A Disciplinary-Based Teaching and Learning Center: A Model for Professional Development

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Rational For Creating the TLC

2005: College of Chemical and Life Sciences External Review (HHMI)

- GTAs felt unprepared for their teaching assignments
- Faculty were often unaware of national STEM education reforms
TLC Overarching Objectives

- To establish training in teaching science as an integral part of the standard graduate program.

- To provide a structured platform for science faculty to communicate and collaborate with science education experts.

"Working closely with the campus CTE and OIT to extend, rather than duplicate, their efforts."
Rational For Creating a Disciplinary TLC

Taking a Research Approach in Creating the TLC

- Using a needs assessment to inform the professional development program

- Using an ongoing assessment to enhance the professional development program
Using a Needs Assessment

What are the Institutional Levels and External Entities that Involved in Change Efforts?
Using a Needs Assessment

The Institutional Levels and External Entities Involved in Change Efforts
*Which stakeholders should be involved?*

*What type of information is needed?*

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**Needs Assessment**

**University**
- Mission Statement
- Interviews

**College**
- Strategic Plan
- Interviews

**Department**
- Interviews
- Departmental meetings
- Advisory Board

**Faculty Members**
- Surveys
- Interviews

**Graduate Students and Postdocs**
- Surveys
- Interviews

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*Departments play an important role in change efforts*  

Wieman, et al., 2010  
Austin, 2011  
Quardokus & Henderson, 2014
Gathering Information About the Departments

- The department vision, goals, organization structure, and main activities.
- Background about departmental subunits and the people with whom we are going to meet.
- Key personnel to speak with and involve in future initiatives.
### Departmental Needs Mapping

- Identify priorities in terms of teaching and learning and professional development.
- Identify what existing resources are available within the department.
- Define what additional value the TLC could provide.
- Identify a potential starting point for collaborations between the TLC and the department, such as a pilot programs.

#### Undergraduate students (Biology)

<table>
<thead>
<tr>
<th>Type and focus of program</th>
<th>Recent Initiatives</th>
<th>Contact person</th>
<th>Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course reform</td>
<td>Introductory to Cell Biology BSCI 330 (HHMI) – pedagogy and curricular reform</td>
<td>Course instructors</td>
<td>Mechanism for coordinating sequenc es of courses</td>
</tr>
<tr>
<td></td>
<td>Organismal Biology (BSCI 207) – pedagogy and curricular reform</td>
<td>Faculty coordinator</td>
<td>Assistance with science education topics</td>
</tr>
<tr>
<td>Teaching/mentoring opportunit ies for science majors</td>
<td>BSCI 329 – course using undergraduate teaching assistants</td>
<td>Faculty coordinator</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prep program for undergraduate teaching assistants</td>
<td>Faculty coordinator</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Number of Departmental Honors degrees has tripled</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Graduate Students (Chemistry and Biochemistry)

<table>
<thead>
<tr>
<th>Type and focus of program</th>
<th>Recent Initiatives</th>
<th>Contact person</th>
<th>Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prep course for new GTAs</td>
<td>Mandatory prep course for new Chemistry and Biochemistry GTAs</td>
<td>Course instructors</td>
<td>UTLP needs to be pushed more</td>
</tr>
<tr>
<td>Opportunities for professional development and dissemination</td>
<td>GAANN grants to support graduate students in areas of national need</td>
<td>Faculty coordinator</td>
<td>Training in teaching and mentoring</td>
</tr>
<tr>
<td>Other</td>
<td>Participation in teaching and learning conferences</td>
<td></td>
<td>Additional funding</td>
</tr>
</tbody>
</table>

#### Faculty (Cell Biology and Molecular Genetics)

<table>
<thead>
<tr>
<th>Type and focus of program</th>
<th>Recent Initiatives</th>
<th>Contact person</th>
<th>Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acculturation of new faculty</td>
<td>Every new faculty member is assigned a mentor</td>
<td>Chair</td>
<td></td>
</tr>
<tr>
<td>Faculty professional development in teaching</td>
<td>Host Pathogen Interaction FLC</td>
<td>FLC Coordinator</td>
<td>Assistance with grant writing and data analysis</td>
</tr>
<tr>
<td>Travel and other grant opportunities for teaching and learning</td>
<td>Grant support for implementing blended learning in BSCI 410 upper-level course</td>
<td>Course instructors</td>
<td>Assistance with grant implementation</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Faculty members and GTAs: Survey of Teaching Beliefs and Practices (STEP)

