



Spreadsheets Across the Curriculum

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For more Information

http://serc.carleton.edu/sp/ssac_home

Summary

Spreadsheets Across the Curriculum (SSAC) (DUE 0442629) was a three-year Phase-2 CCLI project which had a one-year no-cost extension, and now (5/2009) has a second extension with supplemental funds to support "NSF Projects Supporting QL Education," the workshop producing this Web site.

The purpose of the SSAC project was to develop, test and disseminate a large, multi-course, multi-institution collection of educational modules patterned after those developed by Co-PI, Len Vacher, in a Phase-1 (Proof of Concept) CCLI project, DUE 0126500 Spreadsheet Exercises in Geological-Mathematical Problem Solving, which focused on one course (Computational Geology, an upper-division geology majors course), and one institution (University of South Florida).

The SSAC project was a workshop-based project. There were three annual (2005-2007), week-long workshops in Olympia WA, facilitated by Co-PI Emily Lardner of the Washington Center for Improving the Quality of Undergraduate Education (The Evergreen State College). Each attracted about 20 participants, who received stipends if they completed a draft of a module that they would use in one of their courses. After review and editing by the Co-PI and two PhD students at USF, and revision by the participants, most of the submitted modules have been accepted into the "General Collection" of the library of SSAC modules on the SSAC Web site. The Web site is part of the Pedagogical Services NSDL project [DUE 0532768] of the Science Education Resource Center [SERC]), which hosts the NNN Web site as well as this site for "NSF Projects Supporting QL Education."

The SSAC General Collection includes all the completed (reviewed, revised, and accepted) workshop-generated modules together with some by the USF Co-PI and members of the resource team, including graduate students, who helped facilitate the workshops. At present (5/2009), the general collection has 57 modules from 42 authors, from 21 institutions in 11 states ranging from WA to AZ to NH to FL. Illustrating the broad range of contexts consistent with the "across-the-curriculum" title, they are classified into 28 Library of Congress categories ranging from DT (history, Africa) to WY (nursing), with many stops in the Q (science) categories.

Project Goals

The central goal of the project is to promote quantitative literacy by providing a resource to infuse problem solving involving mathematics into as many courses as possible. As indicated on the home page on the SSAC Web site, SSAC entails a pedagogy as well as a library. The Web page Teaching with SSAC on the Web site tells the what, why and how – students build spreadsheets (i.e., they do not import ready-made spreadsheets) to do a calculation or create a graph to solve and explore a problem in context. The intention is to enhance know-how in mathematics. "What is know-how in mathematics? The ability to solve problems." (Polya, *Mathematical Discovery*, 1962, p. xi-xii).

Project Design/Elements

The spreadsheet modules are the key element of the project. The modules have a rather prescriptive design, which is spelled out at SSAC Library page on the SSAC Web site. Briefly, a module consists of about

15-20 PowerPoint slides. The PowerPoint presentations are designed with the assumption that the students will work through the slides on their own, although instructors can certainly use them as parts of lecture or in laboratory settings; the modules are easily modified and adapted (a feature of the PowerPoint construction). The core of the module is a sequence of ~10 slides that take the students through the construction of the spreadsheets. The spreadsheets, which are embedded as pictures in the student version of the modules, are strongly color-coded. For example, numbers appear in yellow and orange cells – the yellow cells are for data or known values, and the orange cells are for cell equations. Students are instructed to construct the cell equations that go in the orange cells. They use the numbers that appear in the orange cells as checks on their equations.

Instructor versions of the modules are available on request. Instructor versions differ from student versions in that the spreadsheets are embedded as Excel sheets that can be activated to reveal the cell equations in the orange cells. Instructor versions can be obtained from the cover pages associated with the particular modules. To find the cover page, go to the SSAC home page, then General Collection, then SSAC General Collection Modules, and then use either the keyword or "narrow the view" search feature to find a module of interest. The student version can be downloaded from a link under Teaching Materials on the cover page. Click on "request" for a form to request the link to download the instructor version. As of 4/3/2008, the request statistics were: 36 requests for 19 modules, by 28 instructors (1 high school; 4 community colleges; 1 each from Canada, Italy, Mexico, Spain, Sudan, and Venezuela; and the rest from American colleges and universities).

