STEM in Secondary Education:

Quantitative Literacy in Population Ecology and Coral Reef Ecosystem

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Description

This mini hybrid course aims to teach quantitative literacy concepts and skills is necessary to help students make sense of real-world situations. This course will take students through the steps of collecting, analyzing and presenting data from a given set of scientific data about population ecology. By the end of the course, students will be able to predict the impact of environmental changes for a specific species population and propose a possible solution for conservation and sustainability within the species' ecosystem.

Content

Rationale or Need

Over a decade ago, "national and international studies showed that most U.S. students left high school with far below even minimum expectations for mathematical and quantitative literacy" (Steen, 1999). Students did not have the technical and quantitative skills needed to compete in the employment world. According to Steen, "despite years of study and experience in an environment drenched in data, many educated adults remained innumerate" (1999). They did not have a basic foundation for collecting, analyzing and presenting data. Now with the massive amount of distributed content and data via the Internet, "the need to establish levels of quantitative literacy becomes ever more important" (Steen, 2002).

Quantitative literacy is closely related to mathematics and the skills are oftentimes confused with those taught in mathematics (Manaster, n.d.). Quantitative literacy is the "quantitative reasoning capabilities required of citizens in today's information age" (Steen, 2002). Basically, it is the analysis of data. Some of the skills include arithmetic equations, percentages, ratios, simple algebra, measurement, estimation, logic, data analysis, and geometric reasoning (Steen, 1999).

Lynn Arthur Steen, a professor of mathematics at St. Olaf College, observes (1999):

> Educators know all too well the common phenomenon of compartmentalization, in which skills or ideas learned in one class are totally forgotten when they arise in a different context. Students need to learn numeracy in multiple contexts—in history and geography, in economics and biology, in agriculture and culinary arts. . . . All teachers need to help students think of mathematics not just as tasks on school worksheets but as something that arises naturally in many contexts.

Therefore, a mini online course that teaches quantitative literacy concepts and skills is necessary to help students make sense of real-world situations. This course will take students through the steps of collecting, analyzing and presenting data from a given set of scientific data about population ecology. By the end of the course, students will be able to predict the impact of

environmental changes for a specific species population and propose a possible solution for conservation and sustainability within the species' ecosystem.

Why the web?

Many digital tools, available on the Internet, "have had a profound effect on how we learn, through radical shifts in the way we find things out, communicate, collaborate, create, share or play" (Clark, 2011). These include Google, Wikipedia, YouTube, Dropbox, and Twitter just to name a few. These tools provide opportunities to overhaul traditional methods of teaching by allowing for asynchronous sessions, reply of presentations, collaboration by multiple users, and content publishing.

Many higher education intuitions have already made the move to offering classes online using many of the aforementioned digital tools. According to the Pew Social & Demographic Trends website, out of "1,055 college and university presidents interviewed for the Pew Research survey, 77% reported that their institution offers courses for which the instruction takes place exclusively in an online environment" (Taylor et al., 2011). Slowly, online learning is moving into K-12 classrooms where teachers have more flexibility for any-time learning and differentiated instruction. This mini course provides a solution for increasing quantitative literacy via online instruction delivery.

Resources

Clark, D. (2011, December 07). More pedagogic change in 10 years than last 1000 years - all driven by 10 technology innovations [Web log post]. Retrieved January 22, 2012, from http://donaldclarkplanb.blogspot.com/2011/12/more-pedagogic-change-in-last-10-years.html

Manaster, A. B. (n.d.). Mathematics and numeracy: Mutual reinforcement. *Mathematics and Democracy: The Case for Quantitative Literacy*. Retrieved from http://www.maa.org/ql/067-72.pdf

Steen, L. A. (1999). Numeracy: The new literacy for a data-drenched society. *Educatonal Leadership*, *57*(2), 8-13. Retrieved from http://www.ascd.org/publications/educational_leadership/oct99/vol57/num02/Numeracy@_The_New_Literacy_for_a_Data-Drenched_Society.aspx

Steen, L. A. (2002). Quantitative literacy: Why numeracy matters for schools and colleges. *FOCUS*, *22*(2), 8-9. Retrieved from http://www.maa.org/features/QL.html

Wenner, J. (2011, September 21). Teaching online literacy. *Teaching Quantitative Skills in the Geosciences*. Retrieved from http://serc.carleton.edu/quantskills/methods/quantlit/index.html

Goals and Objectives

Goal of the course

9th grade Biology student will be able to describe how ecosystems are affected by changes in the environment and show quantitative literacy by creating basic tables and graphs from a given set of scientific data in population ecology.

Specific learning objectives/outcomes

- 9th grade Biology student will be able to describe physiological, ecological, and behavioral strategies used for successful population growth.
- 9th grade Biology student will be able to compare random sampling with data obtained by an actual count.
- 9th grade Biology student will be able to construct a basic graph with provided data.
- 9th grade Biology student will be able to predict the impact of environmental changes on the organisms in an environment.
- 9th grade Biology student will be able to interpret data given a table or graph and describe trends regarding population relationship.
- 9th grade Biology student will be able to propose a possible solution for conservation and sustainability of an organism in an ecosystem.

Audience

- 9th grade Biology students at Punahou school have laptops connected to the school's wireless network. They are digital natives with prior experience navigating through the school's Moodle course websites in middle school.

Procedures

Job descriptions

- Plans all the steps for the design and development process (write planning documents).
- Develop course on Laulima site with pertinent links.
- Creates a Google Site (http://sites.google.com) describing what is expected of the information gathered from the learning object and listing links to learning objects.
- Develops a Google forum where students can upload their findings and comment on other students' results.
- Develops the instructor's guide and post the online module

Breakdown of tasks and timeline

Target Dates	**Task**
January 26 - February 1	Brainstorm and find potential learning object (Group)
February 2 - 8	Research and create Planning Document - Part 1 Rationale or Need (Riddle) Goals and Objective (Ketpura-Ching) Procedures (Takayama)
February 9 - 22	Research and create Planning Document - Part 2 Planning Tools - Content outline (Riddle), Course map (Ketpura-Ching), Description of learning objects (Takayama) Expert Review Plan - Describe qualifications of reviewer, Describe process in which course will be reviewed, List the review criteria (group) Collaborate on creating and locating learning objects for the course (group)
February 23 - March 14	Create WikiSpaces site to post weekly module (Ketpura-Ching) Develops “Discussion and Private Messages” in Laulima where students can upload their findings and comment on other students’ results (Nan) Develop Weeks 1 and 2 modules (Riddle) Develop Weeks 3 and 5 modules (Ketpura-Ching) Develop Week 4 module (Takayama)
March 14 - April 4	Peer review
April 8 - 12	Revise Course (group)
April 13	Submit Course
April 14 - May 2	Complete Instructor’s Guide (group)

Software and hardware required

- Software: Web browser with Adobe Flash Player, Google Sites, QuickTime
- Hardware: Computer and Internet connection

Outside resources needed: none

Budget: none