*What kinds of PD programs would help you with your teaching responsibilities?*

- “Feedback on teaching from an impartial observer.”
- “In-class visits and accompanying tutoring in alternative and novel practices.”
- “Observing successful teachers teach.”
- “Small workshops, summer programs.”
- “Coordination among classes...I will admit that I'm really not sure what knowledge instructors in subsequent classes expect students to come away from my class with.”
Acculturation of New Faculty

- Introductory workshop
- Welcome packet
- Ongoing, individualized support

Workshops on Teaching and Learning

- The role of the Graduate Teaching Assistant
- Misconceptions and concept mapping
- Blended learning
- Interdisciplinary teaching
Visiting Teacher/Scholar Seminars

- Nationally recognized teacher/scholars who integrate teaching and research (role models)
  - A Teaching Career to Facilitate Student Learning (Malcolm Campbell)
  - Developing classroom activities that challenge and engage (Robin Wright)
  - Scientific Teaching: Evidence for change in science education (Jo Handelsman)
Training Programs for New Graduate Teaching Assistants

- 6-week mandatory course for all new biology and chemistry GTAs
  - Building a community (including experienced GTAs and faculty)
  - Modeling teaching with well-documented, innovative teaching and learning techniques
  - Helping GTAs to understand their roles within the department and their specific course
Advanced Training Programs for Graduate Teaching Assistants

- 2-credit course for science GTAs “Biology/Chemistry Teaching and Learning in Higher Education”

- University Teaching and Learning Program (UTLP)

Individualized Guidance for Instructors

- Classroom observations (based on needs)
- Interpretation of student course evaluations
- Assistance with implementing new technologies
- Assistance with implementing student-centered pedagogies
- Curriculum reform
- Assistance with writing grant application (Career grants, fellowships)
- Assistance with dissemination, IRB application, presentation, and publications
Teaching and Learning Communities

– MathBench
– Host Pathogen Interaction group
– NEXUS
– Bioinformatics
– Cell biology


# HPI Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Enrollment (students/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSCI 223 General Microbiology</td>
<td>600</td>
</tr>
<tr>
<td>BSCI 380 Bioinformatics</td>
<td>30</td>
</tr>
<tr>
<td>BSCI 412 Microbial Genetics</td>
<td>80</td>
</tr>
<tr>
<td>BSCI 417 Microbial Pathogenesis</td>
<td>25</td>
</tr>
<tr>
<td>BSCI 422 Immunology Lecture</td>
<td>100</td>
</tr>
<tr>
<td>BSCI 423 Immunology Lab</td>
<td>80</td>
</tr>
<tr>
<td>BSCI 424 Pathogenic Microbiology</td>
<td>60</td>
</tr>
<tr>
<td>BSCI437 Virology</td>
<td>120</td>
</tr>
</tbody>
</table>
Scientific Teaching

• Approach teaching as we approach research
  – Establish learning goals (13 concepts)
  – Assess students’ understanding (Concept inventory)
  – Design curricula (Alignment map)
  – Design and apply appropriate/innovative pedagogy (e.g., groupwork, concept mapping)
  – Reassess student learning and refine curricula and pedagogy
TLC Support

Goals:

• Increase awareness of the education literature among the HPI teaching group

• Develop innovative pedagogies to be implemented in HPI courses (e.g., case studies, project-oriented labs, debates)

• Document and evaluate the science education interventions and disseminate in conferences and journals
Ongoing Assessment: Measuring Five Levels of Program Evaluation

- Participation
- Satisfaction
- Learning
- Application
- Impact


Level 1: Participation

- How do participants know about the TLC and its activities?
- Who participates and in what activities do they participate?
- Why do individuals participate?