Evaluation and Assessment Strategies

Rebecca Hartzler (Seattle Center Community College) and Jennifer Wenner (Department of Geology, University of Wisconsin – Oshkosh) evaluated faculty-development aspects of the project. Dr. Hartzler surveyed the SSAC workshop participants. She found it remarkable that 86% of faculty participating in the workshops completed modules that made it all the way to publication on the SSAC Web site. She reported that participants identified the opportunity to work with others on strategies for addressing students' quantitative literacy to be of greatest benefit. Dr. Wenner visited the home department (Geology at USF) to evaluate the local impact of SSAC and the preceding proof-of-concept grant. Consistent with the findings of Dr. Hartzler's evaluation for the NSF project overall, Dr. Wenner noted that both USF faculty and students were positive about the effects of using spreadsheets to develop problem-solving and quantitative literacy skills.

Data on the effect of modules on student learning of QL has been difficult to get from workshop participants who have used their modules in the classroom. One problem is that non-mathematics participants were slow to recognize that the purpose of the modules was to teach QL using context, and less so the context itself. QL assessment could not proceed in a meaningful way until a key, testable objective was identified; therefore, the workshops added specific sessions on identifying the single most important (key) QL skill (2006, 2007 workshops) in each module, and then assessing for student learning of that skill explicitly (2007 workshop). Products of the 2007 (last) workshop include a pre/post test for each module, based on a collaboratively designed template, and focused on the key QL issue in the module. Participants were offered additional stipends to submit the results of the pre/post tests, with other measures they may have developed. From the evidence gathered so far (3/2009), it appears that modules do facilitate student learning and improve attitudes about quantitative work, but there needs to be a match between the module and the skill level of the student. Absent such a match, the module is not helpful.

Year 3 (2007) also included a supplemental subcontract to Laura Wetzel (Eckerd College) for a summer-session test-bed project. Twenty-one undergraduate students were paid to work through 1-6 modules, complete pre/post tests and, in some cases, exit interviews. Results of that study showed that student learning of QL increased, and attitudes improved, as students did more modules. The implication is that if one teaches with SSAC modules, one needs to use several because of the high "start-up cost" for the student who is unfamiliar with Excel and possibly uncomfortable with math.

In the broad view, the student-learning assessments in the SSAC project are formative as they give suggestions about how to implement SSAC-style modules further. To the two lessons learned that we have mentioned – match the module to the skill level of the students, and use more than one module if you use

any – we can add a third due to a fortunate unexpected consequence of the project. The Chair of the USF Geology Department, Chuck Connor, a volcanologist, became so enthusiastic about SSAC-style modules that he instigated the creation of a set of modules for an upper-division course in physical volcanology. The resulting set of nine modules is housed in the SSAC Library as the Physical Volcanology Collection. Unlike the modules in the General Collection, the intent of these modules is to teach the disciplinary subject, volcanology, less so QL. The collection has been promoted by the International Association of Volcanology and Chemistry of Earth's Interiors. As of 4/3/2008, there were 10 requests for the entire set of instructor modules, from around the world (England, Germany, Italy, Iceland, West Indies). The large number of requests for modules of the volcanology collection compared to the modules of the general collection (~2 per requested module at the time) suggests the third lesson: create sets of course-specific modules, and they will be used.

The three lessons learned led the proposal of a derivative project, Geology of National Parks: Spreadsheets, Quantitative Literacy, and Natural Resources, which has been funded as DUE-0836555. The idea is to build SSAC-style modules for the introductory course, Geology of National Parks (Learned-lesson 3). The course will use 4-8 modules drawn from the collection of 16 developed in the project (Learned-lesson 2). The QL will involve foundational math, consistent with the ability of the preponderance of students taking freshman-level general-education service courses in universities and community colleges (Learned lesson 1).

