An Optics “First Year Experience” Course for Community College Students

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Overview

- What is an FYE course?
- FYE in the first year optics sequence for Laser and Fiber Optic Technology
- “Studio Optics” – an adaptation
- Sample activities
- Conclusion
Why an FYE course?

- The problem with (some) freshmen.....
  - Socially and academically unprepared for college
  - Unaware of how college differs from high school - responsibilities and resources
  - First generation students often lack home support

- FYE courses are often required by colleges and universities as a semester-long orientation

- TRCC technology programs don’t want to give up a math/science/technology course!
First year Optics sequence for Laser and Fiber Optic Technology

- Originally, the “usual” Geometric/Wave Optics
- 2003: Changed to Intro to Optics/Applied Optics
  - Same topics, different order – “spiral” approach
  - Accessible to students in developmental math
  - Can be adapted by high schools as part of the College Career Pathway (CCP)
- Still needed to address critical thinking and lack of hands-on experience, plus FYE issues
New Course Philosophy

- Two 2-hour blocks (we lost an hour in 2006)
- Fewer topics, better learned
- Interdisciplinary applications
- Explicit math connections
- Mix “science” and “technology” activities and equipment
- Using tools, learning the names of components
New Course- Dual Objectives

- **OPTICS**
  Light sources, rectilinear propagation, reflection, refraction, thin lenses, interference, diffraction, polarization – all with applications

- **FYE**
  Who’s who in the college and what do they do?  
  How to navigate the Banner system 
  What’s a plan of study and how is it used?  
  Where can I find academic and financial aid assistance?  
  What’s add/drop? What does a “W” mean to my GPA?  
  Other questions from students
Model: Studio Physics

- First instituted at Rensselaer Polytechnic Institute
- “..employs activities, computer tools, and multimedia materials that allow students to participate in their own learning and to construct their own scientific knowledge.” (RPI website)
  - Little formal lecture time
  - Dedicated room with space for experimentation
  - Active, collaborative small group learning
  - Uses activities and methods from physics education research
Studio Physics Adapted to TRCC Intro to Light and Lasers

- Adjoining classroom and lab
  - Separate space allows light control
  - Hands-on activities every class
Mixing FYE and Optics Activities

Typical 2-hour class during first two weeks of the course

<table>
<thead>
<tr>
<th>Optics Topic</th>
<th>FYE Topic (10-15 minutes)</th>
<th>Activities (10-15 minutes intro, 15 minutes wrap up)</th>
<th>Homework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waves: amplitude, speed, frequency, phase, wavelength ($v=\lambda f$)</td>
<td>Where to go for help for academic and financial aid issues, who’s who in the college</td>
<td>Measure $f$, $\lambda$, and calculate $v$ for slinky, string vibrator, wave video (ocean waves), ripple tank. Describe method used to obtain data for video and ripple tank and estimate error.</td>
<td><em>LIGHT</em> ch 2 pages 17-24 Written assignment on guided activities with three web applets illustrating amplitude, wavelength, frequency, phase and one applet illustrating an electromagnetic wave</td>
</tr>
</tbody>
</table>

Later FYE topics include how to withdraw from a course, how to register for the next semester, why there’s no “extra credit”.

SPIE O&P San Diego, 2009
### Sample Activities

#### Rectilinear propagation

<table>
<thead>
<tr>
<th>Activities</th>
<th>Math Connections</th>
<th>Technology Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light and shadows (U WA exercise with LEDs and masks) Pinholes for cameras</td>
<td>Trigonometry</td>
<td>What makes a good pinhole? Using a USB microscope to image pinholes - calibration</td>
</tr>
<tr>
<td></td>
<td>Similar triangles</td>
<td></td>
</tr>
<tr>
<td>Making and using a pinhole camera</td>
<td>Optimizing with several variables-pinhole size, exposure, development time</td>
<td>Chemistry of film development MSDS and hazardous waste disposal</td>
</tr>
</tbody>
</table>

SPIE O&P San Diego, 2009
## Sample Activities

### Interference

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</tr>
</thead>
<tbody>
<tr>
<td>Double slit demonstration</td>
<td>Sine function- phase</td>
<td>Measurement of small displacements and wavelength</td>
</tr>
<tr>
<td>Build a Michelson interferometer from components</td>
<td></td>
<td>Types of interferometers and their uses</td>
</tr>
<tr>
<td>Multiple slit demonstration</td>
<td>Radians</td>
<td>Types of gratings and their use in spectroscopy</td>
</tr>
<tr>
<td>Measure CD groove spacing</td>
<td>Small angle approximation</td>
<td></td>
</tr>
</tbody>
</table>

(Photo credit: John Shishmanian/ NorwichBulletin.com)
Critical Thinking and Problem Solving

- 2008-2009 incorporate two PHOTON PBL Challenges
- TRCC students included in research interviews*:
  - PBL does increase student’s ability to systematically solve open-ended problems.
  - The more exposure they have to PBL, the better they are at solving new problems.

Conclusion

- Students perform as well or better in subsequent courses as students who learned by “traditional” methods.
- Students’ problem solving and critical thinking skills have improved.
- Enrollment of non-majors has increased—and several have switched majors to LFOT.