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Promoting Online Students' Engagement in Genetics through the Review of Scientific Literature

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ABSTRACT

Analysis of the research literature is an authentic practice of the scientific community. Students who interpret and discuss the implications of these research findings are learning science in an authentic context. To address whether this activity engages students, a study was conducted in three online sections of Genetics (Fall 2009, n=33). Students identified one web site and four articles to review, and they discussed these via an online forum. To measure the impact of each course activity, students completed an end-of-term survey in which they rated each assignment type (discussions, self-quizzes, web/article reviews, written assignments, final project) and participated in a discussion reflecting on their course experiences. Pre- and post-course surveys also measured students' engagement with the research literature and other sources of scientific information.

The vast majority of students strongly agreed or agreed with the following statements: "The web/article review assignments supported my learning." (91%); "Reading scientific journal articles increased my understanding of scientific: a. content" (94%); b. process" (88%). In their reflections, students described how this activity helped to "bridge the gap" between textbook and real-world science, and helped to extend their learning. They also described how the article reviews encouraged them to learn about topics that they might not normally read about, and it kept them "up to date" with new advancements in the scientific community. When students were asked if they currently read or viewed stories related to genetics and/or science in general, 56% cited mainstream sources (television, magazines, and websites). While this decreased only slightly to 53% by the end of the course, there was a much larger decrease in students who did not follow science (17% vs. 0%), and an even larger increase in those who read journal articles (27% vs. 47%). Overall these findings demonstrate that the review of research articles can support students' learning of content and process, and promote a continued interest in science beyond the last day of class.

INTRODUCTION

The concept of science literacy has long been debated and refined. Generally speaking, scientific literacy can be described as a "general, broad, and practical understanding of science that contributes to [that person's] competence, interest and disposition to use science to meet the personal and social demands of their life at home, at work, and in the community" (Murcia, 2005).

Approaches for achieving scientific literacy can be viewed in two ways: in the fundamental sense, which is the ability to read, interpret and write a scientific text; and in the derived sense, which is the knowledge of scientific ideas and the ability to use them in a scientific manner (Norris & Phillips, 2003; Falk & Yarden, 2009). These complementary views can inform educators when designing learning activities (Table 1):

TABLE 1: ACTIVITIES THAT PROMOTE SCIENTIFIC LITERACY

Approach	Mode of Learning	Learning Activity
Learning *from* scientists.	Engaging in science through observed experimentation.	Scientific texts.
Learning as scientists.	Engaging in science through first-hand experimentation.	Laboratory experiments.

It is possible to incorporate science literacy in course assignments, but can such approaches be used effectively in online science courses? This question is the focus of this research study.

METHODS

STUDY SITE

Participants for this study (n= 33) consist of students who enrolled in SMT-273384: Genetics during September 2009 and November 2009 (15 week terms),. This population is largely made up of adults who are enrolled as undergraduate degree and non-degree seeking students, with an average age of 35. Course modules and assignments are summarized in Tables 2 and 3:

TABLE 2: COURSE MODULES

Module Topics (two weeks)
1: Introduction to Genetics (one week)
2: Mendelian Genetics
3: Sex Chromosomes & Quantitative Genetics
4: Mutations & Chromosome Mapping
5: Molecular Genetics
6: DNA and Gene Expression
7: Biotechnology
8: Final Project

TABLE 3: COURSE ASSIGNMENTS

Course Assignments	
Written Assignments (six)	30%
Self-Quizzes (four)	10%
Article/Website Reviews (five)	25%
Small Group Project	5%
Final Project Proposal & Final Project	25%
Start- and End-of-Course Activities: Genetics Concepts Surveys (start- and end-of-term); Ice-breaker and Closing Discussion; End-of-Course Survey	5%

DATA SOURCES

A mixed methods approach was used to collect and analyze study data. Data sources are summarized in Table 4. Additional data sources (course assignments, student submissions, post-course surveys) will be analyzed in further studies.

