TRESTLE Course Transformation Report Outline

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Course name: IPHY 3410: Anatomy, IPHY 3470: Human Physiology 1 & IPHY 3480: Human Physiology 2

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1. Introduction

The project, *Development and implementation of case studies across the foundational IPHY curriculum --- a continuation of the SEI effort,* strives to build on the accomplishments of the SEI effort by creating case studies that will be implemented into the IPHY introductory courses that serve as a foundation for our upper division courses. Case studies in particular have been shown to be a viable way to improve student learning and are an active learning approach that students enjoy. We feel this has been an important step in furthering science education in our department as it better prepares students for our upper division courses, improves critical thinking skills, and helps us to achieve curricular alignment. In addition, this provided the opportunity, and continues to provide the opportunity, for the Curriculum Coordinators to work with faculty to develop active learning tools for their courses.

2. Course specific information

- Course description
  - Introduction to Human Anatomy (IPHY 3410), Human Physiology 1 (IPHY 3470), and Human Physiology 2 (IPHY 3480)
- Reason this course was chosen for transformation
  - First, all of these courses have learning goals that were developed in collaboration with the Science Teaching Fellows of the SEI. From these goals, we identified potential troublesome/challenging concepts for students that could be taught and assessed using case studies.
  - Second, these are the first IPHY courses our majors must complete. Therefore, this project has the potential to impact several hundred students each year: 750 students in IPHY 3410, 430 students in IPHY 3470, and 430 students in IPHY 3480.
  - Third, these three courses serve as the foundational courses for our upper-division courses. By introducing case studies into the introductory courses, students will be better prepared for the challenges of the upper-division courses.
  - Finally, the current faculty members teaching these courses recognize the need for additional activities for their students, and quickly agreed to participate in this project.
- Course Structure (e.g., face-to-face lecture, hybrid, lab)
  - Face-to-face lecture

A. What did you do in the course transformation?

- What happened and how was the work structured (in general, specific details below)?
  - Utilizing faculty working groups, we developed an interrupted case study on Celiac's disease for the three introductory courses. The faculty groups met monthly during the year and included the Curriculum Coordinators (Casagrand, Foley, Heisler) and the faculty teaching that particular course (Bustamante, Saul, or Byrnes). Each course followed a fictional patient "Eliana" throughout the semester and emphasized a different aspect of the anatomy or physiology of Celiac's disease. Concurrently, we revised, updated, and aligned the learning goals for each of the courses. We also did student attitude surveys, and used a variety of assessment measures.
- Individuals Involved (List name and role)
  - Janet Casagrand – developed and implemented case studies and clicker questions for Phys 1; reviewed learning goals for Anatomy, Phys 1, and Phys 2
  - Ruth Heisler – developed and implemented case studies, clicker questions, and worksheets for Anatomy; reviewed learning goals for Anatomy, Phys 1 and 2
  - Heidi Bustamante –developed and implemented case studies and clicker questions for Phys 2; reviewed learning goals for Human Physiology 2
  - Teresa Foley –reviewed learning goals for Anatomy, Phys 1, and Phys 2
  - Leif Saul – developed worksheets for Anatomy; reviewed learning goals for Anatomy
  - Bill Byrnes - reviewed learning goals for Phys 2
- Learning Goals Developed (List)
  - No new learning goals were developed for this project, although learning goals were revised and refined.
- Assessments Developed
  - For each case study, we developed a set of clicker questions and/or worksheet activities. We also designed and administered student attitude surveys, and examined student performance on exam questions that were given both before and after the project.
- Pedagogies Used
  - Active learning, student-centered
  - Faculty working groups
  - Iterative, backwards design
  - Case studies, clicker questions, worksheets

B . What assessments or documentation of impact were or will be used?

- What measures were (or will be) used to monitor student learning related to the course transformation efforts? (e.g., attitudinal surveys, two-stage learning exams, pre-post course surveys, gains in learning on exams related to active learning activities, in-class participation ratings, faculty evaluations, case studies, student interviews, ratings of learning-level based on Bloom's taxonomy, evaluation of student samples/work)

- What were the results, if you have any?

- We used a several measures to monitor student learning related to the course transformation in the three courses.
- Anatomy (IPHY 3410):
  - The initial assessment has been to look at learning gains by reusing exam questions from previous years that directly related to Case Study worksheets and clicker questions. Exam questions are not released or returned to students. There were no other notable changes made to the lecture material.
  - **Results**: Nine multiple choice exam questions were taken from exams given during the Fall 2013, Fall 2014, and Fall 2015 semesters. The following table summarizes the percent of students who answered the exam questions correctly in the transformed Fall 2016 semester compared with the percent of students who answered the question correctly in earlier semesters. Wording of questions was not altered in any way.

