



The Math You Need, When You Need It

Resources For Students in Introductory Geoscience

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Funding provided by NSF Grant Numbers DUE-633755 and DUE-633402
Sponsored by the National Association of Geoscience Teachers

For More Information

[The Math You Need When You Need It](#)

Summary

The Math You Need, When You Need It modules cover quantitative topics that are important in introductory geoscience courses. Each topic includes a page for the instructor, quantitative information for the students, a set of practice problems and culminates in an on-line quiz that is automatically graded and submitted to the instructor. The project is designed to give introductory geoscience students the quantitative knowledge that they need, just before they need to use it in their concurrent geoscience course. This program includes pre- and post-testing and self-paced modules.



Project Goals

- Production and use of appropriate "the math you need, when you need it" modules
- Improving introductory geoscience students' mastery of, and comfort with quantitative skills.
- Increased retention and student success in introductory geoscience courses
- Facilitating the addition of more quantitative materials in introductory geoscience courses.

Our project is designed to increase quantitative literacy of geoscience students by facilitating use and transfer of mathematical concepts to multiple geologic contexts.

Project Design/Elements

This project is designed to include stand alone modules covering quantitative concepts that can be used in conjunction with a concurrent introductory geoscience course. The modular nature of this project makes it readily adaptable to any introductory geoscience course that involves quantitative concepts - instructors can choose which modules work with their syllabus and which subjects are covered on the final quiz. These modules are designed to be completed by the students who need them most, just before quantitative concepts are covered in class.

Each module consists of an explanation of the quantitative concept (e.g., [unit conversions](#), [rearranging equations](#)), a number of sample problems for the student to work through (e.g., [unit examples](#), [equation examples](#)), and a culminating exam testing whether the student understands the concepts. The explanation

and problems are written from the perspective of geoscientists who teach these concepts regularly. Each module uses best practices in teaching college level mathematics and are all in the context of the geosciences.

Instructors can readily adapt these modules for use in any geoscience course. The modules are designed so that they could be used in any order and have an instructor page explaining what is important on the page (e.g., [calculating density](#), [trigonometry](#)). Questions on the pre-test and the post-module quizzes can be adopted from a bank of questions that address a given quantitative concept in multiple geoscience contexts. The multiple contexts speak to the issue of transfer of mathematical concepts to new and distinct topics. We also encourage instructors to author their own questions for the quizzes/tests.

What does the program do, why is it important, why was it designed this way. Challenges, great success, tips for others doing this? How is it done. Collaborating partners. Research questions

This is the place to tell us all about what you are doing, how you are doing, and why you are doing it that way. Also what is working, what is challenging, and what you have learned about doing it better or more easily.

Evaluation and Assessment Strategies

Project evaluation focuses on three outcomes:

1. the production and use of the modules in geoscience courses
2. student performance in modules and in geoscience courses
3. faculty comfort with the addition of quantitative content of introductory geoscience courses.

Formative assessment of the project relies on quantitative and qualitative measures of these outcomes in the form of pre-and post-module data collection, walk-throughs, surveys and interviews. Feedback from these assessment are used to modify our product during the development phase of the project and as summative feedback for final project evaluation.

Products, Key Findings, Publications

[The Math You Need When You Need It modules](#)

[Assessing Quantitative Learning with The Math You Need When You Need It](#), AGU Annual Meeting 2008 (to be presented December 18, 2008, 12:05 pm)

[The Math You Need When You Need It: Web-Based Modules to Help Students Succeed in Introductory Geoscience Courses](#), GSA Annual Meeting 2008, [download poster](#) (Acrobat (PDF) 41.8MB Nov14 08)

[The Math You Need, When You Need It: Student-Centered Web Resources Designed to Decrease Math Review and Increase Quantitative Geology in the Classroom](#), AGU Annual Meeting 2007

Related or Similar Projects



Infusing Quantitative Literacy Throughout the Social Science Curriculum (QSSDL)

Lynette Hoelter
ICPSR, University of Michigan

For more Information

www.qssdl.org

Summary

The Quantitative Social Science Digital Library is a virtual repository of educational materials designed to improve quantitative literacy skills in social science courses. Built especially for faculty teaching post-secondary courses in such areas as demography, economics, geography, political science, social psychology, and sociology, QSSDL will provide a single portal where faculty can find and use real data in post-secondary classes. QSSDL will provide comprehensive links to teaching modules, social science data sources, applications for statistics and mapping, and research on teaching and learning. Extensive searchable metadata relevant to the needs of instructors will make finding resources easy.