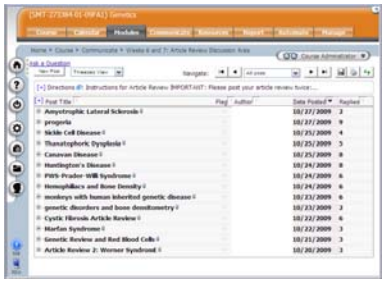
TABLE 4: DATA SOURCES

Data Source	Description
Icebreaker & Closing Discussion (start- and end-of-term)	Students reflected on their questions and goals related to Genetics.
Genetics Concepts Assessment & Student Views Survey (start- and end-of-term)	Based on the tool developed by Smith, *et al.* (2008). Additional questions focused on students' views of science and their scientific reading and viewing preferences.
Student Experiences Survey (end-of-term)	Students' reflection on their learning in the context of the various course assignments and activities.

RESULTS

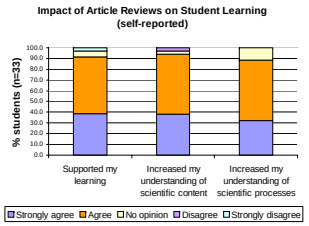
DISCUSSION FORUMS

During each two week module (total=8), students participated in online, asynchronous discussions. During four of these modules, students reviewed and discussed articles in genetics. In the following example, students were asked to select articles related to genetic disorders. These discussions were highly interactive; note the number of replies per discussion posting, with an average of five replies per article review in this example.



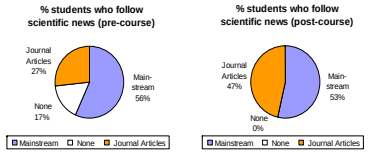
IMPACT OF ARTICLE REVIEWS ON STUDENT LEARNING

At the end of the term, students rated the extent to which they agreed or disagreed with statements related to the course activities. Focusing specifically on article reviews, we found that the vast majority of students strongly agreed or agreed with the following statements: "The web/article review assignments supported my learning." (91%); "Reading scientific journal articles increased my understanding of scientific: a. content" (94%); b. process" (88%). These results are summarized below:



CHANGES IN STUDENTS' READING/VIEWING PREFERENCES

At the start and end of the term, students were asked: "Do you currently read articles or view stories related to genetics and/or science in general? If so, how often do you read or view such reports? Please give examples of the sources that you read or view." Changes in students' practices were observed, as follows:



RESULTS (continued)

STUDENT REFLECTIONS ON SCIENTIFIC ARTICLE REVIEWS

In the end-of-term survey, students were asked to comment on their experiences related to reading of scientific articles and participating in these discussions. Below is a word cloud of students' comments as a whole, along with representative student quotes:

→ *"The journals and discussions helped to "bridge the gap" from what information was offered in the book. I think I enjoyed the journal articles more than the text."*

→ *"The scientific articles will be something I will continue to utilize to keep up to date with all the new science news and changes that are happening in the science community."*

→ *"Reading all of the articles I've read really has opened my eyes to a number of scientific concepts. Not just the ones I chose, or the ones that other people chose that I responded to, but I read most of the other ones that I didn't respond to, which were also interesting"*

→ *"I think with the Article Reviews, it allowed me to look beyond the text in all the areas my classmates chose to study. I liked that we had to read and respond to classmates because it was a way for me to read what they wrote and get at least a general understanding of whatever topic they chose."*

CONCLUSIONS

Having students review journal articles and then comment on classmates' reviews is a very effective way to engage online students in researching peer-reviewed journals, summarizing and interpreting genetics experiments, and getting exposure to cutting edge research.

When asked whether these article reviews supported their learning, students reported overwhelmingly that these assignments increased their understanding of scientific content and process. At the end of the course, many more students reported reading journal articles as a way to keep up with recent genetics news than at the beginning of the course, indicating that these assignments may have a lasting effect on students beyond the end of the course.

Research will continue next year with newly designed discussion areas and article review assignments that are more focused on well-defined topics in order to further support student engagement in genetics.

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