...[I benefit from] hearing about new developments in teaching and learning, discussing new research that may influence my teaching, giving feedback to other faculty who are trying new things or trying to assess the impact of teaching innovations, getting motivated!
Level 2: Satisfaction

- Assessing the achievement of programmatic goals.
- Assessing participant satisfaction.
Level 3: Learning

**Stage 1:** Knowledge of evidence-based teaching practices.

**Stage 2:** Belief in the effectiveness of evidence-based teaching practices in enhancing student learning.

**Stage 3:** An understanding of how to employ evidence-based teaching practices.

Is this what they mean by blended learning...?
Do Research University Faculty, Graduate Teaching Assistants and Senior Undergraduates Agree on Educational Goals?

<table>
<thead>
<tr>
<th>What are the most important skills for undergraduates to acquire?</th>
<th>Seniors N=288</th>
<th>GTAs N=99</th>
<th>Faculty N=71</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquire major scientific concepts</td>
<td>96%</td>
<td>94%</td>
<td>99%</td>
</tr>
<tr>
<td>Applicability of science to everyday life</td>
<td>82%</td>
<td>82%</td>
<td>88%</td>
</tr>
<tr>
<td>Dynamic nature of science</td>
<td>85%</td>
<td>83%</td>
<td>84%</td>
</tr>
<tr>
<td>Scientific writing</td>
<td>78%</td>
<td>81%</td>
<td>83%</td>
</tr>
<tr>
<td>Learn basic sets of lab skills</td>
<td>89%</td>
<td>69%</td>
<td>61%</td>
</tr>
<tr>
<td>Memorizing basic facts</td>
<td>72%</td>
<td>46%</td>
<td>30%</td>
</tr>
<tr>
<td>Remember formulas, and procedures</td>
<td>49%</td>
<td>24%</td>
<td>19%</td>
</tr>
<tr>
<td>Work in groups</td>
<td>50%</td>
<td>70%</td>
<td>55%</td>
</tr>
</tbody>
</table>
Level 4: Application

- Faculty self-reports of the teaching practices they used (via STEP survey).
- Student reports of teaching practices they experienced (via exit survey of graduating seniors).
- Classroom observations and peer evaluations.
Student reports of instructional techniques experienced in their undergraduate curriculum. (Bolded values represent the modal answer.)

<table>
<thead>
<tr>
<th>Instructional Technique</th>
<th>None of my courses</th>
<th>Rarely</th>
<th>Sometimes, mostly intro courses</th>
<th>Sometimes, mostly upper level courses</th>
<th>In most courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensive lecturing</td>
<td>1%</td>
<td>3%</td>
<td>5%</td>
<td>8%</td>
<td>83%</td>
</tr>
<tr>
<td>Communicating course goals</td>
<td>0%</td>
<td>4%</td>
<td>16%</td>
<td>18%</td>
<td>63%</td>
</tr>
<tr>
<td>Answering questions in class</td>
<td>1%</td>
<td>16%</td>
<td>6%</td>
<td>20%</td>
<td>58%</td>
</tr>
<tr>
<td>Asking students to interpret graphs</td>
<td>2%</td>
<td>12%</td>
<td>15%</td>
<td>29%</td>
<td>42%</td>
</tr>
<tr>
<td>Multimedia instruction</td>
<td>2%</td>
<td>24%</td>
<td>21%</td>
<td>19%</td>
<td>34%</td>
</tr>
<tr>
<td>Real-life problems</td>
<td>15%</td>
<td>37%</td>
<td>13%</td>
<td>17%</td>
<td>17%</td>
</tr>
<tr>
<td>Class discussions</td>
<td>2%</td>
<td>29%</td>
<td>32%</td>
<td>25%</td>
<td>13%</td>
</tr>
<tr>
<td>Graphic organizers</td>
<td>1%</td>
<td>24%</td>
<td>28%</td>
<td>35%</td>
<td>12%</td>
</tr>
<tr>
<td>Group work outside of class</td>
<td>2%</td>
<td>21%</td>
<td>26%</td>
<td>41%</td>
<td>10%</td>
</tr>
<tr>
<td>Personal Response System</td>
<td>4%</td>
<td>12%</td>
<td>64%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Group work during class</td>
<td>5%</td>
<td>38%</td>
<td>30%</td>
<td>18%</td>
<td>8%</td>
</tr>
<tr>
<td>Out of class discussions</td>
<td>11%</td>
<td>50%</td>
<td>24%</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>Reflective writing/journaling</td>
<td>27%</td>
<td>43%</td>
<td>19%</td>
<td>6%</td>
<td>4%</td>
</tr>
<tr>
<td>Debates in class</td>
<td>24%</td>
<td>43%</td>
<td>14%</td>
<td>15%</td>
<td>4%</td>
</tr>
<tr>
<td>Online modules with immediate feedback</td>
<td>8%</td>
<td>28%</td>
<td>55%</td>
<td>6%</td>
<td>3%</td>
</tr>
<tr>
<td>Games, simulations, role-play</td>
<td>33%</td>
<td>48%</td>
<td>12%</td>
<td>4%</td>
<td>2%</td>
</tr>
</tbody>
</table>
Relationship between classroom experiences and the importance attributed to corresponding skills