Project Goals

The overarching project goal is to make it easier for faculty to bring real social science data into courses across the curriculum ranging from introductory classes to senior seminars. In doing so, we aim to:

- improve quantitative literacy among students, particularly those in undergraduate social science courses, thereby exposing them to the creativity and excitement of empirical research;
- assist instructors in the development of content by developing resource collections that support discovery of teaching materials, pedagogic resources, data sources, and data analysis and visualization tools;
- create tools that support discovery and extraction of data subsets of high utility for teaching;
- develop a community of faculty and librarians who use such resources and may be able to contribute to the collection; and
- collaborate with the NSDL, other libraries, and service providers as a representative of the social science fields.

Project Design/Elements

The project design has four major parts.

1. Creation of a virtual repository for quantitative literacy in the social sciences. This repository will include at least four types of objects. First, data-driven learning modules (DDLs) will be catalogued and included. These standalone activities are meant to be used with included or pre-packaged data/tables, generally for the substantive purpose of teaching a social science concept. DDLs will also be linked to materials in the Pedagogy in Action service at SERC. Second, the repository will include links to important and interesting data sources in the social sciences (e.g., the Census Bureau, ICPSR, etc.). These resources currently exist, but including them in the repository will save time for instructors as they will not need to search each individual website. The third type of material is pedagogical resources such as journal articles and conference presentations (when available online) related to using data in the classroom or quantitative literacy. Finally, the repository will also include links to data analysis and visualization tools. Accompanying documentation will be created when possible to help

instructors take advantage of these tools.

2. Data translation services. As part of the digital pathway, services will be built to assist faculty with finding data relevant to their objective and paired with tools to make it easier to extract data from the identified source in a form appropriate for instruction. That is, we hope to design tools so that instructors can simplify the process of locating, downloading, manipulating, and using data for their classes. As part of this effort, some focus will be put on repackaging the American Community Survey so that using it for instruction becomes more straightforward.
3. Building community within the social sciences. QSSDL brings together representatives from the major social science professional associations to assist the project by serving on an Advisory Board and topical editorial committees. In addition to the professional associations' involvement, we will use Web 2.0 features in an attempt to build community among users of the materials. The main features discussed to date include the ability to tag, rate, and comment on materials as well as the creation of forums (blogs, community bulletin boards) for discussion among instructors. Finally, outreach for the project is designed to take place through papers, workshops, and exhibits presented at professional meetings as well as a series of Webinars on topics of interest to those using data in the classroom.
4. Creation of tools for developing additional data-driven learning modules. The repository will not only catalog existing tools for analysis and the like, but will work to develop a series of tools to make it easier for instructors to create their own learning modules. Such tools include templates and guides for writing materials in the style of existing modules in the Social Science Data Analysis Network and ICPSR Online Learning Center, a search capability to assist users in identifying datasets in the ICPSR collection that include a certain combination of variables, and tools to match data with analysis and visualization applications.

Evaluation and Assessment Strategies

The evaluation for this project centers around approximately ten focal campuses. We make use of ICPSR's Official Representatives on a diverse sample of campuses to collect both formative and summative feedback. A combination of surveys, focus groups, and analysis of Web-metrics will allow for evaluation of the scope and utility of the resource collections, satisfaction with the interface design and Web 2.0 features, the utility and usability of tools for discovering and extracting data from data sources, and the design and content of workshops and webinars. Additionally, the behaviors of a sample of social science faculty on the ten campuses will be examined to determine reach and penetration of the QSSDL repository, potential changes in the availability of resources to target users due to the introduction of QSSDL (e.g., are the collections comprehensive enough to satisfy the needs of many users), and whether faculty report an increase in use of data in the classroom to support quantitative literacy.

A partner project, funded by NSF under the CCLI mechanism, focuses on the assessment of quantitative literacy skills and the impact of materials such as those in the Social Science Data Analysis Network on students' achievement of intended learning outcomes relating to quantitative literacy.

Products, Key Findings, Publications

We are just in the first six months of our project, so there are no publications yet.