Products, Key Findings, Publications

There are 57 modules published on the SSAC Web site. See associated file titled "Card catalog of SSAC modules." [Card catalog of SSAC modules \(3/13/2009\)](#) (Microsoft Word 273kB Apr14 09)

Related or Similar Projects

Geology of National Parks: Spreadsheets, Quantitative Literacy, and Natural Resources



Quantitative Reasoning (QR) in the Contemporary World

Bernard Madison

For more Information

[none](#)

Summary

The ability to reason about issues that mix words and numbers is now an essential competency for US residents. The proliferation of quantitative data and analyses has reached all aspects of life in the US, including informed participation in democratic processes. Traditional education in mathematics and statistics is not sufficiently effective for the quantitative reasoning (QR) required, so innovations are necessary. This is a proposal to continue development of an educational infrastructure about an innovative QR course, created by PI Bernard L. Madison and evolved through its offering at the University of Arkansas over the past five semesters. The proposed project includes making the course transportable, adaptable, and more effective and creating assessments and scoring rubrics to both measure learning in the course and to compare that learning to the learning in two other courses, one somewhat similar and one traditional. Several research questions concerning QR will be investigated in the process. The innovative course, called QRCW in this proposal, derives from a collection of newspaper and magazine articles and is organized by processes of QR and not by mathematical or statistical topics. The project will produce a volume of case studies of QR-based media articles, an accompanying volume documenting the learning results, pedagogical strategies, and a guide for using the volume of case studies in a QR course, including classroom videos of students reasoning about quantitative situations.

Project Goals

- Produce a casebook of media articles for use in teaching QR
- Identify impediments for students QR
- Produce an instrument for assessing QR
- Identify unifying constructs in the use of units across mathematics and the sciences
- Identify language issues in QR

Project Design/Elements

- Videos of the experimental class
- Videos of think aloud sessions with students
- Teaching class and modifying based on results

Evaluation and Assessment Strategies

- Pre- and post-testing results
- Student attitude surveys

Products, Key Findings, Publications

Case Studies for Quantitative Reasoning: A Casebook of Media Articles by Bernard Madison and Shannon Dingman, Pearson Custom, 2008

Second edition due in 2009 with added co-authors Stuart Boersma and Caren Diefenderfer



Active Learning and Inclusion of Mathematics and Modeling for Biology Undergraduates at Everett Community College

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For more Information

Summary

The three quarter biology series offered at Everett Community College is in the first phase of a major re-design. Guided-inquiry, problem-based learning activities and interactive computer simulations with reflective writing exercises will occur during "lecture" time. Lecture sections enroll 48 students and students will work in pairs on wireless enabled lap top computers during a majority of classroom sessions. Appropriate case studies² including multi-media cases from the Case It! Website³ will be presented to students working in small groups. Students will be engaged in meaningful "active learning" during "lecture" time as opposed to the passive learning of listening to a lecture and taking notes. Mathematical problems with biological applications will be built into lecture and lab. Several computer simulation exercises from SimBioticTM Software⁴ will be used and STELLA¹ modeling software will allow integration of wet labs, quantitative analysis and computer modeling. More sophisticated molecular biology labs will be added to the curriculum. New case studies and new STELLA¹ modules will be designed, written and integrated into the curriculum.

Project Goals

The objectives of this proposal are to:

- Increase access to computers with modeling software in lecture mode and laboratories
- Integrate student-centered activities using interactive websites which provide guided-inquiry exercises and multi-media case-based learning
- Restructure the laboratory to include inquiry and significant student input into experimental design
- Increase student exposure to molecular biology techniques
- Incorporate mathematical problems, interactive computer simulations and modeling exercises in both lecture and lab
- Incorporate student use of STELLA software to quantify and model experimental results

The following student outcomes are expected to result. 1) Students will demonstrate scientific literacy, including implementation of experimental design. 2) Students attitudes toward learning science will improve. 3) Students will express and demonstrate increased a. retention of biological concepts b. increased ability to apply mathematics to biological issues c. comprehension and skills with regard to molecular biology techniques d. awareness of the connections between biology and mathematics e. confidence with mathematics, modeling and computer use f. awareness of the personal and professional usefulness of mathematics and modeling.

Project Design/Elements

Develop additional writing exercises for three quarter sequence to complement interactive content at textbook website.

Preparation of case studies for curriculum.

Create curriculum specific "biomath" application problems.
Develop additional STELLA modules.
Survey student attitude pre & post.
Evaluate results for further curricular changes & modify as needed.

Evaluation and Assessment Strategies

Use of CLASS for Biology as pre-test and post-test for the majors 3 quarter series.
Comparison of specific exam items from old sequence to new.

Products, Key Findings, Publications