Digital Storytelling in Introductory Biology:
Increased Engagement and Inclusiveness through Alternate Modes of Learning
Final Report
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Project Description:

I. Course Details and Goals:

BIOL116: Information in Living Systems is the second installment of the introductory biology series at Kenyon College. The course content includes fundamentals of genetics, molecular biology and evolution. Up until now, student performance in this course as evaluated using weekly quizzes, four in-class exams and a cumulative final exam. Despite a wealth of material featuring the most exciting challenges and accomplishments of contemporary molecular biology and genetics, the course structure limited students ability to engage with the material in a more personal and creative manner and favored the success of students with strong test-taking abilities. *Our overall objective was to implement a guided, semester-long project that directly integrated content from the three major course modules and inspired students of diverse backgrounds and test-taking abilities to view course material through the lens of their own interests and motivations.*

II. Project Summary:

The CRISPR-Cas9 system, a recent technological advance, simplifies gene editing capabilities, enabling heritable genetic change in any organism, including humans. In fact, its recent use to edit genes in human embryos garnered enormous public scrutiny and skepticism. Given its scientific and social relevance, sustained exploration of gene editing as a course theme in BIOL116 was well aligned with course content **and** offered the opportunity to leverage intrigue, interest and creativity to engage students beyond simple acquisition of course content. To this end, student groups worked across the semester to assemble short digital stories in which they detailed the phenotypes and genetics of a heritable disease of their choice. Each group consisted of either 2-4 members, depending on which of the two sections of BIOL116 they were enrolled in. In their digital stories, students developed a CRISPR/Cas9-based gene editing strategy that could have therapeutic value for some, or all, patients with the disease and advocated for, or against, the actual implementation of this therapy.

III. Story Assembly:

Course content in BIOL116 is broken up into four modules, each lasting 3-4 weeks. Digital stories were developed across the semester as three individual storyboards. The content of each storyboard was directly related to the content of each course module. Each storyboard contained a narrative and supporting visuals, and its construction was preceded by an in-class workshop introducing students to the bioinformatic databases needed to gather pertinent information/data. Each storyboard was evaluated and returned to groups prior to construction of the final digital story.

At the end of the semester, student groups compiled the information from the storyboards they produced. As each individual storyboard encompassed considerably more information than could be incorporated into the final project, students were required to critically review the data/information they would present to develop a story that best supported their gene editing strategy. Students were allowed to strategize and develop digital stories during an in-class workday, with assistance from Joe Murphy (Center for Integrative Pedagogy). The 3-4 minute digital stories were assembled as voice-over PowerPoint videos. Students evaluated the videos of other groups during an in-class presentation day and were allowed to modify their work based on constructive criticism from both the instructor and their peers.

The construction of individual storyboards and the final digital story required significant resources beyond the classroom. Preceding the due date for each storyboard, three peer-led evening help sessions were held. Peer leaders were upperclassmen with proficiency in cell and/or molecular biology, either through coursework or laboratory involvement. In addition, peer leaders were also trained by the Center for Innovative Pedagogy to provide assistance in the development of voice-over PowerPoint presentations. Peer leader training and work at help sessions were funded by the Digital Storytelling grant.

Outcomes:

I. Pedagogical Outcomes:

The implemented project was successful in allowing students to achieve the BIOL116 course objectives developed by the Biology Department (shown below). Specifically, integrating the development of the digital story into the course structure was an effective strategy for allowing students to deepen, and even diversify, their understanding of fundamental concepts taught in class and build their "toolbox" by putting new-found knowledge and vocabulary into practice. Notably, this digital storytelling project was perhaps the only course activity that allowed students to develop their scientific writing and reading of the scientific literature.

Biol116 Course Objectives:

- Deepen their understanding of foundational concepts related to inheritance, gene expression, and evolution as well as the experimental evidence that biologists have used (and continue to use) to characterize these processes.
- Build a "toolbox" of vocabulary, techniques and approaches used to describe and study biological processes.
- Develop critical reading, thinking and writing skills through application of their understanding in addressing new questions and through reading of scientific literature.

More broadly, the digital storytelling project was also well aligned with many of the general education goals of the College. The project required students to:

- Gather information from a variety of sources and evaluate its quality
- Formulate ideas rigorously and communicate them effectively, orally and in writing
- Work creatively
- Work both independently and collaboratively

To a lesser extent, the project also required to:

- Address ethical questions and make informed qualitative judgments
- Acquire quantitative skills and analyze data

II. Student Impact:

Largely, the students were excited by the concept and content of the project and this was evident by their comments on course evaluations and during in-class communications. This is particularly important because one goal of implementing the digital storytelling project was to promote engagement with the course content in a more personal and creative manner. It was also well communicated that students preferred to complete the project in place of their final exam. Assembling the final digital stories required that students revisit important concepts in molecular biology and genetics, the very topics they would have had to revisit in preparation for the cumulative final exam. Notably, students were able to have relevant and high-level conversations with their peers and the instructors about the details of their project beyond what was incorporated in the final digital story.

Future Directions and Considerations:

Overall, our gene editing digital storytelling project was a success. Through this project, students had the opportunity to engage with the material in a more meaningful manner than they had in the past. In addition to improved performance in the BIOL116 course, we believe that the work done on this project has better prepared students for more advanced courses in Biology, Molecular Biology and Biochemistry. As we (Wade Powell and Arianna Smith) will both be teaching BIOL116 in the Spring 2020 semester, we look forward to undertaking the project again, with some revisions.

There are two points that will make future implementation of this project less cumbersome. First, efforts to generate the appropriate materials to guide students through the educational/scientific and technical aspects of this project was substantial, but crucial for the success of the project. With these materials now in hand, preparation for in-class workshops will be much less onerous in upcoming iterations. Second, in most cases, peer leaders required training before help sessions. As the students who have just completed the project in BIOL116 have the necessary skills to serve as peer mentors, much less training will be required. In addition, we have learned that the number of peer leaders required for successful implementation of this project can be reduced. This will relieve some of the costs associated with using digital storytelling in BIOL116 in the future.

Perhaps the most notable challenge we encountered was that of group size/dynamics. We offered two section of BIOL116. Section 01 had 21 students arranged in groups of two. Section 02 had 46 students arranged in groups of four. In both sections, groups were formed randomly, using the Grouper app for iPad. The most common student criticism of the project from both sections concerned group composition or size. More specifically, most students would have preferred to choose their own group partners. This desire seemed to be connected to struggles to find times to meet as a group with people they did not know. We are developing a strategy on how to improve group dynamics for future iterations.

BIOL116 is an introductory biology course with teaching responsibility shared across the department. A significant consideration for the future is the feasibility of implementing this project when the instructors research expertise does not align with biomedical research. In such cases, we envision that the scope of the project can/would expand and/or shift to be more aligned with the interests of other faculty members. While feasible, it will require the generation of a significant additional instructional resources.