2</td>
<td>35/35</td>
<td>25/35</td>
<td>15/15</td>
<td>18/18</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total</th>
<th>14/18</th>
<th>37/40</th>
<th>278/285</th>
<th>59/105</th>
<th>38/38</th>
<th>39/40</th>
</tr>
</thead>
<tbody>
<tr>
<td>94%</td>
<td>89%</td>
<td>93%</td>
<td>98%</td>
<td>55%</td>
<td>100%</td>
<td>65%</td>
</tr>
</tbody>
</table>

RA: Reading assignments; CT: ConceptTests; PT: Pretest; L: Laboratory; PS: Problem Set; HE: Hour Exam; OT: Online Test; FE: Final Exam;
3. Light enters horizontally into the combination of two perpendicular mirrors as shown below.

After reflecting off both mirrors the direction of the incident light
1. bounces back and forth many times, until it hits the corner.
2. depends on the mirror angle $\theta$.
3. is reflected back and upwards.
4. is turned around by 180°
5. is reflected back and downwards.

Answer: 4. Because the angles marked $\theta$ and $\alpha$ add up to 90°, the back reflected beam is incident on $\theta$. See figure.

4. To look at a tattoo on the back of her shaved head, a woman stands 4 ft. in front of a wall mirror 1 ft. high with a hand mirror on her forehead. How far back from the wall mirror is the image of the tattoo?
1. 3 ft.
2. 4 ft.
3. 5 ft.
4. 6 ft.

Answer: 4. The “object” for the image of the tattoo in the wall mirror is actually the image of the hand mirror, which is 1 ft. away.

5. You are standing a long distance away from a concave mirror (a mirror with a surface that curves slightly away from you). The image that you see is

ILT: Course Statistics

Attendance: 95/155
Pre correct: 62%
Post correct: 79%

Correct pre (f_parallel): 62%
Correct post (f_parallel): 70%
Revised answer: 63%
Gain ($f_{\text{post}} - f_{\text{pre}}$): 0.55
R -> R: 42%
W -> R: 37%
W -> W: 21%
R -> W: 12%
No 2nd: 0%
Acknowledgments

**NSF** Distinguished Teaching Scholar Award

**DEAS** Information Technology Group

**ASA** Assessment of Student Achievement in Undergraduate Education

For more information please visit:

http://mazur-www.harvard.edu/lt3