Abstract

Transforming a traditional lecture course to an active learning format can be daunting. Over the past six years, we developed a Student Success Program which resulted in an average 15% improvement over multiple semesters in successful course completion rates for our introductory Biology I and 2 courses (250-500 students per section). We have created a toolkit of tested hands-on activities, skits, and demonstrations for the lecture hall and supplemental peer-facilitated instruction. Our toolkit is freely available via the website (http://cssphmi.nsm.uh.edu/) that includes: (1) videos of skills, demonstrations, models used in the classroom, (2) modules and problem solving activities designed specifically for peer led learning sessions, (3) materials used in student study groups for training facilitators and advisors materials provided to students, (4) training modules for peer facilitators, (5) materials used in faculty professional development activities, and (6) videos of interviews in which our STEM faculty describe their undergraduate experiences and current careers.

Comprehensive Student Success Program in Freshman Biology

A Comprehensive Student Success Program was developed in Biology to address the low successful course completion rates. Key elements of the program are shown in Figure 1.

- Students are placed into recitation sections based on their diagnostic test scores that assess their ability to interpret data and think critically about answers they give in their tests. Recitations are required for students scoring below a determined threshold and available to anyone who wants to attend.
- Faculty have developed curriculum for recitation sections, lecture models, and case studies to emphasize critical thinking and quantitative reasoning skills. A departmental final was developed to assess student mastery of material across sections. Questions were classified using Bloom’s taxonomy to ensure that approximately 50% of the exam questions are at the level of analysis or higher on the triangle.
- The program was expanded to physics in Fall 2014 through an NSF Science Education Grant.

Successful Course Completion Rates

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall 2011</th>
<th>Fall 2012</th>
<th>Fall 2013</th>
<th>Fall 2014</th>
<th>Fall 2015</th>
<th>Fall 2016</th>
<th>Fall 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory Biology 1</td>
<td>62%</td>
<td>77%</td>
<td>70%</td>
<td>77%</td>
<td>74%</td>
<td>77%</td>
<td>72%</td>
</tr>
<tr>
<td>Spring 2013</td>
<td>64%</td>
<td>78%</td>
<td>70%</td>
<td>79%</td>
<td>81%</td>
<td>78%</td>
<td>80%</td>
</tr>
</tbody>
</table>

Available Peer Facilitator Materials and Training Videos

- Peer Facilitator Materials
  - Undergraduate Education in the Classroom
  - Teaching for Learning (PF)
  - Student Motivation (PF)
  - Time-Learning and Memory (PF)
  - Classroom Dynamics (PF)
  - Classroom Learning Environment (PF)
  - Conceptual Learning (PF)
- Peer-led Group Learning Scenario Videos
  - The Mouse Runner
  - The Iguana
  - The Rat
  - What to Do and How to Say Rather Part I
  - What to Do and How to Say Rather Part II
  - Transforming Students into Coaches
  - The Review Session

Biology Recitation Activities

Recitation activities are led by a team of peer facilitators. Students work in small groups to complete each activity. Hands-on activities using or building models are used as often as possible (figure 4). The curriculum has been designed to provide students an opportunity to practice critical thinking skills to develop their skills in data analysis and interpretation. Our activities are included on the website as well as teacher materials for the recitation and course instruction. The videos often include explanations about why we are presenting the material in a particular format which is often helpful for the peer facilitators to understand so that they do not revert to the “lecture on the stage” method which they may see as more efficient even though evidence suggests it is ineffective. Explaining the “why” to the class is also helpful in reducing resistance to the activities, it should be noted that answer keys are not provided on the website. We firmly believe that all peer facilitators and instructors should do the activity themselves before implementing it in class. In fact, all of our peer facilitators participate in weekly meetings where they complete the exercise for the next week. This ensures that they are comfortable with the activity and show it without hesitation. It also allows us to correct any misconceptions they may have or share their knowledge on the topic if there are weaknesses that need to be addressed.

STEM Career Videos

As students enter college, they often feel lost and overwhelmed. Eight videos were created to collaborate with Houston Public Media, in which alumni from the College of Natural Sciences and the College of Engineering were interviewed. The alumni share information about their current STEM careers and also their experiences as undergraduates. Their family circumstances and transitioning from a small rural community to a big city campus are highlighted. Issues faced as students such as supporting themselves financially, family situations, failing their first class, and changing majors are touched upon as well as things they wish they had done differently earlier in their academic careers, and tips for success in academics and professionally. We hope by sharing their stories, future students will connect with the themes presented and be encouraged to persevere. We use the videos in our freshman introductory courses.

Faculty Development Materials

Our faculty development workshop series was created to provide training in teaching and pedagogy. It serves as a means for our faculty to share best practices in the classroom and has served to stimulate conversations on teaching and learning across the STEM departments on campus. In the spring of 2014, the workshops were revised by the feedback from the workshop participants. An introductory session set the stage for the workshop by introducing professional development principles. The rest of the session was focused on teaching strategies and tools that can be used to improve student learning in STEM classrooms. The workshop included a brainstorming activity on tips and tools for incorporation of active learning strategies and then participants were asked to identify and report on what they would try in their own classrooms. Workshop participants also viewed a video presentation of tips and tools for incorporating active learning strategies in their own classrooms. It was hoped that the workshop would help to improve teaching effectiveness and to foster a culture of collaborative and continuous improvement in teaching.