Question # on Fall 2016 exam	Previous semester question used	% of students who answered correctly before case study (Fall 2013-2016)	% of students who answered correctly Fall 2016 (out of 260 students)
16	Fall 2013	96%	98%
18	Fall 2015	76%	84%
22	Fall 2013	64%	86%
25	Fall 2013	80%	95%
26	Fall 2013	52%	85%
27	Fall 2015	77%	90%
33	Fall 2013	74%	77%
34	Fall 2014	54%	70%
36	Fall 2013	63%	85%

  - We are encouraged by the initial results that the use of case studies, worksheets, and in-class discussions are having a positive impact on comprehension of the material.

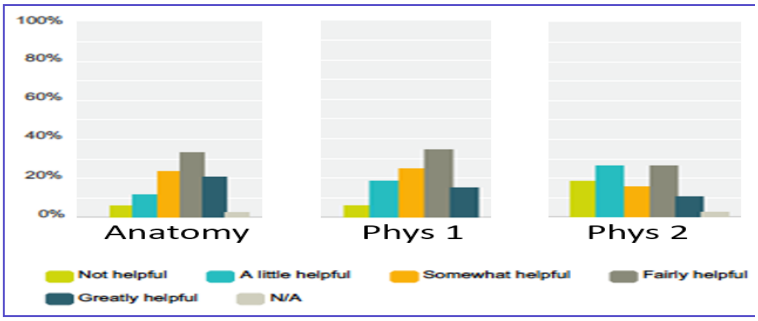
- Physiology 1 (IPHY 3470):
  - The initial assessment involved measuring performance on learning goal-centered questions given both before and after case study activities, after lecture on a topic.
  - **Results**: Pre/post assessments showed significant learning gains on some key concepts after the in-class case study.

Topic	Question (& sample sizes)	Pre-CS % Correct	Post-CS % Correct	Class Average Normalized Gain	p-value (Chi-square
Homeostasis	Effector (n=33,34)	63 (n=21)	82 (n=28)	***51.35**	0.011
	Integrator (n=33,34)	88 (n=29)	82 (n=28)	-50	0.31

	Sensor (n=33,34)	88 (n=29)	91 (n=31)	25	0.53
mRNA	Where find (n=34,34)	65 (n=22)	91 (n=31)	***74.29**	0.001
	Purpose (n=34,34)	68 (n=23)	86 (n=29)	***56.25**	0.028
	Happens to (n=34,34)	79 (n=27)	63 (n=21)	*-76.2	0.011
Transport	Facilitated diffusion (n=35,35)	60 (n=28)	94 (n=33)	***85**	0.00004
	Secondary active (n=35,35)	66 (n=23)	91 (n=32)	***73.53**	0.0014
	Primary active (n=35,35)	71 (n=25)	94 (n=33)	***79.31**	0.003
	Antiporter (n=35,35)	74 (n=26)	91 (n=32)	***65.38**	0.02
	Carrier-mediated (n=35,35)	63 (n=22)	71 (n=25)	21.62	0.29

We also gave attitude surveys to students in all three courses (Anatomy, Physiology 1 & 2).

- Initial results were positive with students finding the case studies helpful for their learning.



C. How will you maintain the changes over time and across structures?

- Location of Course Material Archive (how will others access your work)?
- Plan for Sustainability
- Challenges for sustainability

One of the main ways we will maintain the changes over time will be through the Curriculum Coordinator positions that the IPHY department recently created. These positions (which the three of us occupy) were specifically designed as a sustainability mechanism, and to provide pedagogical support to faculty. As part of these efforts, we will continue to meet regularly with the faculty involved in teaching the three foundational courses. If any changes in faculty occur, we will also work with the new faculty to help them transition and provide continuity. All case studies and related activities and assessments will also be archived on a shared Google Drive.

D. Plans for future work

What did and didn't work well in the course transformation? What would you like to do next? What are some unsolved challenges?

Some challenges we faced included:

1) Faculty vary considerably in how they use learning goals; their views on importance of learning goals; and how learning goals should shape their lectures. Observationally, we can say that:
    - *Faculty originally involved in development of learning goals 7-9 years ago are more likely (than faculty not involved in learning goal development) to:*
        - *(1) find them valuable/helpful,*
        - *(2) give them to students,*
        - *(3) use them to design activities and write exams, and*
        - *(4) look at learning goals of prerequisite courses.*

- *Faculty who tend not to find learning goals helpful, also view them as lists of content to know, rather than skills to learn.*

2) Faculty vary in their level of comfort in implementing a case study. Some road blocks are:
    - varying levels of comfort in implementing new active learning techniques;
    - lack of appreciation for interactive learning in classroom; and
    - concerns about spending too much of class time on one thing and/or having to learn background material for the case study.

Consequently, we decided to take a step back and approach the case study implementation differently. The faculty working groups provide a mechanism by which faculty who teach similar courses can meet to discuss the learning goals, differences in approaches to the material, terminology, and expectations of the case studies, and how to implement interactive approaches in the classroom. We are finding it beneficial to revisit the goals, have a discussion about how they are being used, and make changes as needed. This is a needed and natural progression to discussing where a case study might be helpful to the student. Faculty seem to enjoy having a venue to talk about teaching, and one faculty member has been encouraged to begin using active learning in class.