![Graph showing the relationship between classroom experiences and the importance attributed to corresponding skills.](image)
Level 5: Impact

- Student satisfaction with their courses and course instructions.
- Students’ attitudes and beliefs about science.
- Students learning in individual courses.
- The progression of student learning across sequences of related courses.
Training programs for new Graduate Teaching Assistants

![Bar chart showing scores for different survey items over three years (2009, 2010, 2011). The x-axis represents the survey items, and the y-axis represents the score. The chart compares how students rated the instructor's treatment of students, the instructor's preparation for class, the instructor as an effective teacher, the course as intellectually challenging, and whether they learned a lot.]
Evaluating Course Activities Designed to Enhance Student Writing Skills

### How Well do Students Retain Concept Knowledge from Previous Courses as They Move to Subsequent Courses?

<table>
<thead>
<tr>
<th>Course</th>
<th>Pre</th>
<th>Post</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Microbiology - BSCI223/Fall 2006 (N=109, 16 questions)</td>
<td>31.1±15.6</td>
<td>48.1±16.9</td>
<td>&lt;.001***</td>
</tr>
<tr>
<td>General Microbiology - BSCI223/Spring 2007 (N=127, 16 questions)</td>
<td>31.9±15</td>
<td>44.2±19.4</td>
<td>&lt;.001***</td>
</tr>
<tr>
<td>General Microbiology - BSCI223/Fall 2008 (N=90, 18 questions)</td>
<td>26.1±15.6</td>
<td>47.1±16.2</td>
<td>&lt;.001***</td>
</tr>
<tr>
<td>General Microbiology - BSCI223/Spring 2009 (N=107, 17 questions)</td>
<td>30.1±14.8</td>
<td>49.1±14.1</td>
<td>&lt;.001***</td>
</tr>
<tr>
<td>Immunology Lecture - BSCI422/Spring 2007 (N=48, 16 questions)</td>
<td>59.9±19.4</td>
<td>64.3±21.9</td>
<td>&lt;.05*</td>
</tr>
<tr>
<td>Immunology Lecture - BSCI422/Spring 2008 (N=53, 18 questions)</td>
<td>53.7±16.9</td>
<td>56.6±17.8</td>
<td>.132</td>
</tr>
<tr>
<td>Immunology Lecture - BSCI422/Spring 2009 (N=31, 17 questions)</td>
<td>58.8±15.7</td>
<td>61.6±16.4</td>
<td>.572</td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENTS

KACI THOMPSON
ANN SMITH
KATIE ZIEMER-SCHAEFER
LAURA EGAN
NEETI SALUJA
CARLY HUNT
DEANS AND CHAIRS

Howard Hughes Medical Institute Undergraduate Science Education Program

National Science Foundation Course, Curriculum, and Laboratory Improvement grant (CCLI)