Related or Similar Projects

Social Science Data Analysis Network (www.ssdan.net)

ICPSR Online Learning Center (www.icpsr.umich.edu/OLC)



Improving Quantitative Reasoning and Inquiry-Based Learning in the Undergraduate Biology Curriculum

Doreen J. Schroeder
University of St. Thomas

For more Information

Summary

Student success in STEM courses is correlated with science reasoning ability, which requires advanced intellectual development. Intellectual development can be facilitated using inquiry-based teaching, which incorporates exercises that encourage students to examine cause and effect relationships, make predictions, and evaluate responses. The goal of this project is to promote intellectual development in undergraduate biology students by increasing the emphasis on quantitative reasoning and inquiry-based activities in the laboratory experience. We propose to accomplish this by introducing digital microscopy and systems for the quantitative analysis of gas exchange within the introductory laboratory curriculum at the University of St. Thomas and North Hennepin Community College.

Project Goals

Our project has four specific goals:

1. Integration of math and technology to promote higher order thinking skills; Higher levels of intellectual development are modeled in the inquiry-based lab, as students apply a procedure to a new situation, analyze the data, evaluate if it fits their understanding, and incorporate the new information to create a coherent whole.
2. Improve and expand inquiry-based laboratories; Research in STEM learning has indicated that an inquiry-based approach to learning lead to greater student engagement, better retention of knowledge, and promotes a positive attitude toward science.
3. Improvement in student understanding of biological diversity; We propose to improve student understanding of, appreciation for, and retention of information about biological diversity through laboratories that incorporate the utilization of digital microscopy and gas analysis.
4. Promotion of cooperative learning and community building within laboratories; The use of both technologies will requires that pairs or small groups of students work together. By incorporating technologies that require cooperative work, we hope to facilitate the establishment of student learning groups early in their undergraduate learning experience.

Project Design/Elements

We have implemented the technologies in four key areas:

1. Introductory biology course at St. Thomas
2. Mid-level plant biology course at St. Thomas;
3. Introductory and mid-level biology courses at North Hennepin Community College; At both institutions, the technologies have allowed students to make measurements, analyze data, and draw conclusions that were not possible previously. Additionally, students taking the mid-level courses are able to build on knowledge from their previous introductory course.
4. Other areas of the curriculum at St. Thomas; Already the technologies have been implemented in a non-science majors course and a mid-level comparative anatomy course where students are able to design experiments and collect quantitative data.

Evaluation and Assessment Strategies

A variety of assessment strategies are underway at St. Thomas. In the introductory biology course, we have pre- and post-implementation final lab exam scores for evaluation, pre- and post-implementation lab report scores for student-designed experiments, and attitudinal surveys given at the beginning and end of the course, combined with a science reasoning exam.

Similar assessments have been implemented in the mid-level plant biology course: lab report scores and attitudinal surveys. Additionally, a requirement that students demonstrate quantitative reasoning, beyond mere presentation of statistics, has been added to the final laboratory project.

Products, Key Findings, Publications

Publications are planned after three years of the project.



Enhancing Success in STEM by Building Skills and Intervention

Alicia Paul Thomas

Morehouse College - Funding provided by NSF STEP

For more Information

Summary

With NSF support, one of our main objectives is developing a Scientific Literacy course at Morehouse College. This program will identify at-risk students in their freshman year and then providing these students with skills that are necessary to overcome stumbling blocks in the majors. Skills such as quantitative literacy and critical thinking will be taught to these students in a one-hour credit/semester, three semester Scientific Literacy course designed for STEM majors.

Project Goals

1. Identify at-risk STEM students in their freshman year to enroll in the Scientific Literacy course.
2. Develop quantitative literacy skills.
3. Develop critical thinking skills through quantitative literacy exercises.

Project Design/Elements

The quantitative literacy component was offered in a pilot not-credit course in the 2007- 2008 HBCU-UP Pre-Freshman Summer Science Bridge program. A pre and post-test was given to students in the program. Analysis of the data showed that all students performed better on the post-test than on the pre-test. Eighty percent (80%) of the students showed improvement of 15-38% in test scores. It is predicted that the at-risk students taking Scientific Literacy will have a significantly higher post-test due to the added incentive of being graded for a credit course.

In the Scientific Literacy course offered in the fall of 2009, students will be divided into four separate groups (classes) of approximately 30 students each. Each group will represent a different set of skills that the students may need to develop as determined by the pre-test. The class period will be divided between the instructor and small PLTL subgroups of no more than eight students. These subgroups will then participate in quantitative literacy, guided-inquiry exercises designed to challenge the students in a way to develop critical thinking skills.

Evaluation and Assessment Strategies

Qualitative and quantitative measures will allow for the development of a goal based assessment plan. Designing of an evaluation matrix to address program objectives will include formative and summative assessments.

Products, Key Findings, Publications