FACULTY: Our experience has illuminated the need to be more inclusive in our approach to the case studies. Each working group has its own personality, yet all involved faculty seem engaged in and eager to be a part of the process. Moving forward, our intent is to:

1. STAY CURRENT: Continue to work with the course specific groups to revisit learning goals and update them as needed.
2. LISTEN, LEARN AND STAY FLEXIBLE: Work within the parameters of each faculty member and course, to see what they are comfortable with, and what they hope to get out of the project.
3. INCENTIVIZE: Explore the need for further incentives to use and be guided by learning goals.
4. ASSESS: Work on further assessing the case studies to demonstrate the effectiveness of their use in the classroom.

STUDENTS: Students also recognized the value and importance of case studies, and often requested more. However, some students felt the case study disrupted the flow of lecture and did not aid learning.

"…looking at case studies was very helpful for realizing how concepts can be applied in many different situations ."
–IPHY Anatomy student

"The case studies made me learn even more because they are real life situations and students learn better that way cause they feel like they're in charge for that person's health."
–IPHY Physiology 1 student

"I wish more case studies were incorporated into the course."
–IPHY Physiology 2 student

"I did not like the case studies in this course or my Phys 1 course. I understand the purpose is an attempt at making the knowledge more integrative and engaging yet I think they take away from the class learning. I felt that they interrupted the flow of lecture and they are unnecessary for learning the topics."
–IPHY Physiology 2 student

Some other things we learned:

- Case study stories need to be well-integrated into a course in a way that makes sense to faculty. So we are working with faculty to help them better integrate case studies into their lectures.
- Because students felt the case studies interrupted the flow of lecture, we also are removing the embedded pre/post questions for a semester or two. We will assess whether to reintegrate these into the courses at a later date, or develop a different assessment tool.

What worked well:

- Faculty working group meetings have been helpful as they have provided a needed venue to allow course-specific discussions and exchange of ideas.
- Collection of student attitude and assessment data has been provided insight into the effectiveness of the case studies and student attitudes towards the case studies. These data have been helpful in motivating some faculty to try something new, and incorporate active learning into their classroom.

Overall, the addition of a case study on celiac disease has been successful, and addressed many learning objectives across the three course sequence. Students found the case studies helpful for their learning, and measures of learning support this. One of our next goals is to add a second case study on stress to address other key learning objectives across the three courses. We also plan to continue meeting regularly with course stakeholders, and working with faculty on refining and using the course learning goals.

3. Community and expertise building in the department

- How did you use or generate broader expertise and/or community in your work?
- Expertise you drew on (yours, others)
- Community built – were faculty across the department adequately involved? Did you engage in community building across departments or institutions?
- Future plans or room for improvement in this area

Initially, we drew on the depth of expertise that the three of us possess to brainstorm case study ideas that we felt would work well across the three courses. Concurrently, we reached

out to all of the instructors involved in teaching the Human Anatomy, Human Physiology I and Human Physiology II courses and started having course specific meetings with each group about once a month. During these meetings, in addition to discussing the case studies, we revisited learning goals; discussed ideas for implementing worksheets and activities; and worked on trying to create a stronger community amongst the instructors teaching these courses. Overall, this approach was successful. We did have one instructor who was uninterested in participating. And we also found that each group progressed in a different manner and had a different focus. In the future, we would like to continue to facilitate these course collaborations and expand them to include some or all of the IPHY core courses. Additionally, working on this project has provided the impetus for the PIs to disseminate our approach to building case studies, and lessons learned, at national conferences, including poster presentations and workshops.

4. The process and structure of the work in the department

- What worked well about the process and structure of the work? What could be improved? Consider the role of various experts leading and completing the work, whether you had adequate resources to do the work, whether roles were clear, and whether there was adequate leadership within the project and the department. What are your open questions or concerns?

Overall, the approach we took to creating case studies worked well. We relied on individual expertise to create questions appropriate to each course; asked fellow instructors to give feedback on the appropriateness of the case study and associated questions; and worked directly with the interested course instructors to implement the case study. The role of the Curriculum Coordinators worked well during this process. The one "eye opener" for us was how much time was required to fully create and implement an interrupted case study that spanned an entire semester. We had envisioned integrating two or more different case studies across the introductory courses. However, we are still working to finalize the first case study, especially as we needed to go back and revisit the learning objectives for the courses with the involved faculty.

5. Future Plans

- What future plans do you have related to the work, other than work on a specific course?

We have plans to develop additional case studies around other clinical disorders. For instance, we would like to create a case study on stress responses and how stress may play a role in a variety of health conditions. There is potential for these case studies to move beyond the introductory three semester sequence we have been focusing on, and be used in some capacity in our upper division courses. We are also planning to revisit the learning goals for the upper division courses, that students enter upon completing the introductory, three course sequence. As we collect more data, we hope to be able to publish our results in the future.